The Development of an Orientation Manual for New Hemodialysis Nurses

By © Sasha Hayse

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Abstract

Background: End stage renal disease (ESRD) incidence and prevalence in Canada have been steadily increasing. In Newfoundland and Labrador, the prevalence of ESRD is the highest in the country. Over fifty percent of patients started on a treatment modality for ESRD choose hemodialysis. Due to the increasing demand for hemodialysis facilities for the increased patient population diagnosed with ESRD, there is a need for more nursing staff to be trained in nephrology nursing. **Purpose:** The purpose of this practicum project was to develop a manual for new nurses orientating into the nephrology unit in hemodialysis. **Methods**: An informal needs assessment, integrated literature review, and consultations and collaborations were conducted. **Results:** The need for a new manual was substantiated from results gained from the informal needs assessment, integrated literature review, and consultations and collaborations. Using principles of Knowles' Adult Learning Theory, and Benner's Novice to Expert Model, a learning resource manual was developed for orientation of new hemodialysis nurses. The manual was divided into seven working modules that covered the important aspects of hemodialysis that a newly orientated nurse would need to know prior to working independently. **Conclusion:** Implementation and evaluation of the manual will be done prospectively. After final approval by the divisional manager and the clinical educator, the manual will be implemented in the orientation of staff. Evaluation will involve knowledge based questions after each module towards the learners' feelings towards the usefulness, relevance, and usability of the learning resource manual. Six-months post orientation, this survey will be repeated to determine if the manual met the learners' needs.

Key words: hemodialysis; orientation; learning resource manual.

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The Development of an Orientation Manual for New Hemodialysis Nurses

Nursing job transitioning has been studied extensively in the literature, revealing multiple challenges for a successful transition of both newly hired and experienced nursing staff (Dyess & Sherman, 2009; Honan Pellico et al., 2009). Providing a comprehensive orientation that allows newly hired staff to be prepared in their new role is an integral aspect of preventing attrition and promoting retention (Kells & Koerner, 2000; Remus, Smith & Schissel, 2001; Winter-Collins & McDaniel, 2000). An ideal orientation program for nursing staff, must address each nurse as an individual, and subsequently must address his/her needs in a unique manner (Burk, Gillman & Ose, 1984). To be useful and relevant for practice, orientation manuals must be routinely updated, and composed of the most current literature and the best evidence based practices using current recommendations (Peltokoski, Vehvilainen-Julkunen, & Miettinen, 2015).

Background

Currently, end stage renal disease (ESRD) is a population health issue with disease incidence and prevalence rising in Canada. In Newfoundland and Labrador (NL) the prevalence of ESRD is the highest in the country (Canadian Institute for Health Information, 2017). Presently, hemodialysis is the treatment option used most often in Canada (Canadian Institute for Health Information, 2017). Due to the increasing demand for hemodialysis facilities for the increased patient population diagnosed with ESRD, there is a need for more nursing staff to be trained in nephrology nursing.

There are seven hemodialysis units under Eastern Health's Authority. The registered nurses and licensed practical nurses that are hired within the hemodialysis program, participate in an orientation process conducted at the Waterford Hospital in St.

John’s, Newfoundland. The current manual that is being utilized for orientation purposes was developed in 2005 and has not been revised to support changes made in the hemodialysis program despite multiple changes in: policies and procedures, a new hemodialysis machine manufacture tenure, and the increased scope of practice of licensed practical nurses in the clinical setting that have occurred since its development. Anecdotal evidence from the clinical educator, newly hired nurses, and nurses that preceptor, agree that the current manual needs to be updated to prepare registered nurses and licensed practical nurses to be comfortable, confident, and competent, when caring for hemodialysis patients. Currently, new information and knowledge in the area is taught verbally by the clinical educator but is not present in the content of the learning resource manual.

Rationale

Since I graduated in 2011 from nursing school I have been employed as a registered nurse in the nephrology program as a hemodialysis nurse. During these years, I have been involved in the preceptoring of various newly graduated and experienced nurses that were orientating in the hemodialysis unit. A vast majority of these nurses have expressed frustration, uncertainly, and anxiety with their orientation into hemodialysis, due to the information presented in the currently used learning resource manual.

Currently, the orientation manual that is utilized for orientation of new staff was developed in 2005. Anecdotal evidence from the informal needs assessment substantiated the need to develop a new orientation learning resource manual to reflect the current practices currently employed in the hemodialysis unit.

Practicum Project

Resource

The practicum project that I decided to complete focused upon the development of a new orientation manual to the nephrology unit for hemodialysis nurses. The newly developed orientation manual would be directed towards the learning needs of both newly graduated and experienced nurses, newly hired to hemodialysis. The learning needs of each nurse completing the orientation is individualized therefore the learning resource manual developed was done whereby nurses orientating can complete the manual at a self-directed pace. The development of this manual would allow nurses to work independently through the manual allotting the appropriate amount of focus that is needed per module, based upon their individualized and unique learning needs. An integrated literature review was completed regarding the importance of orientation and transition into Nephrology nursing, which can be found in Appendix A.

Contact Person

Prior to the development of the learning resource manual, two contact persons that were integral to the development of the learning resource manual were identified. Both the clinical educator, Mrs. Cathy Cake BN RN M.Ed. C(Neph)C, and the divisional manager Ms. Cheryl Harding BN RN MHS C(Neph)C were involved in the initial needs assessment of the learning resource manual. During the duration of this practicum project, both contacts were integral throughout the process of the creation and development of the learning resource manual.

Ethical Approval

The Health Research Ethics Authority (HREA) Screening Tool was completed to determine if the project needed to be submitted to a research ethics boards for approval.

Following completion of this screening tool, it was determined that ethical approval was not needed as it was not classified as a research project. This screening tool and the HREA checklist can be found in Appendix B.

Practicum Goals

My goal for the practicum project was to develop an orientation learning resource manual to be utilized in the orientation of newly hired staff into the hemodialysis program. The purpose of the orientation manual is to provide the most current practices, policies, and roles and responsibilities, utilized at present in the hemodialysis unit to all newly hired nursing staff.

Methodology Overview

The methodologies employed in the development of the learning resource manual included an integrated literature review and consultations and collaborations. A summary of the results are discussed below. The fully completed integrated literature review and consultation and collaboration report can be found in Appendices A and B respectively. Results from both the integrated literature review and the consultation and collaboration report guided the development of the learning resource manual which can be found in Appendix C.

Integrated Literature Review

PubMed, the Current Index to Nursing and Allied Health Literature (CINHAL), and the Cochrane Library search engines were utilized to search for pertinent literature applicable to nursing orientation in a hemodialysis setting using broad search terms. To ensure the most up to date literature was obtained, limits were set to find articles from the Year 2000 onward. When sufficient literature was not obtainable with these time constraints, older literature was used. Articles were retrieved regarding the required nursing care of the hemodialysis population. However, there was a scant amount of research focused specifically upon the orientation needs of nurses transitioning into nephrology nursing. Due to the lack of hemodialysis orientation articles, broader research limits were utilized, and qualitative articles surrounding orientation to critical care areas similar to hemodialysis were utilized in the literature review. Articles were read and reviewed, with the most pertinent literature being analyzed and critiqued for the integrated literature review.

The completion of the integrated literature review yielded many important aspects to consider in the development of the learning resource manual. Firstly, it was shown that orientation, for all nurses regardless of prior experience, is important (Burk, Gillman & Ose, 1984; Kells & Koerner, 2000; Remus, Smith & Schissel, 2001; Winter-Collins & McDaniel, 2000). Transitioning to a new job rendered uncertainty and anxiety, therefore a well-developed learning resource manual would be a vital source of information for those newly orientating to the hemodialysis unit (Butt et al., 2012; Dyess & Parker, 2012; Fero, Witsberger, Wesmiller, Zullo & Hoffman, 2009; Rush, Adamack, Gordon, Janke, & Ghement, 2015). The care required for hemodialysis patients is complex because they are afflicted with a multitude of contributing comorbidities, whereby critical thinking needs to be employed in the assessment and treatment of each patient (Gill, Rose, Pereira & Tonelli, 2007; Keshin & Engin, 2011; Martchev, 2008). Nurses, when assigned to care for these hemodialysis patients need to be informed to provide education and support to the patients and their families (Baines & Jindal, 2000; Barnett, Li Yoong, Punikahana & Si-Yen, 2007; Finkelstein at al., 2008; Kutner, 2001; Nozaki, Oka, & Chaboyer, 2005;

Oliver-Calvin, 2004; Sandlin, Bennett, Ockerby & Corradini, 2013). Additionally, the need to understand procedures commonly utilized in the hemodialysis unit such as arteriovenous fistula and arteriovenous graft cannulation and the accessing of a central venous catheter, warrants the nurse to be proficient and comfortable in performing skills following Eastern Health’s policy (Broscious & Castagnola, 2006; Hardwood, Locking-Cusolito, Spittal, Wilson & White, 2005). The completed integrated literature review report can be found in Appendix A.

Consultation Results

Consultation for this practicum project was used to gain insight and input on the relevance of the orientation manual and what information should be updated and contained in a new orientation manual, as identified by key stakeholders. This information was obtained through interviews conducted with the divisional manager and clinical educator and focus groups that included nurses that preceptor, and newly hired nurses. Advanced nursing practice competencies were demonstrated through the consultation and collaboration with key stakeholders regarding the need to develop a new learning resource manual (Canadian Nurses Association, 2008).

Consultation with the identified key stakeholders was completed through individualized semi-structured interviews and focus groups. All participants verbally voluntarily agreed to be a part of the consultation process and a letter of intent highlighting the consultation purpose was given prior to the consultation commencement. Specific interview and focus group questions were asked with participant responses transcribed. Following the transcription of the responses, the data was analyzed for content to identify common emergent themes. Once developed, the key stakeholders were debriefed on the findings derived from the consultation process based on the most repeated responses noted throughout the consultation period to ensure participant validation of results. These results were then summarized in the results section of the consultation report.

The key stakeholders all agreed that a new learning resource manual needed to be developed as the old orientation manual was outdated and irrelevant for use in practice. They identified that the current manual was not being used because it contained outdated information regarding the specific nursing skills, assessments, and policies and procedures that nurses working in the hemodialysis unit are expected to follow. The old orientation manual contained in-depth content that is beyond a novice practitioner level. Nurses in orientation expressed frustration, anxiety, and apprehension when learning this information. All key stakeholders agreed that a new orientation manual would benefit the hemodialysis unit. Suggestions on specific modules highlighting the nursing assessments, skills, policies, and procedures, to concentrate on were identified by the key stakeholders which were utilized to determine the finalized content of the developed learning resource manual.

Theoretical Basis

The utilization of learning resource manuals in orientation are effective, if current and relevant, in the provision of educational knowledge to nurses (Peltokoski, Vehvilainen-Julkunen, & Miettinen, 2015). The theoretical basis utilized in the development of this learning resource manual included Knowles' Adult Learning Theory (1984) and Benner's Novice to Expert Model (1984).

Knowles' Adults Learning Theory. Knowles' Adult Learning Theory (1984), is an andrological model that states that adults are self-directed autonomous learners that will learn best in an environment when asked to utilize their past or previous experiences to apply new knowledge in the solving of issues. Adults are more likely to learn if the information is viewed as relevant (Candela, 2016). According to Knowles' Adult Learning Theory (1984) for optimal learning to happen, there are six elements which should be present, which include: the need to know, a self-responsibility for self-directed learning, one's experience used as a resource in learning, application of the learning to one's life situation, a motivation to learn, and problem centered learning utilizing realistic scenarios (Mitchell & Courtney, 2005).

During the learning phase, adults transition at different rates moving towards self-directed learning which is dependent upon the learner's life events. The incorporation of an educational intervention that incorporates these features is deemed more likely to elicit positive leaning outcomes (Mitchell & Courtney, 2005). All orientating nurses will have the need to know the information presented in the developed learning resource manual to meet the orientation requirements. The educational learning resource was written for a novice practitioner under the realization that some nurses may be more, or less knowledgeable than others in certain learning modules. This allows nurses to progress through the modules at a self-directed pace, allowing them to focus their attention on their perceived knowledge deficits.

Benner's Novice to Expert Model. "Any nurse entering a clinical setting where she or he has no experience with the patient population may be limited to the novice level of performance" (Benner, 1984, p.21). Benner (1984) identified five levels of learning proficiency that can be applied to nurses entering the workplace based on formal knowledge and knowledge gained from experience (Dunnum & Respess, 1990). These levels include: novice, advanced beginner, competent, proficient, and expert (Benner, 1984). Based on the Dreyfus model of skill acquisition, it is hypothesized that nurses will start at the novice level of skill acquisition and through varying education, motivation, and experiences, will progress in an individualized manner through the varying skill acquisition stages (Carlson, Crawford & Contrades, 1989; Marble, 2009; Thomas, 2003).

Although it is common for nurses to progress through the levels of proficiency, during job changes, nurses may regress (Butt et al., 2002). The learning resource manual developed will be utilized in the orientation of nurses of varying experiences. Since hemodialysis is a specialty area, all nurses will be considered novice practitioners when completing the orientation. The learning resource manual was written from a novice perspective, allowing all nurses to gain the entry-level knowledge required of them to begin working in the hemodialysis unit. With time, practice, and exposure to preceptorship and independent practice, both newly graduated and experienced nurses, will gain hemodialysis work experience, allowing them to work and build on knowledge, moving upward from the novice level at an individualized pace (Benner, 1984).

Learning Resource Manual

The developed topics covered in the learning resource manual were based upon the information gathered through the integrated literature review and consultations with the various key stakeholders. The learning resource manual was divided into seven modules with several subtopics contained in each module. Aspects of learning were utilized in the form of tables, flow diagrams, pictures, and the ability to practice skills while independently working through the learning resource manual content. The seven modules that are contained in the learning resource manual include:

- Module 1: Kidney Disease
- Module 2: Hemodialysis Machine
- Module 3: Patient Assessment
- Module 4: Vascular Access
- Module 5: Hemodialysis Medications
- Module 6: Hemodialysis Complications
- Module 7: Nutrition

The completed learning resource manual can be found in Appendix C.

Plan to Implement and Evaluate the Learning Resource Manual

The completed manual will be produced and presented to the clinical educator and the divisional manager for review and approval. Once approved, the learning resource manual will be produced and utilized in the orientation of new nephrology nurses orientating into hemodialysis. The manual will be updated annually, or when there is a change in policy, equipment, procedure, scope of practice, or evidenced based practice.

Following the implementation of the learning resource manual, evaluation will be performed both post orientation and retrospectively six months following the completion of the orientation period. Post orientation, the nurses will complete a survey composed of written questions to determine if the learning resource was easy to follow and understand,

and if they felt the learning resource manual prepared them with the knowledge and skills needed to enter practice as a hemodialysis nurse after its completion.

Retrospectively, six months after the nurse has been employed in the hemodialysis unit, a repeat survey, similar to the structure of the first, will be administered to the same nurses. The evaluation survey will aim to determine if the learners felt that the learning resource manual adequately prepared them for entry into practice as a hemodialysis nurse, its relevance into practice, and upon their ability to apply knowledge and theory presented in the learning resource manual into practice based upon the learner's confidence in their knowledge and psychomotor ability.

Advanced Practice Nursing Competencies

Advanced nursing competencies of research, leadership, collaboration and consultation, and clinical were utilized in the completion of the practicum project during the development of the learning resource manual (Canadian Nurses Association, 2008). These competencies include the judgment, skills, and knowledge that are required for a registered nurse to provide comprehensive holistic care.

Research

Research is an integral aspect of advanced nursing practice. Through the generation and synthesis of research, practitioners can utilize evidence based practice to enhance nursing practice and quality patient care (Canadian Nurses Association, 2008). The utilization of research competencies in an integrative literature review was performed through the gathering, synthesizing, and disseminating of the literature to corroborate the need for an up to date orientation manual for the transitioning of nurses newly hired to the hemodialysis unit.

Leadership

By encompassing a leadership role, practitioners can be agents of change in the delivery of educational resources and the delivery of care to patients (Canadian Nurses Association, 2008). Leadership was demonstrated through the identification of the learning need and through the initiation and planning in the development of the learning resource. Following the completion of the learning resource manual, further leadership competencies were demonstrated through the learning resource manuals' dissemination.

Consultation and Collaboration

Advanced nurse practitioners utilize consultation and collaboration to gain input on gaps in the literature, education, and patient care. This information can be utilized to advocate for changes in education at various levels (Canadian Nurses Association, 2008). During the practicum project and in the development of the learning resource manual, consultation with my practicum supervisor Professor Best and with the identified key stakeholders was integral to course and project success. Consultation with my practicum supervisor allowed for the fulfillment of the course objectives and guidance and opinion on how to further develop and improve on the practicum project. Consultations with the key stakeholders allowed for valuable input regarding the importance of the development of a learning resource manual that is up to date, and evidenced based, and upon the topics that should be covered in the orientation period of any newly hired nephrology nurse orientating into hemodialysis.

Clinical Competence

Through holistically incorporating theory, research, and knowledge, the advanced care practitioner practices using clinical competence (Canadian Nurses Association, 2008). Overall competence was enhanced with the development of this learning resource as it is the goal that all novice nursing questions or concerns can be addressed in its content through the incorporation of current theory, research, and nursing knowledge. My personal clinical competence was enhanced by incorporating the knowledge that I have gained in the clinical area through work experiences and teaching into the developed learning resource manual.

Conclusion

Completion of this practicum project has enhanced my advanced nursing practice competencies in research, leadershup, consultation and collaboration, and clinical. This was facilitated by the completion of an informal needs assessment, integrated literature reivew, consultations and collaborations, and through the development of the learning resource manual.

The overall goal of the practicum project to develop a learning resource manual for usage in the orientation of newly hired hemodialysis nurses was accompolished. Prospective work will include the approval of the learning resource manual for implementation into orientation. The evaluation of the learning resource manauls relevance and effectiveness, as deemed by the learners, will be done through the completion of surveys. Once employed, the learning resource manual will be annualy updated to facilitate a good transition with updated resources, which is pivotal to nursing transition and retention.

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Appendix A

Integrated Literature Review

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Abstract

In Canada, an estimated 2.6 million Canadians are at risk for kidney disease. Treatment options for those afflicted with kidney disease are: transplant, peritoneal dialysis, or hemodialysis. At present, fifty-nine percent of all Canadians are being treated by hemodialysis. Both the incidence and prevalence of kidney disease is rising in Newfoundland and Labrador. The demand for hemodialysis facilities to support the increasing population needing hemodialysis, necessitates the need for the hiring and training of more nursing staff. Nurses transitioning into the hemodialysis unit must complete an in-depth orientation and preceptorship program. Newly graduated nurses-and experienced nurses-transitioning into the hemodialysis unit, struggle with the assessments, procedures, critical thinking, time management, and the technological components of the hemodialysis machine. In this paper, an integrated literature review was completed, exploring the importance of orientation to hemodialysis by analyzing the difficulties faced by nurses, both newly graduated and experienced, that transition into the hemodialysis unit. The importance of the content that is needed in an orientation, and how to facilitate the transition of newly hired nurses will be explored. Additionally, Knowles' Adult Learning Theory and Benner's Novice to Expert Theory will be explored as theories deemed useful in the development of a learning resource manual.

Key words: *hemodialysis, orientation, transitioning, preceptorship, integrated literature review, learning resource manual*

Introduction

Currently, end stage renal disease (ESRD) is a population health issue with disease incidence and prevalence rising in Canada. In Newfoundland and Labrador (NL) the prevalence of ESRD is the highest in the country (Canadian Institute for Health Information, 2017). There are three treatment options for ESRD patients which include: transplantation, peritoneal dialysis, and hemodialysis. Presently, hemodialysis is the treatment option used most often in Canada (Canadian Institute for Health Information, 2017). Due to the increasing demand for hemodialysis facilities for the increased patient population diagnosed with ESRD, there is a need for more nursing staff to be trained in nephrology nursing. Unfortunately, once hemodialysis is used as a treatment option, patients report higher rates of depression, anxiety, and coping abilities with reported lack of knowledge regarding their treatment modality when compared with patients followed in the pre-renal clinical (Cohen, 2013; Gill, Rose, Pereira & Tonelli, 2007; Hardwood et al., 2005; Keshia & Engin, 2011; Martchev, 2008). Due to the increasing rise of ESRD patients being treated by hemodialysis, orientation surrounding the intensive holistic nursing care required for ESRD patients is important.

Nursing job transitioning, has been studied extensively revealing multiple challenges for a successful transition of both newly hired and experienced nursing staff (Dyess & Sherman, 2009; Honan Pellico et al., 2009). Lack of knowledge about the new area and patient care required is one barrier that nurses encounter when transitioning to a new job, a barrier that can be conquered with effective orientation and educational resources. A review of the literature was completed to identify the barriers faced by nurses facing job transition which supported the need for current, up-to-date orientation manuals based on evidence based practice (Peltokoski, Vehvilainen-Julkunen, & Miettinen, 2015). The current orientation manual utilized by the hemodialysis program is outdated and no longer relevant as policies and procedures have changed. In this paper, I will complete an integrative literature review detailing the complexities of caring for ESRD patients, and the orientation needs of both the newly graduated and experienced nurse in the transition to nephrology nursing. I will also explore relevant learning theories that will be used to develop an orientation learning resource manual.

Background of the Topic

The number of Canadians being treated for ESRD has tripled over the past twenty years. ESRD is diagnosed when a patient’s estimated glomerular filtration rate (eGRF) is measured to be less than fifteen mL/min. ESRD, for any patient presents a multitude of substantial challenges to those affected (Twomey et al., 2014). Some of these challenges include: electrolyte imbalance, hypotension, muscle cramping, fever and chills, dialysis disequilibrium, membrane reaction, hemolysis, air embolism, and infection (Checherita, Turcu, Dragomirescu, & Ciocaliteu, 2010; Davenport, 2006). Patients diagnosed with ESRD have a fifteen times decreased rate of survival when compared to that of the average population contributable to the increased prevalence of morbidity in this patient population (Tong et al., 2013). An estimated 2.6 million Canadians have, or are at risk, for ESRD. Treatment options for patients with ESRD, are renal transplantation, peritoneal dialysis, or hemodialysis. In 2010, there were fifty-nine percent or 23,188 Canadian patients being treated for ESRD with hemodialysis (The Kidney Foundation of Canada, 2012). Both the incidence and prevalence of ESRD is increasing in Canada, and especially in the province of Newfoundland and Labrador. The incidence of ESRD in the Newfoundland and Labradorean population increased from 158.9 rate per million population in 2006 to 248.2 rate per million population in 2015. The prevalence of ESRD is seen the highest in the Newfoundland and Labradorean population with a prevalence rate of 1,578.6 rate per million population (Canadian Institute for Health Information, 2017).

The Canadian Association of Nephrology Nurses and Technologists (CANNT), defines nephrology nursing as a specialty area whereby nurses employed in the area should meet guidelines and standards set forth by the association (Canadian Association of Nephrology Nurses and Technologists, 2008). Nursing competence is one standard identified by CANNT (2008), stating that “the nephrology nurse acquires, maintains and continues to develop knowledge, skill and judgment to provide the best care possible with kidney disease” (p. 15). One way nurses can achieve this standard is through the acquiring of knowledge through participation in a nephrology unit orientation program (CANNT, 2008).

Topic Relevance

Currently, there are seven hemodialysis units under Eastern Health’s Authority. The registered nurses (RNs) and licensed practical nurses (LPNs) that are hired within the hemodialysis program, participate in an orientation process conducted at the Waterford Hospital in St. John’s, Newfoundland. The current manual that is being utilized for orientation purposes was developed in 2005 and has not been revised to support changes made in the hemodialysis program. Multiple changes in policies and procedures, a new hemodialysis machine manufacture tenure, and the increased scope of practice of LPNs in the clinical setting, have occurred since the development of the current manual. To ensure a comprehensive evidenced based orientation, the orientation manual utilized to train and orientate staff, must be composed of the most current literature and the best evidence based practices that are currently being recommended. Although this twelve-year-old manual has not been formally evaluated, anecdotal evidence from the clinical educator, newly hired nurses, and nurses that preceptor agree that the current manual needs to be updated.

Providing a comprehensive orientation that allows newly hired staff to be prepared in their new role is an integral aspect of preventing attrition and promoting retention (Kells & Koerner, 2000; Remus, Smith & Schissel, 2001; Winter-Collins & McDaniel, 2000). An ideal orientation program for nursing staff, must address each nurse as an individual, and subsequently must address his/her needs in a unique manner (Burk, Gillman & Ose, 1984).

Nurses, when surveyed regarding their opinions regarding the orientation they received in a critical care unit, similar to a hemodialysis setting, stated that the most important factor in the orientation was the need to be provided more opportunities to practice new clinical skills (Meyer & Meyer, 2000). The Association of Registered Nurses of Newfoundland and Labrador (2003) position statement on orientation programs has identified key elements to ease transition and increase recruitment and retention. One of the essential key elements identified is “all new graduate nurses and experienced nurses in transition require a comprehensive nursing orientation with clearly defined time frames, goals and expectations (Association of Registered Nurses of Newfoundland and Labrador, 2003, p.4.).

In 2005, an orientation manual was developed for the use of governed Eastern Health hemodialysis units utilizing Morrison, Ross, and Kemp's (2001) instructional competency-based design model which, informally has been indicated as an effective guide for the orientation of newly graduated and experienced nurses transitioning into the hemodialysis unit (Del Buneo, Barker, & Christmyer, 1980; Ludlow et al., 2007; Stokes, 1991). One key concept of this model is the continual need for evaluation and improvement (Morrison et al., 2001). Despite this, no updating of the *Learner's Manuel for Hemodialysis Nurses* by Ludlow et al., (2007) has been done on the two-hundred-and-fifty-page manual despite multiple changes in: the hemodialysis machinery, scope of practice of LPNs, equipment utilized, in addition to a multitude of changes in policies and procedures that have occurred since the manual was developed twelve years prior. In order to be useful and relevant for use in practice, orientation manuals must be constantly updated (Peltokoski et al., 2015). The plan for this practicum project is to redo the orientation manual with the most up-to-date evidenced based practices and research.

Integrative Literature Review

Search Terms and Databases

PubMed, the Current Index to Nursing and Allied Health Literature (CINHAL), and the Cochrane Library search engines were utilized to search for pertinent literature applicable to nursing orientation in a hemodialysis setting. To ensure the most up-to-date literature was obtained, limits were set to find articles from 2000 onward. When sufficient literature was not obtainable with these time constraints, older literature was used. Terms utilized in the literature search included: “hemodialysis”, “orientation”, “nursing”, “nursing care”, “new graduates”, and “transition”. To encompass literature and research on the care of hemodialysis patients, other searches included “vascular access”, “fluid assessment”, “hemodialysis complications”, and “nursing interventions”. Articles were retrieved regarding the required nursing care of the hemodialysis population. However, there was a scant amount of research focused specifically upon the orientation needs of nurses transitioning into nephrology nursing. Due to lack of hemodialysis orientation articles, broader research limits were utilized, and qualitative articles surrounding orientation to critical care were utilized in the literature review.

Articles were read and reviewed, with the most pertinent literature being analyzed and critiqued for the integrated literature review. It was found that most of the data retrieved did not focus specifically upon nephrology nursing, therefore orientation literature from various disciplines was utilized in the integrated literature review. Research articles were evaluated and rated with the Public Health Agency of Canada (PHAC) rating tool for quantitative research, and by analyzing and critiquing research methodology and rigor for qualitative research. For the purpose of this integrated literature review, literature summary tables of the most relevant research studies were completed and can be found in the appendices.

Hemodialysis as a Treatment for End Stage Renal Disease

For the one in ten Canadians that are diagnosed with ESRD-and are unsuitable for renal transplantation or peritoneal dialysis, hemodialysis is the only alternative treatment option (Bayhakki & Hatthakit, 2012). A patient's hemodialysis routine involves a complex medical regime including: a strict medication regime, strict fluid and diet restrictions, and on average eleven hours (or three treatments) each week.

Patients with ESRD face difficulty with coping with their diagnosis and with the transition to hemodialysis (Gill, Rose, Pereira & Tonelli, 2007; Keshin & Engin, 2011). Once hemodialysis is initiated, patients self-reported high rates of both depression and suicidal ideation, related to the inability to cope with the immense amount of change and barriers faced medically, socially, and economically (Keshin & Engin, 2011). In the reviewed literature, the most thematic barriers to coping for ESRD patients included: lack of social support, increased stressors, loss of control, psychological impact of being on hemodialysis as a palliative life sustaining measure, and lack of knowledge (Cohen, 2013; Hardwood et al., 2005; Martchev, 2008).

Nephrology nurses, by CANNT (2008) guidelines, are responsible in their scope of practice to provide patient education on the etiology of ESRD and the management of ESRD by patients. Although nursing staff cannot address all patient's responses to chronic disease and lifelong treatment, they can provide integral knowledge and information to patients regarding their health. A patient's initial knowledge, attitude, and perception regarding living life on dialysis can have a major impact on motivation for the self-care management of ESRD. A lack of motivation for self-care has been shown to have a negative impact on patient's lifestyle choices and if unmotivated, patients are less likely to seek education and knowledge when needed (Finkelstein et al., 2008). The challenges involved in providing education to ESRD patients are numerous. ESRD patients have identified a lack of knowledge regarding their health and treatment care options. In a nonrandomized, cohort prospective study studying ESRD patients' perceptions of their disease, only twenty-three percent of the 2295 enrolled in a survey reported an extensive knowledge of their disease and how to manage their diet, fluid, and medications (Finkelstein et al., 2008). Additionally, thirty-five percent reported no knowledge about the life sustaining treatment they receive. In the same study, patients reported hemodialysis knowledge increased with each clinic visit from 40.4% to 64.3%, (p value of 0.001) after having the opportunity to ask questions and talk about treatment modalities and alternatives to care. Patients that reported a higher level of hemodialysis knowledge, had a higher reported quality of life and coping skills when directly compared to patients that reported minimal knowledge (Finkelstein et al., 2008).

Similar findings were found in a grounded theory study conducted by Oliver-Calvin (2004). Interviews, transcripts, and field notes were used to determine the feelings, knowledge, coping abilities, and quality of life regarding end of life care of twenty hemodialysis patients. Once conducted, input regarding patient's feelings were coded using a constant comparative method, identifying emergent themes that saturated the data set. Patients that were knowledgeable regarding their disease process and dependence on the hemodialysis machine for sustainability would rather "focus on living rather than dying" (p.558). Through knowledge of the odds of long term survival, beating the odds, being optimistic, and personal preservation, they felt a greater need to live in the moment and to embrace each new situation as it arose rather than dwelling on the potential of what could have been. Alternatively, patients who were not well educated reported lower quality of life due to impending thoughts of fear of the unknown, death, and dying. Without education, these patients reported being less likely to live day by day, to take risks, and to enjoy the things that they previously loved.

Educating hemodialysis patients is integral to the role of the hemodialysis nurse. Many research studies have shown that patient compliance and responsibility for self-care can be increased with nursing educational programs and intervention focusing on enhancing patient knowledge surrounding their disease and treatment options (Baines & Jindal, 2000; Barnett, Li Yoong, Pinikahana & Si-Yen, 2007; Kutner, 2001; Nozaki, Oka, & Chaboyer, 2005; Sandlin, Bennett, Ockerby & Corradini, 2013). One study on the effectiveness of nursing education on patient's fluid compliance was utilized to determine if interdialytic fluid gain can be controlled by nursing interventional education and weekly reinforcement about diet and fluid restrictions. Results showed that patient's weight gain decreased following the intervention from a mean weight gain of 2.64 kg to 2.21 kg each week and self-reported adherence to fluid restrictions increased from 47% to 71%. "Interactions between the nurse and patient is crucial to ensure that teaching is effective and on-going" (Barnett et al., 2007, p. 305). It is imperative for nurses to educate patients and their families about hemodialysis and the various self-care behaviors such as fluid and dietary restrictions that they must adopt and cope with. This transition can be a difficult time for patients and their families, therefore, it is essential that education is performed by a nurse that is educated, knowledgeable, and comfortable in presenting the information in a non-hurried manner allowing for questions, concerns, or comments to be addressed.

Nursing Responsibility and Interventions with the Hemodialysis Population

With hemodialysis, a patient's blood is filtered through an artificial semipermeable kidney (dialyzer) using the principles of osmosis and diffusion to remove excess waste products and electrolytes that can no longer be removed by the kidneys (Broscious & Castagnola, 2006). During this treatment, patients may have complications such as: vascular access dysfunction, electrolyte imbalance, hypotension, hypoglycemia, muscle cramping, dialysis disequilibrium, air embolus, hemolysis, and fluid overload, that require individualized nursing care (Broscious & Castagnola, 2006; Hardwood et al., 2005). Patient assessment is critical in the ESRD population and include assessments of the following body systems: cardiovascular, immune, musculoskeletal, hematological, neurological, gastrointestinal, renal, respiratory and integumentary (Broscious & Castagnola, 2006). Additionally, the monitoring of bloodwork results, hemodialysis machine values, vital signs, and the rate and amount of fluid removal is critical to patent care with the need for each patient to be given individualized care, as patients tolerate hemodialysis differently.

Nurses with advanced assessment skills are essential for beneficial outcomes for each hemodialysis patient (Broscious & Castagnola, 2006). Vascular access, is a hemodialysis lifeline that the patient requires to use for treatments. It is the responsibility of the nurse to assess the arteriovenous fistula, central venous catheter, or the arteriovenous graft, prior to initializing hemodialysis to ensure patency, to detect infection, or to identify problematic issues. “Failure to properly access the vascular access, on a repeated basis can result in serious complications for patients” (Wilson, Harwood, & Oudshoorn, 2013, p. 11). Cannulation of the arteriovenous fistula or the arteriovenous graft is a skill that is only gained with experience and practice. In the hemodialysis setting, it has been noted that nurses are uncomfortable with their cannulation skills as patient dictate which nurses they want to access their vascular access, and dictate needle placement during arteriovenous fistula or arteriovenous graft cannulation. Furthermore, patients are often fearful of nurses they know are new and are hesitant to allow them to access their vascular access. This produces fear and anxiety in newly hired staff and avoidance of cannulation. However, with time, newly hired nurses will transition and may be the most experienced on the unit after just one year of practice. If this fear and anxiety is not addressed, and if cannulation not practiced, it may longitudinally jeopardize patient vascular access (Wilson et al., 2013).

To prevent infection, when caring for central venous catheters, nurses must be able to maintain sterile technique when assessing the central venous catheter, and when changing the TEGO® connectors and the occlusive dressing once weekly. Central venous catheter use is associated with a six times increase in the risk of patient death and is directly associated with increased rates of morbidity, mortality, and hospital costs compared to patients dialyzing with an arteriovenous fistula or graft. Thus, central venous catheter assessment and compliance with sterile technique are important skills for a nurse to employ and to be cognizant of when providing care (Lok et al., 2003; Moist, Trpeski, Na, & Lok, 2008).

Orientation of Newly Graduated Nurses

The knowledge and orientation needs required by newly graduated nurses is a phenomenon studied extensively in the literature (Berkow, Virkstis, Stewart & Conway, 2009; Butt et al., 2002; Loiseau, Kitchen & Edgar, 2003). The experience of transition from student to practicing nurse, workload stress, and the ability to provide safe patient care that is standard to organization expectations are all concerns described by newly graduated nurses upon being hired (Dyess & Sherman, 2009). Due to the rising acuity of patients, staffing shortages, novice clinical assessment skills, lack of knowledge, and complex technologies, successful orientation is essential for the transition of newly graduated nurses into the workplace (Bevan, 1998; Dyess & Sherman, 2009; Peltokoski et al., 2015).

It has been suggested that an adequate orientation affects a nurse's intent to continue in a job (Dellesage, Gabbay & Martinez-King, 2009). The turnover rate at one year for newly graduated nurses in specialty nursing areas who felt they were not adequately prepared or supported-was ninety-two percent. With newly graduated novice nurses fulfilling approximately twenty three percent of all nurses hired in acute care facilities, and ten percent of all nurses hired in critical care facilities, it is of the upmost importance that these nurses are prepared in orientation to meet the job objectives expected of them to maintain patient safety and promote patient wellbeing (Berkow et al., 2009; Morrow, 2008).

Entering the workplace for the first time, or job transition early in a nurse's career, forges mixed emotions in newly graduated or novice nurses. Although excited to start their careers, these nurses are often faced with various difficulties as they transition into the professional role as a nurse and the role change experienced from nursing student to practicing nurse (Dyess & Parker, 2012). Transitioning to a new job is easier for nurses that are provided with an effective orientation (Peltokoski et al., 2015). Despite this, many barriers to effective orientation and transition have been identified, researched, and explored in the literature. Thematically, the common barriers include: communication, colliding expectations, lack of critical thinking, need for increased knowledge and speed, fear, and disorganization in the management and organization of responsibilities, which will be explored further in the following dissemination of the literature (Berkow et al., 2009; Fero, Witsberger, Wesmiller, Zullo & Hoffman, 2009).

Research studies by Honan Pellico et al. (2009) and Peltokoski et al. (2015) revealed new nurses' perceptions of their needs and the barriers faced upon orientation to a new unit. New nurses are often expected by coworkers and the employer to be as knowledgeable and to work as quickly as skilled expert nurses (Berkow et al., 2009; Fero et al., 2009; Honan Pellico et al., 2009). Often new nurses felt they were rushed or pushed through orientation, and were given complex full patient workloads on day one post orientation, leading to increased stress before they felt competent to fulfil the role expected of them (Honan Pellico et al., 2009). Honan Pellico et al. (2009) conducted a qualitative study to determine how newly licensed registered nurses feel regarding their first workplace experience. A survey was mailed out to a cross section of newly graduated nurses that had been finished school for eighteen months or less. Over eighty percent of the nurses stated that despite feeling prepared skill wise to perform nursing duties, the expectation and the rush to do them quickly led to stress and eventually burnout. Nursing educators in that study acknowledged that “the speed of doing will take time” (p. 198) however, assignments are never tailored to allow new nurses the opportunity to ease into a full workload and often new nurses would have the same workload as a veteran nurse (Honan Pellico et al., 2009).

Nurses employed in specialty settings provide care for complex patients requiring high-level critical decision skill making (Dyess & Sherman, 2009). New nurses identified fear and lack of clinical confidence and critical thinking ability when transitioning into the workplace (Butt et al., 2002; Dyess & Sherman, 2009; Fero et al., 2009; Rush, Adamack, Gordon, Janke, & Ghement, 2015). This lack of ability to critically think and perform under stress is corroborated by nurse leaders and hospital and health systems nurse executives, who report only twenty-five percent satisfaction with new graduate performance, and ten percent satisfaction with the ability of these graduates to provide safe patient care (Dyess & Sherman, 2009).

Effective orientation of new staff, is a way to enhance new graduate transition (Meyer & Meyer, 2000; Rush et al., 2015). In a quantitative online research study by Rush et al. (2015), the Casey Fink Graduate Nurse Experience Survey was disseminated to newly graduated nurses to quantify the orientation experience. Investigators found that new graduates who were provided with an up-to-date orientation and transition program reported statistically significantly higher rates of positive transition than their peers ($p < 0.0001$). The ability to think and act critically has been shown to be higher in new nurses that avail from an in-depth orientation and utilize educational manuals as guiding resources than those not privy to these resources upon the commencement of orientation (Rush et al., 2015). In a study conducted by Fero et al., (2009), the concern for patient safety and the critical thinking ability of newly graduated nurses was studied and compared to that of experienced nurses. Since the safety of the patient can be directly affected by nursing critical thinking ability, nurses must demonstrate this ability to think and intervene appropriately in the recognition of: patient status condition change, the anticipation of orders, the need to intervene, and the ability to prioritize. Critical thinking includes the ability to "clarify questions, gather relevant data, reason to logical or valid consultations, identify key assumptions, trace significant implications, or enter without distortion into alternative points of view" (Paul, 2004, p.3). Orientation programs that have manuals with modules that focus on a body systems approach, helped develop a new graduate nurses' ability to critically think when providing care. Therefore, the need for learning resource modules that encompass a body systems approach is important for the development of critical thinking skills in newly graduated nurses (Kaddoura, 2010).

A post hoc retrospective study used a consecutive sample of 2144 newly hired nurses to complete the Performance Based Development System Assessment (PBDS) which consisted of ten videotaped vignettes that showed a change in the status of a patient. After viewing the vignettes, the nurses wrote what they believed to be the problem, how they would respond if they were the nurse taking care of the patient, and the rationale behind all actions and interventions they would provide. Results were recorded as a pass or fail dependent upon if the nurses met the set responses or not. From the results, it was determined that 74.9% of the nurses met assessment expectations.

However, the learning needs identified for those nurses not meeting the expectations were: the initiation of nursing interventions, the differentiation of urgency, the need to report essential clinical data or to seek assistance if needed, the anticipation of medical orders, providing evidenced based rationale to support all care decisions, and the recognition of problems when they arise. When controlled for years of experience, new graduates were less likely than nurses with over ten years of experience to meet the expectations of the PBDS ($p < 0.046$). Problem solving and critical thinking are integral abilities of effective nursing practice. To enhance these abilities, nursing education needs to be developed, integrated, and incorporated into the orientation of newly hired nurses, in an attempt to enhance novice nurses ability to think and manage critical situations (Fero et al., 2009; Honan Pellico et al., 2009).

Inability to communicate to other interdisciplinary team members was a common theme noted in the literature as a major barrier for new nurses entering the workplace (Dyess & Sherman, 2009; Honan Pellico et al., 2009). Newly graduated nurses often identified workplace horizontal violence by colleagues, or frequent experiences of less than ideal communications with physicians and other interdisciplinary team members (Dyess & Sherman, 2009). In response to the less than ideal communications, new nurses are found to be less likely to ask for help, to ask questions, or to contact the physician unless “a patient experiences an extreme physiological decline”, which jeopardizes patient’s safety (Dyess & Sherman, 2009, p.403). As part of the orientation manual, opportunities to converse with, and to meet other staff members has been shown to positivity influence transition. Interpersonal communication skills and the intentional preparation for such, has been shown to enhance communications between nurse and fellow coworkers and members of the interdisciplinary team (Dyess & Sherman, 2009).

Orientation of Experienced Nurses

Orientation, and the need to generate a good transition, is not only essential for the novice nurse but is essential to the job satisfaction, retention rates, and work ability of experienced nurses (Butt et al., 2002; Dellasenga, Gabbay, Durdock & Martinez-King, 2009; Fero et al., 2009; Lartey, Cummings & Profetto- McGrath, 2014; Pool, Poell, Berings & Cate, 2015). For nurses that are transitioning to a new area from an area in which they were deemed experienced, the expert, or the “go-to” staff member, transitioning into a new position where the experienced nurse now needs to assume a novice role, can create feelings of fear and inadequacy (Butt et al., 2002; Dellasenga et al., 2009). In an ethnographic research study conducted by Wilson et al. (2013) nine novice hemodialysis nurses, with varying years of experience as nurses in other areas, were surveyed about being a novice hemodialysis practitioner in arteriovenous graft and arteriovenous fistula cannulation. These experienced nurses who were now placed in the novice role expressed feeling additional pressure to perform without assistance with cannulation when compared to their peers that were new in the nursing profession and had little to no prior nursing work experience (Wilson et al., 2013). All nurses that transition into new job roles have backgrounds that vary in education, skill, and experience, therefore, it is pivotal that every nurse transitioning into the unit is given the same learning opportunities. Some nurses may need little orientation regarding certain skills or assessments, whereas others may require more, but consistency in the provision of equal learning opportunities is integral in the development and delivery of an effective orientation education learning resource manual (O'Grady & O'Brien, 1992).

Experienced nurses orientating to a specialty setting were studied to gain insight on the orientation needs when transitioning into a new job (Dellasenga et al., 2009) During orientation, nurses were asked to keep a journal and to participate in a focus group on their experiences and responses to situations they encountered in their orientation. Both the journals and the focus group responses were analyzed and coded for emerging themes. Three themes were identified from the data obtained which included: the assessment of expectations, realism, and adjustment. Experienced nurses felt conflicted and often questioned their decision to change jobs. Doubt was high in the orientation period, as an immense amount of new material was presented and expected to be learnt and mastered in a short time frame, eliciting stress, anxiety, and nervousness. Experienced nurses faced shock and anxiety over now being a novice practitioner and expressed feelings of intimidation in the learner role and during evaluation periods. Although adjustment occurred, nurses continued to compare their level of preparedness and comfortability to their previous jobs while exhibiting feelings of uncertainty, discomfort, and incompetence which differed from newly hired nurses who had never encountered being an expert nurse (Dellasega et al., 2009).

Patterns of learning differ for that of a novice nurse in comparison to that of an experienced nurse (Bratz, 1999). In a study conducted by Pool et al., (2015), a biographical approach was employed to determine what aspects of life learning influenced the ways in which nurses of varying ages and career stages gain and utilize knowledge. The novice nurses felt that learning and professional development was key for preparedness in the workplace but the experienced nurses felt that they gained and incorporated personal life experiences for use in their practice. Despite the differences, commonalities existed in that both groups felt that the continuance of personal development was important for their jobs, learning was essential to job transitioning, and both wanted help when new skills or new equipment/technology were introduced and made a workplace requirement.

An orientation program that allows an novice or experienced nurse to transition into the new work roles and responsibilities is needed for a positive transition, a decrease in staff attrition, and to enhance patient safety (Mathews & Nunley, 1992; Meyer & Meyer, 2000). Education resources are essential to nurses that experience job change (Butt et al., 2002; Peltkoski et al., 2015). Butt et al. (2002), in a research study searched for the knowledge needs, as perceived by any nurse experiencing change. A reliable survey with a test-retest reliability of 0.67, was employed in two Canadian hospitals, surveying a convenience sample of all nursing personnel employed in the hospitals ($n=3408$). Nurses were classified into three job transitioning groups of nurses that experienced: role change, starting work in a different unit, or starting work in a different hospital. Comparison statistics of one way ANOVAs and chi square determined there were no statistically significant differences amongst the groups ($p< 0.05$). Opinions from the survey found that nurses needed a moderate amount of knowledge and support during any transition regarding up-to-date- policies and procedures, protocols, technical procedures, and nursing interventions ($p <0.000$). It is imperative that nursing staff employed in the hemodialysis unit are supported to become educated, knowledgeable, and comfortable with their new job responsibilities to ensure a smooth transition and to enhance nursing confidence in their new nursing role. The provision of this knowledge justifies the need for an updated unit orientation manual to the area.

The increasing incidence and prevalence of ESRD in Newfoundland and Labrador warrants the need for more hemodialysis nurses to be hired, and orientated, to nephrology nursing. To facilitate a good transition, nurses, both newly graduated and experienced, face barriers during orientation when transitioning to a new job role. If given a supportive orientation using up-to-date learning resources, nurses facing these barriers prevailed, and a successful transition occurred. The current orientation manual in the hemodialysis unit needs to be redone as it is archaic and does not represent the most up-to date evidence based practice. To develop this orientation manual, concepts and underpinnings from Benner's Novice to Expert Model (1984) and Knowles' Adult Learning Theory (1984) will be used.

Theoretical Basis

Benner's Novice to Expert Model

In the development of a learning resource manual Benner's Novice to Expert Model (1984) will be utilized as a guiding theoretical framework. Benner (1984) identified five levels of learning proficiency that can be applied to nurses entering the workplace based on formal knowledge and knowledge gained from experience (Dunnum & Respess, 1990). These levels include: novice, advanced beginner, competent, proficient, and expert (Benner, 1984). Based on the Dreyfus model of skill acquisition, it is hypothesized that nurses will start at the novice level of skill acquisition and through varying education, motivation, and experiences, they progress in an individualized manner through the varying skill acquisition stages (Carlson, Crawford & Contrades, 1989; Marble, 2009; Thomas, 2003).

At a novice level, nurses have minimal experience in the area in which they are expected to work. Both novice nurses and experienced nurses when transitioning to a new area are considered novice practitioners (Dunnum & Respess, 1990). Next, at the advanced beginner level, the nurse can "demonstrate marginally acceptable performance" (Burns & Poster, 2008, p.67). In the competent level, the nurse with two to three years of experience can envision nursing interventions and the short and long-term implications of such (Marble, 2009). In the proficient phase, nurses begin to envision situations and scenarios, incorporating all factors that are influential to patient care and outcomes (Benner, 1984). Finally, at the last step of skill acquisition is the expert level. At this level, the nurse has an immense amount of experience in their given field and their initiation allows for rapid decision and problem-solving skills (Marble, 2009).

"Any nurse entering a clinical setting where she or he has no experience with the patient population may be limited to the novice level of performance" (Benner, 1984, p.21). Although it is common for nurses to progress through the levels of proficiency, during job changes, nurses may regress (Butt et al., 2002). The learning resource manual developed will be utilized in the orientation of nurses of varying experiences. Since hemodialysis is a specialty area, all nurses will be considered novice practitioners when completing the orientation. The learning resource manual will be written from a novice perspective, allowing all nurses to gain the entry-level knowledge required of them to begin working in the hemodialysis unit. With time, practice, and exposure to preceptorship and independent practice, both newly graduated and experienced nurses, will gain hemodialysis work experience, allowing them to work and build on knowledge, moving upward from the novice level at an individualized pace (Benner, 1984).

Knowles' Adults Learning Theory

Knowles' Adult Learning Theory (1984), is an andrological model that states that adults are self-directed autonomous learners that will learn best in an environment when asked to utilize their experiences to apply new knowledge in the solving of issues. Adults are more likely to learn if the information is viewed as relevant, and information and can be shaped by the learners' past experiences and maturity level (Candela, 2016). According to Knowles' Adult Learning Theory (1984) for optimal learning to happen, there are six elements which should be present, which include: the need to know, a self-responsibility for self-directed learning, one's experience used as a resource in learning, application of the learning to one's life situation, a motivation to learn, and problem centered learning utilizing realistic scenarios (Mitchell & Courtney, 2005).

During the learning phase, adults transition at different rates moving towards self-directed learning which is dependent upon the learner's life events. The incorporation of an educational intervention that incorporates these features is deemed more likely to elicit positive leaning outcomes (Mitchell & Courtney, 2005). All orientating nurses will have the need to know the information presented in the learning resource manual to meet the orientation requirements. The educational learning resource will be written for a novice practitioner under the realization that some nurses may be more or less knowledgeable than others in certain learning modules. This allows nurses to progress through the modules at a self-directed pace, allowing them to focus their attention on their perceived knowledge deficits.

Summary of Commonly Identified Themes and Concepts

The completion of the integrated literature review identified several reoccurring themes and concepts. Firstly, due to the increasing rise of both the incidence and prevalence of ESRD in Newfoundland and Labrador, the need for more nurses trained to work in hemodialysis is paramount. Nurses in the hemodialysis unit must be trained and prepared to independently care for, assess, and educate a multifaceted range of patients, working with a multitude of comorbidities that will likely alter and individualize their hemodialysis treatments. Patients that are diagnosed and started on hemodialysis therapy as a treatment regime, face multiple stressors and barriers. Support, and education for them and their families and caregivers is pivotal to allowing them to make informed choices pertaining to their health care decisions.

One commonly identified theme was the need for a good, in-depth, supportive orientation for nurses transitioning into a new job role. The barriers identified by newly graduated nurses included: lack of confidence in skills, lack of critical thinking, ineffective communication, and fear. All barriers if unaddressed in the transitioning orientation period, can facilitate an ineffective transition which in turn can jeopardized patient safety and positive patient outcomes.

Experienced nurses also expressed concerns and faced a plethora of barriers when transitioning between jobs also. Often these nurses experienced anxiety and fear of the unknown. Most experienced nurses struggled with what they perceived as a regression from the area in which they were an expert to being employed in an area where they were viewed as a novice. Due to this, often these nurses felt that they were expected to retain knowledge more easily, perform at a higher level, and experienced anxiety over learning new material in a new unknown area of practice.

The need for an informative orientation program was identified in the literature as imperative to positive nurse transition and ultimately to nurse retention and satisfaction. Nurses when orientated thoroughly, report an easier transition and decreased feelings of fear, anxiety, and helplessness once employed in a new area. A learning resource focused towards nurses orientating into the hemodialysis unit allows nurses, both experienced and novice, to become informed, knowledgeable, and comfortable when performing assessments and skills utilized every day in the provision of patient care in the hemodialysis unit.

Conclusion

The completion of the integrated literature review yielded many important aspects to consider in the future development of the learning resource manual. Firstly, it was shown that orientation, for all nurses regardless of prior experience, is important. Transitioning to a new job rendered uncertainty and anxiety, therefore a well-developed learning resource manual will be a vital source of information for those newly orientating to the hemodialysis unit. Hemodialysis patients, are complex and are afflicted with a multitude of contributing comorbidities, whereby critical thinking needs to be employed in the assessment and treatment of each individual patient. Nurses, when assigned to care for these hemodialysis patients need to be informed to provide education and support to the patients and their families'. Additionally, the need to understand procedures commonly utilized in the hemodialysis unit such as arteriovenous fistula and arteriovenous graft cannulation and the accessing of a central venous catheter, warrants the nurse to be proficient and comfortable in performing skills as per Eastern Health's policy. In this integrated literature review I have highlighted the complexity of care for the hemodialysis patient, and the difficulties experienced by nurses whom transition into the hemodialysis program. Through the utilization of Benner's Novice to Expert Model (1984), and Knowles' Adult Learning Theory (1984), a learning resource manual that provides education needed by novice practitioners can be developed.

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Appendix A1

Study	Sample	Study Design and Methodology	Results	Study Strengths and Limitations	Conclusion
Title: Newly hired nurses' and physicians' perceptions of the health care orientation process: a pilot study.	-Cross sectional convenience sample of nurses (n=145) & physicians (n=37). -Between the years of 2009-2010. -Employed in a specialized hospital in Finland (one university, and one central hospital).	-A cross sectional questionnaire that was descriptive in nature was given (mailed) to the sample study participants. -Cover letters and prepaid and pre-addressed envelopes were sent with questionnaire. -Response rate was 45% (or 182 returned surveys). -Orientation process evaluation (OPE) measured satisfaction with the orientation received (55 item instrument). The instrument has good reliability (Cronbach's Alpha 0.87).	-Orientation ranged in length. Staff that were given longer orientations reported higher satisfaction with the orientation process. -Satisfaction with the orientation was low pertaining to orientation goals and responsibilities, the standardized content, and the implementation of the orientation. -Competence level of participants never measured before, during, or after the orientation. -Positive correlations with a better orientation evaluation was given when a preceptor was used.	<u>Strengths:</u> -OPE used to measure results was reliable and standardized. <u>Limitations:</u> -Small sample size used in one geographical location, therefore generalizability limited. -Moderate response rate.	-Orientation should be based on evidenced based strategies and is important for staff satisfaction, and to increase competence for safe patient care. -The use of a preceptor is good for staff satisfaction.
Study Objective: To examine newly hired nurse and physician attitudes' surrounding the orientation they received.					

Reference: Peltokoski, J., Vehvilainen-Julkunen, K., & Meittinen, M. (2015). Newly hired nurses' and physicians' perceptions of the comprehensive health care orientation: a pilot study. *Journal of Nursing Management*, *23*, 613-622.

Appendix A2

Study	Sample	Study Design and Methodology	Results	Study Strengths and Limitations	Conclusion
Title: The orientation experiences of urgent care nurses: sources of learning. **Study Objective:** To explore the needs of newly hired nurses to urgent care settings.	-10 critical care RNs selected upon selection criteria. -All RNs had a minimum of 1 year in urgent care but less than 3 years.	-Qualitative phenomenological inquiry using case studies and open ended questions. -Interviews 45 minutes in length and tape recorded for coding. -Heuristic phenomenological inquiry for pattern and theme identification.	-Orientation deemed to be a time of transition and adjustment. -Learning can be governed from 1) natural, 2) self directed, 3) peer-directed, and 4) organization based. -Self directed learning was done with material references resources, human resources, and experiential learning	<u>Strengths:</u> -Open ended questions allowed nurses to express their experiences as their lived experiences. <u>Limitations:</u> -Small sample size therefore generalizability is limited. -Study was pertaining to newly hired nurses in critical care with previous experiences. No novice nurse input included.	-Learning in the orientation phase can be achieved in many ways. There are multiple resources a nurse can use to self direct their own learning needs; warranting the need for good up to date references.
Reference: Bratz, K.L.S. (1999). The orientation experiences of urgent care nurses: sources of learning. *Journal for Nurses in Staff Development, 15*(5), 210-216.					

Appendix A3

Study	**Sample**	**Study Design and Methodology**	**Results**	**Study Strengths and Limitations**	**Conclusion**
Title: Transition support for the newly licensed nurse: a programme that made a difference	-109 newly graduated nurses (convenience sample). -Participation in Novice Nurse Leadership Institute (NNLI) course between 2006-2009 (a 10-month program). This program is developed to support newly licensed nurses transitioning in skills, coping, and leadership.	-Mixed method with pre/post evaluation design. Quantitative data gained regarding skill acquisition and leadership development at beginning of the program and again after the program using Nursing Evaluation Competence Assessment instrument.	-Response rate 82%. -Retention was positively associated with the NNLI programme. -Transitioning into the workforce was supported by the NNLI. -Development of leadership, technical, psychosocial, and skill acquisition occurred.	<u>Strengths:</u> -Pre-and post-test evaluation employed. <u>Limitations:</u> -Small sample and isolated geographical area (Southern USA) therefore generalizability is limited. -Self reported data collection may be biased and skew data results.	-The transitioning phase and the competency of newly licensed nurses can be enhanced with education and support during the transitioning phase.
Study Objective: To provide description and evaluation on a program that supports newly hired non-experienced nurses.					.
Reference: Dyess, S., & Parker, C.G. (2012). Transition support for the newly licensed nurse: a programme that made a difference. *Journal of Nursing Management*, *20*, 615-623.					

Appendix A4

Study	Sample	Study Design and Methodology	Results	Study Strengths and Limitations	Conclusion
Title: Moving beyond the “perpetual novice”: hemodialysis nurses and cannulation of the arteriovenous fistula. **Study Objective:** To explore the novice in the Hemodialysis unit and ways to advance skill acquisition.	-9 participants that were new to hemodialysis (less than 3 years) now employed in a teaching hemodialysis facility in Canada (purposeful sampling). -Snowball sampling used to recruit more participants. -Inclusion: Self consideration of being a novice cannulator. -Ethnography study to understand novice hemodialysis culture.	-8 item semi-structured interview to guide the process, conducted in a private area. -Post interview all audiotaped were transcribed verbatim and key themes identified.	-Personal and environmental factors effected the ability to gain skills in the hemodialysis unit in novice nurses. Personal Factors included: avoidance of cannulation, the challenge of cannulation, patients dictating needle placement and nurse cannulator, and the asking for a change in patient assignment. Environmental Factors included: nursing staff working a shift (are they helpful).	<u>Strengths:</u> - Ethnographic study to gain insight into the felling’s of novice nurses. <u>Limitations:</u> -Small sample size therefore generalizability is limited. -The self reported identification of being a novice cannulator may be biased; skewing results.	- Job change and skill acquisition in the hemodialysis unit is stressful. -Not enough time or opportunity is given to gain skills in certain areas i.e. cannulation. -Nurses coming to hemodialysis with prior work experiences felt more pressure to perform independently.
Reference: Wilson, B., Harwood, L., & Oudshoorn, A. (2013). Moving beyond the “perpetual novice”: understanding the experiences of novice hemodialysis nurses and cannulation of the arteriovenous fistula. *The CANNT Journal, 23*(1), 11- 18.					

Appendix A5

Study	**Sample**	**Study Design and Methodology**	**Results**	**Study Strengths and Limitations**	**Conclusion**
Title: Critical thinking ability of new graduates and experienced nurses. **Study Objective:** To identify needs of new and experienced nurses regarding their critical thinking abilities	-Consecutive sample of 2144 newly hired nurses between 2004-2006, completed 2 weeks into employment. -Performance Based Development System Assessment (PBDS) consisting of 10 videotaped scenarios showing patient condition change were used to elicit what would you do situations in nurses. These responses were rated either pass or fail.	-Post hoc retrospective study of responses collected prospectively during nursing orientation to a new job -Pass or fail on what nurses would do based on video seen. -PBDS reliability and validity reported in many publications. -Ethical approval obtained. -Chi-square and Pearson chi-square analyzed for nursing differences (level of preparedness and years of experience).	- 6 areas were identified where nurses did not meet expectations: problem recognition, reporting essential data, initiating nursing intervention, ability to prioritize urgency, anticipation of orders, and rationale to support decisions. -Nurses with more experience more likely to meet expectations.	<u>Strengths:</u> -Large sample size. - Reliability and validly of PBDS. <u>Limitations:</u> -Age, gender, employment location and so forth not taken into consideration. -How you say you will react versus how you would react may differ in real case scenario versus vignette.	- Experienced nurses are more likely to be critical thinkers. It is important for patient safety that all nurses think critically, highlighting the need for a good orientation.
Reference: Fero, L.J., Witsberger, M., Wesmiller, S.W., Zullo, T.G., & Hoffman, L.A. (2009). Critical thinking ability of new graduate and experienced nurses. *Journal of Advanced Nursing, 65*(1), 139-148.					

Appendix A6

Study	Sample	Study Design and Methodology	Results	Study Strengths and Limitations	Conclusion
Title: Fluid compliance among patients having haemodialysis: can an educational programme make a difference? **Study Objective:** To determine if nursing education would influence patient compliance regarding intradialytic fluid gain	-26 patients in a teaching hospital in Malaysia that were deemed to be non-complaint with fluid gains (more than 2.5 kg) in between treatments between 2004-2005. -13 males, 13 females. -Ethical approval obtained. -Patient inclusion criteria.	-Exploratory study using a quasi-experimental single group design. -Intervention carried out of 2 months which included: teaching (by nursing staff), and weekly reinforcement regarding diet, weight control, and fluid intake. -Education based on literature, consultations, and patient needs.	-SPSS used for data analysis. -Patients post intervention showed decreased interdialytic weight gain and reported fluid restriction adherence to increase (47% adherence to 71% adherence following the intervention).	<u>Strengths:</u> -Study design <u>Limitations:</u> -No follow up to determine if longitudinal effects of educational intervention were present. -No comparison control group (no intervention).	-Educational interventions from nursing staff is important for hemodialysis patients. To provide this education, nurses must be well informed, knowledgeable, and comfortable with providing education.
Reference: Barnett, T., Li Yoong, T., Pinikahana, J., & Si-Yen, T. (2008). Fluid compliance among patients having haemodialysis: can an educational programme make a difference? *Journal of Advanced Nursing*, *61*(3), 300-306.					

Appendix A7

Study	Sample	Study Design and Methodology	Results	Study Strengths and Limitations	Conclusion
Title: The learning needs of nurses' experiencing job change. **Study Objective:** To explore learning needs of nurses changing jobs	-All nurses (both RNs and LPNs) (n= 3408) from two large teaching hospitals in Ontario, Canada. -Three groups of nurses 1) those that changed roles (same unit), 2) those that changed hospital (worked in same area), and 3) those that move to a completely different area -Ethics obtained from McMaster Ethics Review Committee.	-Quantitative study design -A questionnaire (Nursing Job-Change Study) given to all nurses (n= 3408) -Response rate 50.7% (n=1728). RNs (85%) and LPNs (15%). - The questionnaire was tested for face validity and reliability. -The questionnaire asked about working environments, orientations, and learning needs.	-SPSS analysis of data. -One-way ANOVAs and chi-square to determine differences in groups. -Nurses need new knowledge (policies & procedures) and orientation (written information, preceptorship, and unit introduction) when changing jobs.	<u>Strengths:</u> -Validity and reliability of the questionnaire used. -Large sample size of both RNs and LPNS <u>Limitations:</u> -Lack of control group. -Questionably of external validity to non-teaching smaller hospitals. -Despite the large sample size the authors believe some statistically significant results may be contributed to the same.	-Nurses that experience change need education. The greatest need is for nurses moving to a new unit or hospital. The job-change can make expert nurses feel like novice practitioners. Educators need to take this into consider to fill the knowledge gaps.
Reference: Butt, M., Baumann, A., O'Brien-Pallas, L., Deber, R., Blythe, J., & Dicenso, A. (2002). The learning needs of nurses experiencing job change. *The Journal of Continuing Education in Nursing*, *33*(2), 67- 73.					

Appendix A8

Study	Sample	Study Design and Methodology	Results	Study Strengths and Limitations	Conclusion
Title: What newly licensed registered nurses have to say about their first experiences.	-612 RNs were randomly selected and surveyed nationally by stratified sampling. -All those surveyed had just passed the National Council Licensing Exam between 6-18 months of completing the survey.	-Cross sectional of a mailed survey from 34 states and the District of Columbia. Participants were given the opportunity to respond to open-ended questions in addition to the survey. -The 16-page survey was tested for validity and reliability. -Content analysis performed and coding identified re occurring themes	-Response rate 56%. 5 themes identified: 1] Colliding Expectations. 2]The need for speed. 3]You want too much. 4]How Dare you? 5]Change in on the horizon. Themes identified that new nurses felt inadequately trained, that they were expected to work to the capacity and speed of an expert nurse, and that they experienced mistreatment from interdisciplinary team members.	Strengths: -Survey that was tested for validity and reliability. -Nationally representative sample Limitations: -Low response rate. -The generalizability of results outside USA may be limited.	-Retention and staff turnover can be contributed to the unrealistic high standards of care placed on new graduates. Orientation and education programs should be derived to allow new graduates to work towards competence without placing too much unrealistic demands on their work performance.
Study Objective: To understand how RNs feel about their working life and ways to improve retention.					
Reference: Honan Pellico, L., Brewer, C.S., Tassone Kovner, C. (2009). What newly licensed registered nurses have to say about their first experience. *Nursing Outlook*, *57*(4), 194-203.					

Appendix A9

Study	**Sample**	**Study Design and Methodology**	**Results**	**Study Strengths and Limitations**	**Conclusion**
Title: Utilization-focused evaluation: evaluating the effectiveness of a hospital nursing orientation program.	-A convivence sample of 59 nurses that worked in a variety of settings were interviewed. -Response rate 60%. -Aim to render judgements, facilitate improvements, and generate knowledge surrounding orientation of nursing staff.	-Descriptive study using Likert scales and open ended questions surrounding orientation programs meant to elicit responses that most closely defined nurses feelings -Survey was pilot tested prior to use. -When returned, surveys were entered onto a computer spreadsheet. Open-ended questions were typed verbatim and content analysis was used to organize and derive themes of results.	-Nurses need to be provided with opportunities to practice new skills, especially in the critical care setting. -Nurses felt that more time needed to be spend on practicing "mock set ups for specific skills" (p. 206). -Common themes supported the need for: the normal unit routine, how to use equipment, and more hands-on experience. -Nurses did not feel that orientation prepared them to be safe practitioners.	<u>Strengths:</u> -Multiple areas of practice surveyed. -High response rate. <u>Limitations:</u> -Small sample size employed. -Limited generalizability due to using one hospital. -No mention on survey validly or reliability authors just mentioned it was piloted.	-Nursing retention and positive transition has been shown directed related to adequate orientation. Nurses, when orientating request more practice with the acquisition of skills, and practice with equipment.
Study Objective: The objective was to determine how nurses felt about the orientation they received					
Reference: Meyer, R.M., & Meyer, C. (2000). Utilization-focused evaluation: evaluating the effectiveness of a hospital nursing orientation program. *Journal for Nurses in Staff Development*, *16*(5), 202-208.					

Appendix A10

Study	**Sample**	**Study Design and Methodology**	**Results**	**Study Strengths and Limitations**	**Conclusion**
Title: Strategies for continuing professional development among younger, middle-aged, and older nurses: A biographical approach **Study Objective:** To determine how lifespan, experience, and age, impact work motives and professional development in career stage.	-21 nurses from general and academic hospitals in the Netherlands (purposive sampling). -No ethical approval required as per national practice in the Netherlands (Dutch Law).	-A qualitative, semi-structured interview was completed from a biographical perspective using a cross sectional design. -Prior to interview, participants were debriefed and a timeline of life events was obtained. -Data collected between February-August 2013. -Vertical processes studied individual learning, horizontal processes studied differences between age groups.	-Interviews were audio recorded and transcribed verbatim and analyzed with vertical and horizontal processes. -All nurses felt orientation and being educated on new skills/equipment was important. -Professional development was gained by younger nurses from new situations. Older nurses developed professionally from personal experiences they have had (i.e. divorce, marriage, having children, death of a loved one, and so forth).	<u>Strengths:</u> -Open ended questions. <u>Limitations:</u> -Small sample size. -Nurses that did not provide direct patient care excluded (omitting many older aged nurses). -Cross sectional design did not allow for disentanglement of age and generation.	-Nurses, depending on lifespan and experiences gain purposeful learning in different ways. .
Reference: Pool, I.A., Poell, R.F., Berings, M.G.M.C., & Cate, O.T. (2015). Strategies for continuing professional development among younger, middle-aged, and older nurses: A biographical approach. *International Journal of Nursing Studies, 52*(5), 939-950.					

Appendix B

Consultation Report: An Orientation Manual for Hemodialysis Nursing

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Introduction

An identified component important to the incorporation of advanced nursing practice is the competency of consultation and collaboration (Canadian Nurses Association, 2008). Consultation and collaboration, in nursing practice, has been employed as a two-way, joint problem-solving approach utilized as a catalyst for identified change where needed. The goal of any nursing consultation period is to improve on nursing practice to benefit practitioners and recipients of their care (Doody, 2014). For the purpose of the practicum proposal, consultation and collaboration will be employed to gain valuable input regarding the orientation needs of newly hired nurses to the hemodialysis unit. Results obtained from this consultation and collaboration, will yield information to be utilized in the development of an updated orientation educational resource manual. Identified key stakeholders that are important in the consultation phase include the clinical educator, divisional manager, nurses that preceptor, and newly orientated nurses. In this paper, I will give a brief description of the practicum proposal, highlight the importance of the consultation process and the participants involved, describe the data collection methods, analysis, and results, and identify how the data obtained will influence the future collaboration and content development of the orientation manual in Nursing 6661.

Substantiating the Need for the Practicum Proposal

The Waterford Hemodialysis unit located in St. John's, Newfoundland is the orientation site for all Eastern Health's orientating Registered Nurses (RNs) and Licensed Practical Nurses (LPNs). These nurses are responsible for the provision of care for a multifaceted range of patients afflicted with a multitude of comorbidities, in addition to their end stage renal disease (ESRD) etiology including, hypertension, diabetes, and vascular disease (Checherita, Turcu, Dragomirescu, & Ciocaliteu, 2010). In the Canadian population, the number of people being treated for ESRD over the past twenty years has tripled. Fifty-nine percent of these people, approximately 23,188, are being treated by hemodialysis, warranting the need for knowledgeable, well-trained hemodialysis nurses (The Kidney Foundation of Canada, 2012).

Summary of Integrated Literature Review

I conducted an integrated literature review and found that patients being treated for ESRD need knowledge, reassurance, and support when managing their kidney disease. The treatment route and needs for each patient is different, so nurses must be comfortable with providing care that is complex (Gill, Rose, Pereria, & Tonelli, 2007; Hardwood, Locking-Cusolito, Spittal, Wilson, & White, 2005). Nurses orientating into the hemodialysis unit face a steep learning curve. In addition to patient assessments, they face the need to learn a lot of complex information and skills that are new to them. Examples of these skills include arteriovenous fistula and arteriovenous graft cannulation, and the utilization of machinery to provide safe competent patient care (Bevan, 1998; Peltokoski, Vehvilainen-Julkunen, & Miettinen, 2015; Rush, Gordon, Janke, & Ghement, 2015; Wilson, Hawood, & Oudshoorn, 2013).

Both newly hired graduate, and experienced nurses, have demonstrated difficulty with role and job transitioning including anxiety, fear, and an inability to communicate (Dellasenga, Gabbay, Durdock & Martinez-King, 2009; Dyess & Sherman, 2009). For example, newly hired graduate nurses have trouble establishing good communication with the interdisciplinary team and are less likely to seek assistance or ask questions pertinent to patient outcomes when compared to an experienced nurse. Without a detailed orientation, new nurses face difficulty in fulfilling the nurse role as they are expected to immediately take on the same patient assignment, and to perform as quickly, as a nurse deemed to be an expert in the area (Berkow, Virkstis, Stewart, & Conway, 2009; Dyess & Sherman, 2009; Honan Pellico, Brewer, & Tassone Kovner, 2009; Winter-Collins & McDaniel, 2000). Similarly, experienced nurses expressed feelings of uncertainty, anxiety, and fear when transitioning to a new job (Fero, Witsberger, Wesmiller, Zullo, & Hoffman, 2009). In the hemodialysis setting, experienced nurses expressed concern and pressure in the cannulation of arteriovenous fistula and grafts (Ludlow, Gaudine, & Jacobs, 2007). Based on their confidence in their previous nursing role, nurses with years of experience felt that they needed to be more independent with cannulation and therefore were less likely to seek out assistance or guidance when needed causing apprehension, anxiety, and failed cannulation attempts which can have detrimental effects on a patient's access (Bratz, 1999; Butt et al., 2002; Dellasega et al., 2009).

To ensure that both experienced and newly graduated nurses are prepared to provide competent patient care once hired, a through orientation highlighting educational needs is important (Lartey, Cummings, & Profetto-McGrath, 2014; Pool, Poell, Berings, & Cate, 2015). Thus, the purpose of this practicum project is to develop an orientation learning resource manual for nurses hired to the hemodialysis unit. Aspects of Benner's Novice to Expert Theory (1984) and Knowles' Adult Learning Theory (1984) will be the integrated theories for the development of the orientation manual. Various aspects of hemodialysis nursing will be included in the orientation manual including, etiology of

ESRD, caring for the hemodialysis population, patient assessment, vascular access care, interdisciplinary collaboration, and the hemodialysis machine. Once developed, this manual will be distributed to the divisional manager and the clinical educator, where further collaboration including their feedback and input will be integrated.

Consultation Purpose

Consultation for this practicum project was used to gain insight and input on what information should be updated and contained in a new orientation manual, as identified by key stakeholders. Once identified, their perspectives and opinions will be adapted into learning modules containing the most pertinent information that needs to be addressed in the orientation of newly hired hemodialysis staff in Nursing 6661.

Participants

During the consultation period, separate interviews were conducted with the clinical educator and the unit manager. In addition to the interviews, two focus groups were conducted with four nurses that preceptor, and four newly orientated nurses (two registered nurses and two licensed practical nurses). These participants were given a letter of intent that highlighted the practicum project and the purpose of their input in the interview or focus group and all participants verbally consented to participate in the consultation period (see Appendix C).

The clinical educator Ms. Cathy Cake BN RN M.Ed. C(Neph)C, is responsible for the orientation of newly hired staff to the hemodialysis unit. Her participation is important as she is responsible in her role to orientate newly hired staff utilizing the available learning resource manual. She is aware of the barriers faced by newly hired staff and the learning material that causes the most problems for newly orientating staff. The unit manager Ms. Cheryl Harding BN RN MHS C(Neph)C is partly responsible in the hiring and supporting of newly hired staff. All incident reports that are compiled go directly to her, therefore she is integral in the identification of issues and incidents that newly hired staff may encounter during orientation, preceptorship, or once independent practice commences. As she is directly aware of issues or incidents that occur regarding newly hired staff, her input on nursing orientation needs is valued. Four registered nurses that preceptor newly hired staff were consulted as they have a direct role and relationship in the orientation preceptorship of newly hired staff. Once preceptorship commences, the preceptor's role is to guide the newly hired staff in the achievement of the mandatory orientation competencies. It is the responsibility of the preceptor to ensure that newly hired staff are competent to practice independently. Preceptors have valuable insight into the most common concepts that newly hired nurses have difficulty with during preceptorship. The preceptor's opinions and perspectives on the learning needs of newly hired nurses is important regarding how the current manual can be updated and adapted to more efficiently meet the learning needs of newly hired nurses. Finally, the input of newly orientated nurses can provide important information regarding the usefulness of the current orientation manual. These staff are integral to identifying what in the orientation manual was helpful in learning, and aspects that need to be updated to reflect the units' current practice and policy, with suggestions on how to improve the manual from the learners' perspective.

Data Collection Methods, Management, and Analysis

Semi-structured interviews and focus groups were conducted during March 2017 in a quiet room located on the hemodialysis unit at the Waterford Hospital in St. John's Newfoundland. Guiding questions were prepared prior which can be found in the appendices. All responses obtained were tape-recorded and field notes were taken during the interviews and the focus groups. Participants were given the opportunity to provide additional information outside the asked questions if requested. Duration of the interviews were approximately twenty minutes with the focus groups lasting approximately forty minutes.

After the interviews and focus groups were completed the tape recordings were replayed and participant responses were transcribed. After transcription, data was analyzed for common themes. After the data was analyzed and the themes were identified, the participants of the interviews and focus groups were debriefed with the results, allowing for further validation of the themes with the participants.

Ethical Considerations

Prior to the commencement of the interviews and focus groups, Ms. Cheryl Harding BN RN MHS C(Neph)C gave permission for the practicum project to commence. After completing the Health Research Authority (HREA) checklist, it was determined that the proposed practicum project did not require ethical approval (see Appendix B). Prior to consultation, all participants were given information regarding the purpose of the practicum project and the purpose of their participation and how their input would be used. To ensure participant confidentiality, no identifying information was affiliated with any material obtained from the consultation process. All data results obtained are securely kept on an encrypted computer that is only accessible by me and will be destroyed after the practicum project is completed in July 2017. Participants were made aware that all participation was voluntary and could be withdrawn at any time without bias.

Results of Consultation

Themes Based on Questions asked to all Participants

There were similarities in answers given by those that were interviewed and those that participated in focus groups allowing for common themes to be identified.

Lack of communication. A barrier identified by all participants was the lack of communication and the lack of staff role identification during the orientation period with the interdisciplinary team. The interviewees in the newly orientated nursing group commented that the role and responsibilities of the clinical pharmacist were not explained to them. Particularly, the scope of practice of the clinical pharmacist and their ability to adjust erythropoietin stimulating agent dosages was not addressed. This led to the new nurse experiencing confusion during transcription of medication orders as pharmacists can independently adjust these medications in a hemodialysis setting without a doctor's co-signature. Other participants spoke about not being introduced to the interdisciplinary team members and thereby not knowing which staff were physicians, registered nurses, or licensed practical nurses, as not everyone wears an identifier. This led to confusion when assistance or guidance was needed in knowing who best to approach for the appropriate help.

Relevance and content of the current orientation manual. Interviewees stated that the currently used orientation manual was outdated and not relevant stating that some information contained was too in depth for the learning needs of any new staff orientating to the hemodialysis unit. This included information on dialyzer coefficients, in-depth anatomy and physiology of the functioning kidney, and medications that were no longer used in practice. Interviewees also stated that a lot of the presented information did not designate between the scope of practice of the registered nurse and the licensed practical nurse. There are several policies that differentiate the scope of practice between registered nurses and licensed practical nurses in a hemodialysis setting. Content not included in the licensed practical nurse scope of practice includes: restricted fluid removal guidelines, use of Alteplase (Cathflo) to close the central venous catheter and for poorly functioning catheters, and cannulation of new arteriovenous fistulas or arteriovenous grafts. When not made aware of their scope of practice, newly hired staff are left questioning what they can or cannot legally and safety do.

Interviewees indicated that it often takes one year of practice to become confident and often during this period new staff look for educational resources to use in practice. The orientation manual is not sought out as a useful resource as anecdotally it is not easy to use nor does it present up to date evidenced based practice based upon currently utilized Eastern Health hemodialysis policies. One participant stated that “a lot of the information was old and not even used anymore as it was written when licensed practical nurses did not do direct patient care besides vitals”.

How to improve on current manual. All participants stated that the current orientation manual would be improved if it were segmented into learning modules. Information contained in these modules, should include the most up to date policies and procedures that are currently being implemented in the hemodialysis setting. All participants that were interviewed agreed that a new orientation learning resource manual was needed for the hemodialysis unit. It was noted that because all Eastern Health's orientation to dialysis is done through the Waterford Hospital, it is pivotal that a thorough up to date orientation manual is developed to identify the current practices and policies currently adopted and utilized regionally.

Interview Themes Identified by Nurses that Preceptor

Important orientation skills. The nurses that preceptor newly hired nurses discussed the importance of newly hired staff to gain confidence in properly accessing a patient's vascular access and calculation of a patients' fluid removal based on nursing assessment skills. One participant stated that the "orientation manual would be an ideal opportunity to provide the newly hired staff with the background knowledge they need to become fully prepared to assess, and access the patient's vascular access". Fluid removal guidelines are policy based, allowing for regulation in the amount of fluid a nurse can remove each treatment. This value is based on a calculated percentage which differs between the scope of practice of the registered nurse and the licensed practical nurse. The old orientation manual does not distinguish between the scope of practice of the registered nurse and the licensed practical nurse, and does not discuss fluid removal or weight calculations.

Important assessment skills. Interviewees stated the importance of the specific assessments skills that nurses need to assess end stage renal disease patients for including: cardiovascular, immune, musculoskeletal, hematological, neurological, gastrointestinal, renal, respiratory, integumentary, and the ability to identify when a patient is unwell. Furthermore, all interviewees identified the need for nursing skills in hemodialysis nursing related areas such as fluid assessment, electrolyte imbalances, and vascular access assessment. All participants strongly agreed that the hemodialysis program would benefit from an updated orientation learning resource manual. When asked what content should be included in the orientation manual participants focused on the breaking of content into modules which included: novice anatomy and physiology of kidney disease and the most commonly identified causes and conditions that precipitate kidney failure, how to assess the patient, how to set up and monitor the values of the hemodialysis machine, how to assess and access the vascular access, nutritional needs of end stage renal disease patients, medications used in end stage renal disease, and complications commonly seen during hemodialysis (for example: hypotension, muscle cramping, gastrointestinal upset, and hemolysis).

Interview Themes Identified by Newly Hired Nurses

Emotions felt during orientation. Newly hired nurses reported feelings of anxiety, unpreparedness, apprehension, and a sense of being overwhelmed upon commencement of the orientation program. Several interviewees attributed these feelings to the too advanced and outdated, learning resource manual that is currently being used for orientation. One participant spoke regarding their anxiety when cannulating an arteriovenous fistula stating that “if ever given the choice I will put on the patient with the line”, further stating that “I don’t like trying a fistula I have never done before because I don’t want to mess it up”.

Educational needs. Nurses stated a lot of anxiety surrounded arteriovenous fistula and arteriovenous graft cannulation and calculations of a patients’ fluid removal requirements. Newly hired nurse interviewees stated that more knowledge, practice, and guidance was needed in the assessment and accessing of a patient’s vascular access as it is an essential hemodialysis nursing skill. Additionally, participants stated the need for more teaching on how to interpret, analyze, and calculate what dry weight to work a patient for, how to assess for fluid gains or depletions, and the importance of the values that are monitored during the hemodialysis treatment in the orientation manual. One participant described “knowing I had to press the button on the machine, but not knowing why, or the reasoning behind me pushing the button”. This caused anxiety in the participant who stated being “uncomfortable” when not knowing the justification behind the nursing care performed in the clinical setting.

Interview Themes Identified by the Clinical Educator

On average, the clinical educator spends approximately fifty percent of work time orientating new staff to the unit. Approximately thirty-two staff are orientated annually to the hemodialysis unit with an estimated ratio of newly graduated to experienced nurses of 1:3.

Learning needs of newly hired nurses. The clinical educator stated that the learning needs of newly graduated nurses and experienced nurses differ and is dependent upon prior experience. She stated that often newly graduated nurses struggle with patient assessment and communication skills whereas experienced nurses struggle with the technology of the hemodialysis machine and their ability to decipher the orientation manual. She stated that a lot of the learning content in the orientation manual is from research articles that experienced nurses “expressed frustration” with as they were never formally trained to read, decipher, or formulate opinions on research articles when they attended nursing school.

Implications for Consideration and Conclusion

The results from the consultations with various stakeholders provided imperative information for the development of the orientation learning resource manual. Results from the consultations substantiated this need, providing merit for the development of the practicum project proposal. The key stakeholders identified many inaccuracies and provided suggestions for a new orientation learning resource manual. That information included the importance of an updated manual that placed emphasis on: communication and interdisciplinary team introductions, etiology, precipitating factors, and comorbidities of ESRD, and nursing assessment and psychomotor skills needed in nephrology nursing. The results obtained from the consultation corroborated the information gathered during the integrative literature review.

From the completion of the integrative literature review and the consultation plan, the importance and need for a new learning resource manual for use in the orientation of newly hired hemodialysis staff is a valuable project to pursue. Further collaborative efforts will be employed longitudinally during the development of the learning resource manual in Nursing 6661. The consultation plan identified the key stakeholders that were consulted for their input for the purpose of the practicum project report and the importance of their participation in the consultation phase. The practicum project overview, data collection methods, ethical considerations, results gathered, and data analysis from the consultation process were discussed. These results, reinforced the importance and merit of the future development of the orientation learning resource manual for use in practice in the orientation of newly hired staff to the hemodialysis unit.

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Appendix B: Guiding Interview and Focus Group Questions

Appendix B1: Interview Questions for Clinical Educator

-What are the reaction of nurses when introduced to the amount of information that must be learnt once orientation starts?

-How relevant do you feel our current orientation educational manual is in preparing nurses to start working in the hemodialysis unit?

-What ways, if any, can the current orientation learning manual be improved for use in practice? Please explain.

-What assessment skills do a nurse need to be proficient in to assess hemodialysis patients? What should be assessed?

-What are the most important skills that newly hired staff find difficult once hired to the hemodialysis unit?

-What do you feel are the most common errors or difficulties experienced by newly hired staff during the orientation?

-Are there any differences noted in the orientation of novice and experienced nurses transitioning to hemodialysis from another area?

-What do you feel are the most common errors or difficulties experienced by newly hired staff during the orientation or preceptorship phase?

-Would the nurses that orientate to hemodialysis benefit from an updated learning resource manual? Please explain.

-Do you receive many telephone calls or emails from new staff regarding the need for further education? If so, for what topics?

Appendix B: Guiding Interview and Focus Group Questions

Appendix B2: Interview Questions for Unit Manager

-How many incidents occur in the unit annually? How many of these are directly linked to newly hired staff members?

-How many staff are hired to hemodialysis each year? How many of those hired are newly graduated nurses versus experienced nurses?

-How is the attrition of staff in the hemodialysis unit? What do you think contributes to this?

-How relevant did you find the current orientation manual for learning?

-What ways, if any, can the current orientation learning manual be improved for use in practice? Please explain.

Appendix B: Guiding Interview and Focus Group Questions

Appendix B3: Focus Group Questions for Newly Orientated Nurses

-What skills do you feel most anxious about performing in the clinical setting? Please explain.

-How relevant did you find the current orientation manual for learning?

-If you could add to, or take away from the current manual, what information would you keep and what information would you remove? Please explain.

-What ways, if any, can the current orientation learning manual be improved for use in practice? Please explain.

-What assessment skills do a nurse need to be proficient in to assess hemodialysis patients? What should be assessed?

-What are the most important skills that newly hired staff find difficult once hired to the hemodialysis unit?

-What are the topics of orientation that are most difficult to understand during orientation?

Appendix B: Guiding Interview and Focus Group Questions

Appendix B4: Focus Group Questions for Preceptoring Nurses

-If you could add to, or take away from the current manual, what information would you keep and what information would you remove? Please explain.

-What are the most common concerns noted by newly hired staff when preceptorship begins?

-How relevant do you feel our current orientation educational manual is in preparing nurses to start working in the hemodialysis unit?

-What ways, if any, can the current orientation learning manual be improved for use in practice? Please explain.

-What assessment skills do a nurse need to be proficient in to assess hemodialysis patients? What should be assessed?

-What are the most important skills that newly hired staff find difficult once hired to the hemodialysis unit?

-Are there any differences noted in the orientation of novice and experienced nurses transitioning to hemodialysis from another area?

Appendix B5

Health Research Ethics Authority Screening Tool

	Question	**Yes**	**No**
1.	Is the project funded by, or being submitted to, a research funding agency for a research grant or award that requires research ethics review	☐	■
2.	Are there any local policies which require this project to undergo review by a Research Ethics Board?	☐	■
	IF YES to either of the above, the project should be submitted to a Research Ethics Board. **IF NO** to both questions, continue to complete the checklist.	☐	■
3.	Is the primary purpose of the project to contribute to the growing body of knowledge regarding health and/or health systems that are generally accessible through academic literature?	■	☐
4.	Is the project designed to answer a specific research question or to test an explicit hypothesis?	☐	■
5.	Does the project involve a comparison of multiple sites, control sites, and/or control groups?	☐	■
6.	Is the project design and methodology adequate to support generalizations that go beyond the particular population the sample is being drawn from?	■	☐
7.	Does the project impose any additional burdens on participants beyond what would be expected through a typically expected course of care or role expectations?	☐	■
LINE A: SUBTOTAL Questions 3 through 7 = (Count the # of Yes responses)		**Total: 2**	

8.	Are many of the participants in the project also likely to be among those who might potentially benefit from the result of the project as it proceeds?	■	☐
9.	Is the project intended to define a best practice within your organization or practice?	■	☐
10.	Would the project still be done at your site, even if there were no opportunity to publish the results or if the results might not be applicable anywhere else?	■☐	☐
11.	Does the statement of purpose of the project refer explicitly to the features of a particular program, organization, or region, rather than using more general terminology such as rural vs. urban populations?	■☐	☐
12.	Is the current project part of a continuous process of gathering or monitoring data within an organization?	☐	■
LINE B: SUBTOTAL Questions 8 through 12 = (Count the # of Yes responses)			
	SUMMARY **See Interpretation Below**	**Total: 4**	

Interpretation:

- If the sum of Line A is greater than Line B, the most probable purpose is **research**. The project should be submitted to an REB.
- If the sum of Line B is greater than Line A, the most probable purpose is **quality/evaluation**. Proceed with locally relevant process for ethics review (may not necessarily involve an REB).
- If the sums are equal, seek a second opinion to further explore whether the project should be classified as Research or as Quality and Evaluation.

These guidelines are used at Memorial University of Newfoundland and were adapted from ALBERTA RESEARCH ETHICS COMMUNITY CONSENSUS INITIATIVE (ARECCI). Further information can be found at: http://www.hrea.ca/Ethics-Review-Required.aspx.

Since the sum of Line A is less than the sum of Line B the purpose of the practicum project is deemed to be quality evaluation. Therefore, an REB is not necessary for the development of the practicum project.

Appendix B6

Letter of Intent

To whom it may concern,

My name is Sasha Hayse. I am currently enrolled in the Masters of Nursing program at Memorial University. A requirement for the completion of this program includes a practicum project. For my practicum project, I have decided to develop an orientation educational learning resource manual to utilize in the training of newly hired staff to the hemodialysis program. Your participation, and the answering of questions in either an individual or group setting, will allow me to gather invaluable input regarding your individual thoughts and feelings regarding the current orientation manual that we use. Information gathered from your input will allow for a list of suggestions on how to improve the content presented in the current manual which will be used in the future development of a new orientation manual. The purpose of the practicum project is to develop an effective orientation manual for future use in nursing hemodialysis orientation. Development of this manual will help me meet Memorial University's requirement in the obtainment of the fulfilment of my Master of Nursing degree. Your voluntary participation in this process is greatly valued and appreciated.

Sincerely,

Sasha Hayse

Appendix B7

Results of Consultations

Interview Questions (See Appendix A)	Responses
What are the most important skills to learn during orientation?	• Arteriovenous graft cannulation • Arteriovenous fistula cannulation • Central venous line care (accessing & dressing change) • Sterile technique • Machine set up and monitoring
What are the most important assessments to learn during orientation?	• Body assessments • Dry weight assessment (fluid calculations) • Electrolyte monitoring (bloodwork results) • Patient inspection (hypotension, muscle cramping, gastrointestinal upset)
How relevant is the current orientation manual?	• Not relevant • Outdated • Archaic • Hard to follow • Too advanced • No distinguishing between nursing scope of practice of registered and licensed practical nurse
How can we improve upon the current orientation manual?	• Break into modules • Up-to-date policies and procedures • Examples • More time to practice psychomotor skills • Introduction to interdisciplinary team members

	• Remove research articles • Remove the in depth irrelevant material
What emotions are elicited by newly hired staff upon orientation?	• Fear • Apprehension • Conflicted • Overwhelmed
What are the barriers of the current orientation manual?	• It does not include the most up to date evidenced based practice • It does not address the current policies and procedures used • It does not distinguish between the scope of practice of the registered nurse and the licensed practical nurse
Are there any differences noted in the orientation of newly hired versus experienced nursing staff?	• Variable • Depends on area where experienced staff is coming from • Each orientating nurse varies in areas they need help/excel in • Older nurses struggle more with the technology of the machine • Newer nurses struggle more with communication and patient assessment • All novice hemodialysis nurses regardless of their prior experiences

Appendix B8

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Updated October 2011

An Orientation Manual for Newly Hired Hemodialysis Nurses

Welcome to Hemodialysis

Welcome to Nephrology Nursing. The following learning resource manual has been developed in consultation with the clinical educator, dietitian, nephrologists, pharmacists, and expert nurses in the nephrology field to facilitate your learning needs and transition into hemodialysis nursing. The learning resource manual has been developed for use by Registered Nurses and Licensed Practical Nurses who are beginning nephrology nursing practice. The learning resource manual may also be utilized as a resource for those wanting to know more about hemodialysis treatment, and by nurses currently employed in hemodialysis, as a reference or resource.

The Waterford Hospital is the site of all orientation for newly hired nephrology nurses for hemodialysis units in: St. John's, Carbonear, Clarenville, Burin, and Bonavista. This learning resource manual will present the basic information needed for a nurse to commence work in a hemodialysis unit. A formal orientation, with a duration of seven weeks, will be followed to prepare new nephrology nurses to commence employment within the hemodialysis unit. Course work using this learning resource manual will be independent. Therefore, you can work through this manual at your own pace and evaluate your learning by completing the post test at the end of each module. If you experience difficulty with the post test, review the module and attempt the post test again. Below is a description of the orientation program, in table format, for the seven-week orientation duration.

Schedule of Orientation

Weeks	Topic	
One	Monday	• Welcome to unit • Module 1 • Machine Set Up
	Tuesday	• Module 2 • Machine Set Up
	Wednesday	• Module 3 • Machine Set Up • Practice with assessment of vascular access
	Thursday	• Module 3 • Machine Set Up • Practice with needling of AVF/AVG/AVFBH
	Friday	• Module 4 • Machine Set Up • Practice with CVC (changing Tegos®, assessing, closing, and dressing change)
Two	Monday	• Module 5 • Machine Set Up • Practice with putting a patient on
	Tuesday	• Module 6 • Machine Set Up • Practice with taking a patient off
	Wednesday	• Module 7 • Machine Set Up • Practice in the unit with clinical educator

	Thursday	• Practice in the unit with clinical educator
	Friday	• Practice in the unit with clinical educator • Conclusions
Three	Skills Week: You will be assigned with a nurse that will demonstrate the baseline skills you will need to work in the hemodialysis unit (setting up a machine, ‘putting on’ a patient, ‘taking off’ a patient, cannulation of arteriovenous fistula; graft; buttonhole, dressing change on a central venous catheter, accessing a central venous catheter, closing a central venous catheter. After each skill has been demonstrated you will be given multiple opportunities in the week to perform the skills repeatedly to increase comfortability with the skill prior to the commencement of preceptorship.	
Four **Five** **Six** **Seven**	Preceptorship (Four-week duration): You will be co-signed with a nurse from the unit for four weeks. In this time, you will take on the responsibility and patient load of a nurse working in hemodialysis. As you progress through the weeks it is the expectation that at the end of week four you can be independent with your nursing assignment.	

Topics

Topic	
Module 1	
Module 2	**<u>Hemodialysis Machine and Prescription</u>** • Machine Setup • Disinfectent • Hemodialysis prescription • Putting on a patient • Taking off a patient
Module 3	**<u>Patient Assessment</u>** • Dry weight • Fluid removal • Assessment pre, intra, and post hemodialysis • Kt/V • Nursing responsibility • Intedisciplinary rounds • Documentation
Module 4	**<u>Vascular Access</u>** • Arteriovenous fistula ○ Buttonhole fistula • Arteriovenous graft • Central venous catheter
Module 5	**<u>Hemodialysis Medications</u>** • Heparin • Citrasate • Calcium Supplements • Phosphate binders • Iron deritatives • Erythropoietin • Central venous catheter locking solution • Elma cream • Blood pressure support medications • Home medications • Role of the Pharmacist • Administration of IV medications
Module 6	**<u>Hemodialysis Complications</u>**

	• Hypotension • Muscle cramping • Clotting in the system • Dialysis disequilibrium • Dialyzer reaction • Hemolysis • Air embolism • Vascular access dysfunction • Vasovagal syncope • Fever and chills
Module 7	**Nutrition** • Protein • Vitamins • Minerals • Fluid restriction

Table of Contents

Module 1

Chronic Kidney Disease & Hemodialysis Principles

Purpose: To understand how to effectively and efficiently dialyze each individual patient it is pivotal to understand what chronic kidney disease is, and the principles that make hemodialysis work.

Learning Objectives: After completing this module the learner will complete a post test that will measure the learner's ability to:

- Explain the functions of the kidney.
- List the various causes of chronic kidney disease.
- Identify the components of a hemodialysis treatment (including blood circuit and dialysate).
- List the complications of transplant, peritoneal dialysis, and hemodialysis.
- Demonstrate how to prepare different ordered solutions of dialysate.

Anatomy & Physiology of the Kidney

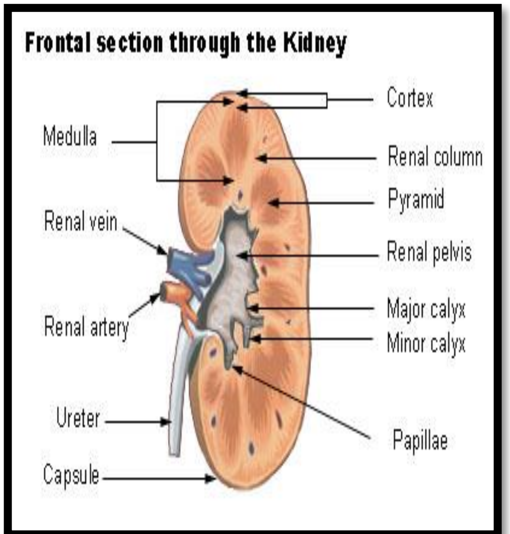


Figure 1.0 Kidney

The kidneys are two bean shaped organs located in the retroperiotoneal space. Their major function is in the removal or excess fluid and waste via the ureters, bladder, and urethra in the form of urine. The kidneys also produce activated vitamin D, which is integral to red blood cell production, and in the regulation of blood prssure (National Kidney Foundation, 2017b).

The functional unit of the kidney is the nephron, which is highly vascular. In each kidney there are over one million nephrons. Each nephron contains a filter (glomerulus) attached to a tubule. These filters aid in the filtinging and sepeartion of waste, electrolytes, and fluid from the blood. The waste products then flow into the tubles where it is excreted in the urine produced. Normal urinary output is two (2) liters per day (The Kidney Foundation of Canada, 2015c).

Renal Blood Flow: (National Kidney Foundation, 2017b).

1] Renal artery

2] Interlobar artery

3]Arcurate artery

4]Interlobular artery

5]Afferent arteriole

6]Glomerulus

7]Efferent arteriole

8]Peritubular capillaries or vasa recta

9]Stellate vein

10]Interlobular vein

11]Arcuare vein

12]Interlobar vein

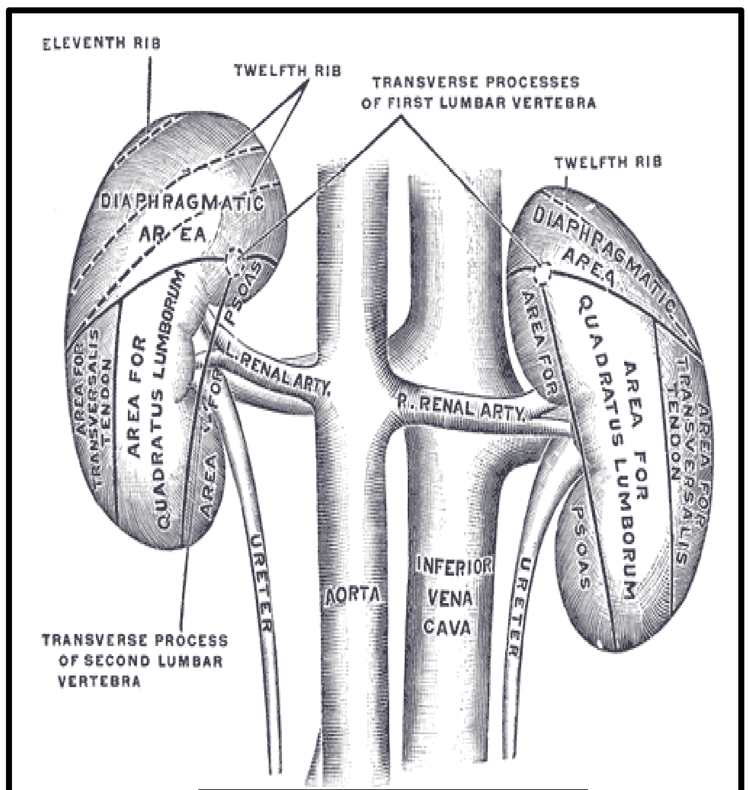


Figure 1.1 Renal Blood Flow

13]Renal vein

What are the Functions of the Kidney? (National Kidney Foundation, 2017b).

1] Exectatory:

-The kidneys are responsible for the movement of fluid and waste soultes across the nephron where it is filtered and excreted.

2] Regulation

The kidneys are important in the regulation and homeostasis of volume, electrolytes, and acid and bases.

1. Volume
   - Water composes 60% of total body weight for men and 50% of total body weight for women.
   - Fluid can be found intracellular, interstitial, or intravascular.
     1. Intracellular: Found in the cell.
     2. Interstitial: Found between the cells.
     3. Intravascular: Found in the blood.
   - Blood flow in the kidneys is controlled by intrinsic and extrinsic factors.
     1. Intrinsic: Renin-Angiotensin.
     2. Extrinsic: Sympathetic nervous system, angiotensin 2, aldosterone, and antidiuretic hormone.
2. Electrolytes

Sodium (Na)

- ❖ Is the main extra cellular cation.
- ❖ Responsible for the regulation of fluid volume.
- ❖ ↑ Na ↑Patient edema and hypertension.
- ❖ ↓ Na ↓Patient dehydration and hypotension.
- ❖ Sodium is regulated by aldosterone and antidiuretic hormone.

Potassium (K)

- ❖ Intracellular cation.
- ❖ Deviations in K can lead to neuromuscular/cardiac activity.

Calcium (Ca)

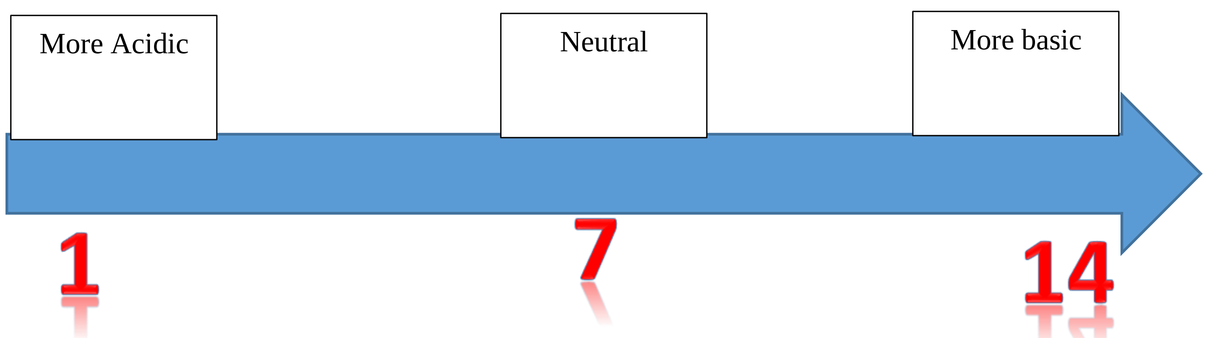
- ❖ Intracellular cation.
- ❖ Adjusted at three body sites: bone, kidney, and intestine.

<u>Phosphorous (Ph)</u>

- ❖ Intracellular anion.
- ❖ Adjusted at three body sites: bone, kidney, and intestine.

3] Acid-base balance (to maintain bodily pH).

- ❖ pH: Is an indicator of acidity or alkalinity.
- ❖ An acid will give a H+ ion.
- ❖ A base will accept a free H+ ion.
- ❖ pH measured from 0 -14
- ❖ 0-7 = acid.
- ❖ 7-14 = base.
- ❖ 7 = neutral.
- ❖ As H ↑, pH↓.



pH of blood is 7.35- 7.45

Figure 1.2: pH Scale

Normal		Acidosis (acid)	Alkalosis (base)
pH	7.35- 7.45	<7.35	> 7.45
PC02	35-45	> 45	< 35
HC03	22-26	< 22	> 26

4] Hormonal Function

The kidneys are responsible for the production of renin, erythropoietin, and activated vitamin D.

Acute Versus Chronic Stage Renal Disease (The Kidney Foundation of Canada, 2015a).

End stage renal disease (ESRD) can be attributed to chronic or acute causes. Acute cases of ESRD can develop quickly due to a variety of reasons and can resolve and be reversed. Chronic kidney disease is irreversable and there is no cure.

Acute Renal Failure (Lancaster, 2001).

Acute Renal Failure: Is sudden most often caused by: trauma, illness, a treatment (medication/ procedural) and is reversible.

Causes of acute renal failure can occur prerenal, intrarenal, or post renal.

Type of acute renal failure	**Occurrence**	**Causes**
Prerenal	70%	Inability of the kidney to filter blood due to reduced kidney blood flow. Nephrons are intact **Causes:** Congestive heart failure Myocardial Infraction Sepsis
Intrarenal	25%	Damage to the kidney tissue that causes a decreased eGFR and increase serum urea and creatinine and the retention of fluid. **Causes:** Acute Tubular Necrosis: Can develop due to exposure to nephrotoxic agents, ischemia, chemotherapy, & radiocontrast dyes.
Post renal	5%	Due to a kidney obstruction in flow anywhere in the urinary tract. **Causes:**

		Stenosis Infection Calculi

Diagnostic Exams:

- Bloodwork
- Urinalysis (↓ specific gravity)
- Ultrasound
- Renal Scan
- Renal Biopsy

Chronic Kidney Failure (ESRD) (Lancaster, 2001).

ESRD, is a irreversabe progression of renal function that can occur over months or years attributable to a variety of causes. ESRD can be classified into stages, based on blood tests that measure glomerular filtration rate (eGRF). The eGFR of a functioning kidney is 125mL/min which procudces approximately 1-2 liters of urine every day.

ESRD, can be contributed by disease of the nephron (the kidneys functional and filtering unit), by an obstruction in the bladder or ureter, gneetic kidney predipisioned diseases, bacterial infections, and drug or medical induced issues.

ESRD is classigied into five stages. See below for common signs and symptoms and clinical manifiscatons of ESRD in the various stages (The Kidney Foundation of Canada, 2015c).

Stage	What occurs	eGFR(mL/min)	Signs & Symptoms
1	Kidney damage occuring with little to no reduction in eGFR	≥90	Typically no signs or symptoms are exhibitied in stage 1
2	Kidney damage occuring with minimal derase in eGFR	60-89	Patients tyically remain asymptomatic in stage 2. Hypetension may be exhibited.
3	Kidney damage occurring with moderate decrease in eGFR	30-59	• Fatigue • Hypertension

4	Kidney damage occurring with severe decrease in eGFR	15-29	• Moderature hypertension • Some abnormalities may be noted to other organs
5	End Stage Renal Disease	<15	• At stage 5 renal replaceent theary is needed. • Severe hypertension • Abnormalities in other organs

Important to Note: Although the above table designates the typical signs, symptoms, and clinical manifestations it is important to note that not all cases of ESRD manifest typically. There are patients that discover they are stage 5 of ESRD after routine bloodwork taken by their family physician and experience no signs and or symptoms.

Urinary Production Descriptive Word	Definition
Hematuria	Blood in urine
Polyuria	Excessive urine production
Dysuria	Painful urination
Anuria	No urine production
Oliguria	Decreased urine output

What Are The Causes of End Stage Renal Disease: (The Kidney Foundation of Canada, 2015a).

There are various causes of chronic renal failure, below will be discussed the most commonly seen. Note: Due to the multiple causes of chronic renal failure not all will be discussed. If a patient is diagnosed with an unfamiliar etiology, research is warranted.

Causes of chronic renal failure:

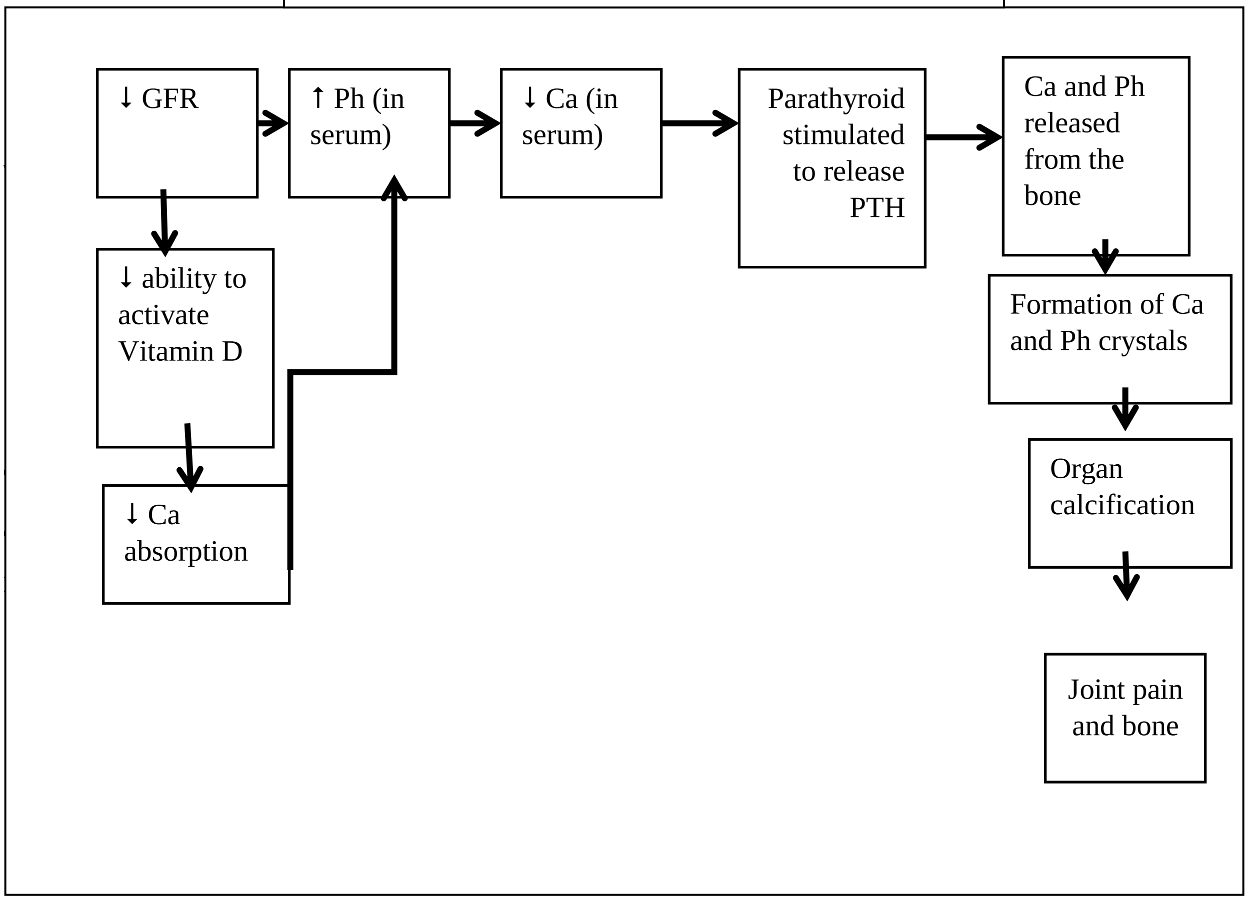
- ❖ Diabetes: 25-40% of all diabetics have chronic renal failure.
  Note: Insulin requirements may decrease because the kidneys can no longer metabolize or excrete the insulin. Therefore, the ½ life of insulin may ↑.
- ❖ Glomerulonephritis: Inflammatory process due to antigen and antibody complexes.
- ❖ Hypertension
- ❖ Polycystic Kidney
  - o Hereditary
  - o Cysts develop in the kidney which occludes blood flow causing the kidney to become ischemic.
- ❖ Pyelonephritis
  - o Inflammation in the kidney
  - o Most contributed by E Coli

Effects of Chronic Renal Failure:

- ❖ Cardiovascular:
  1. Hyper or hypokalemia which can cause cardiac dysrhythmias.
     Management: Hemodialysis removes K from the body quickly in the case of hyperkalemia.
  2. Hypertension: Resultant of fluid and sodium overload.
     Management: Decrease sodium and/or water intake.
- ❖ Reproductive:
  1. If hypertensive, men may experience impotence.
  2. Women, due to hormonal changes may experience amenorrhea, infertility, and decrease libido.
     Management: For men, testosterone and Viagra.
- ❖ Gastrointestinal: Patients may experience: constipation, anorexia, nausea and vomiting, and stomatitis.
  Management: Oral hygiene, nutritional consultations, medications for constipation/diarrhea.

- ❖ Integumentary: Patients may experience: pallor (anemia), pruritus (CaPh crystals), and edema (Na and fluid retention).
  Management: Keep integument clean and dry + medication use (antihistamines for itching)
- ❖ Respiratory: Patients may experience shortness of breath and difficulty breathing due to fluid overload and/or congestive heart failure.
  Management: Diuretics, ultrafiltration with hemodialysis, patient education surrounding fluid management.
- ❖ Hematopoietic: Patients may experience anemia due to the inability for red blood cell production, iron deficiencies, and blood loss that may be experienced pre/intra/post hemodialysis.
  Management: Blood transfusions, use of Eprex® or Aranesp®, use of Ferrlecit® or Venofer®.
- ❖ Neurologic: Uremia: Buildup of uremic toxins due to increased toxic bodily waste. Can cause altered levels of consciousness.
  Management: Dialysis, and monitoring of bloodwork.
- ❖ Musculoskeletal: Altered calcium and phosphorous. Calcium and phosphorous is regulated by bone, kidneys, and intestinal absorption. With chronic kidney failure, less phosphorus is excreted by the kidney. Calcium will bind with the excess phosphorus; leading to decreased serum calcium. In order to utilize calcium consumed orally the presence of activated vitamin d is needed. The kidneys convert inactivated vitamin d to activated vitamin d. Therefore, the inability of the kidneys to activate vitamin d further perpetuates the decreased serum calcium levels. When serum calcium is decreased the parathyroid hormone is released to break down the bone to release calcium from the bone into the intra-vascular space. This breakdown of bone releases phosphorous as well: ↑ serum phosphorous and calcium levels.
  Management: Medication and dietary adjustments.

Figure 1.3: CaPh Pathway



<u>Treatment Options for Chronic Kidney Disease (</u>The Kidney Foundation of Canada, 2015b).

There are currently three (3) treatment options for patients once they reach end-stage renal disease

1. Renal Transplant
2. Peritoneal Dialysis
3. Hemodialysis

1. Renal Transplant

With advances in kidney transplant methods and improvements in transplant success, a kidney transplant is now considered to be the best way of treating kidney failure. A transplant may offer the best chance of returning to a normal life, but is not suitable for everyone.

Transplant Coordinator: Marion Coffey
777-3601
marion.coffey@easternhealth.ca

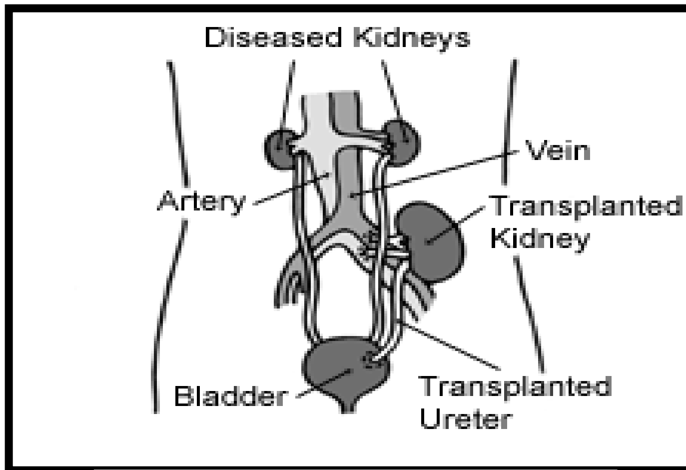


Figure 1.4: Transplanted Kidney

- If your patient is wondering about being on the transplant list, they first should ask the nephrologist if he or she is eligible. You can then contact Marion or ask the nephrologist to contact Marion to begin a work-up.
- Certain medical conditions will exclude patients from being a transplant candidate (heart conditions, cancer, vascular issues). These exclusions will be discussed in detail with a doctor.
- Transplant status needs to be changed in Meditech. When a person is being assessed or activated, the status needs to be changed so that other healthcare professionals are made aware.
- If a patient is looking for information or education on transplant there is a pamphlet available through Nova Scotia Health Authority.

<u>Staff's role:</u>
-Marion may place requisitions in patient's charts that she will need the nurse to give to the patients and answer any questions that they may have.
-Notify the nephrologist if a patient is inquiring about transplant.
-Notify Marion if a patient who has a donor inquiring about live donation.
-Educate the patient (seek out learning and education opportunities on transplant).
-Draw monthly cytotoxic antibodies if they are due for your patient.
-Update any transplant information in Meditech and communications.

<u>Types of transplant:</u>
1. From a live kidney donor
    - Live donation only occurs if a patient has a kidney donor come forward.

2. From a deceased kidney donor (The Kidney Foundation of Canada, 2015b).

2. Periotoneal Dialysis

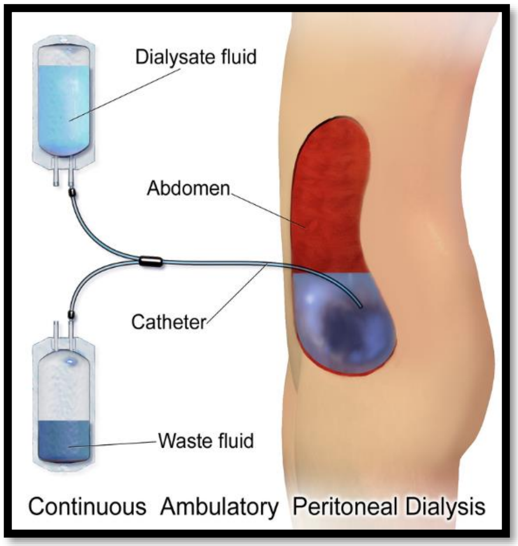
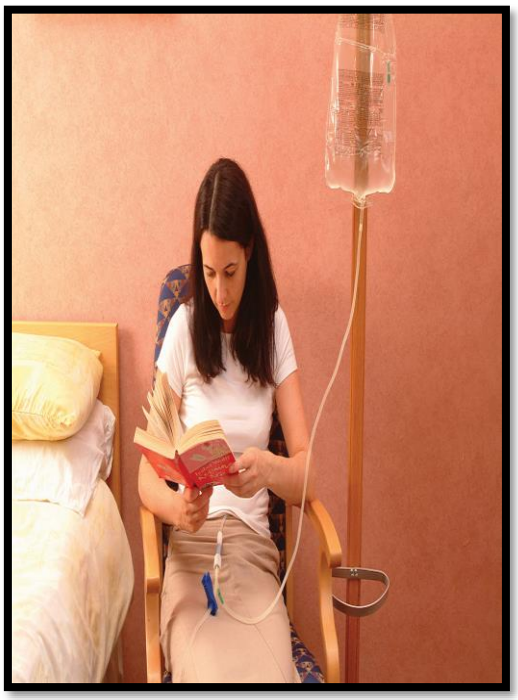


Figure 1.5: Peritoneal Dialysis



Choosing peritoneal dialysis does not prevent patients from changing to hemodialysis in the future. Peritoneal dialysis uses the body's own peritoneal membrane to replace the functions of the kidneys. The peritoneal membrane lines the inside of the belly where many organs are found. This membrane permits the movement of water and waste product from the blood on one side of the membrane into the peritoneal cavity. A catheter is surgically placed in the peritoneal cavity. A special fluid called dialysate flows into the peritoneum through this catheter. The catheter will drain the dialysate into and out of the peritoneum. Dialysis takes place while the dialysate is inside the body. Dialysis is achieved by three (3) components

1. Blood (supplied in the abdomen)
2. Dialysis Solution (dialysate)
3. Semipermeable membrane (peritoneal cavity)

The type of peritoneal cavity will be determned by the PET test.

Peritoneal dialysis occurs through osmosis, diffusion and ultrafiltration

The peritoneal catheter allows for instillation of dialysate into the abdomen into the perioteneal cavity. The dialysate then needs to "dwell" or stay insitu for a prescribed time of four (4) – six (6) hours. After this dwelling time period is completed, the dialysate is then drained by gravity. Aseptic technique is critical to decrease complications and consquences.

Rate of diffusion is affected by:

- The permeability of the membrane.
- Surface area.
- Membrane size.
- Blood flow of the peritoneal cavity.
- Dialysate used.
- Characteristics of the solutes.

Potential Complications of Peritoneal Dialysis.

- Periototnitis
- Membrance failure
- Weight gain
- Hernia

3. Hemodialysis

- ❖ Blood-vascular
- ❖ Dialysate- Acid + bicarbonate
- ❖ Semipermeable Membrane (which is the artificial membrane also known as the dialyzer)
- ❖ Works through osmosis, diffusion, and ultrafiltration
- ❖ Water used for the hemodialysis machine is exposed to purification and is constantly being monitored and tested by biomedical staff.
- ❖ Simply put: blood is taken from the patient away from their body to the machine, through the artificial kidney (dialyzer) [where it is cleaned; toxins removed], back to body; in a cyclic nature.

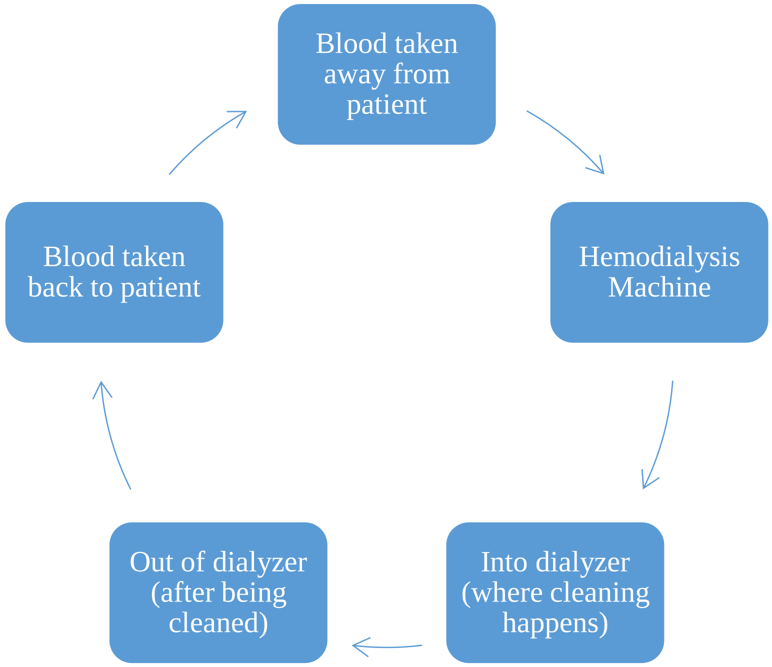


Figure 1.6 Hemodialysis Sequence [Simplified]

Treatment Options:

There are many ways in which a patient can receive their prescribed treatment modality. Some of the options currently available with Eastern Health include:

- In center hemodialysis
- Outpatient hemodialysis
- Home hemodialysis (patient does their own treatment at home)
- NxStage (patient does their own treatment at home)
- Nocturnal home hemodialysis (patient does their own treatment at home at night)

Princlples of Hemodialysis

How are solutes dialyzed?:

With hemodialysis, the blood and dialysate are exosped to each other through a semi-permerable membrane. Solutes are removed in hemodialysis through princples of diffusion.

Diffusion: The movement of mocules from a higher concetration gradient to a lower concentration gradiet. Diffusion can occur from the blood to the dialysate OR from the dialysate to the blood.

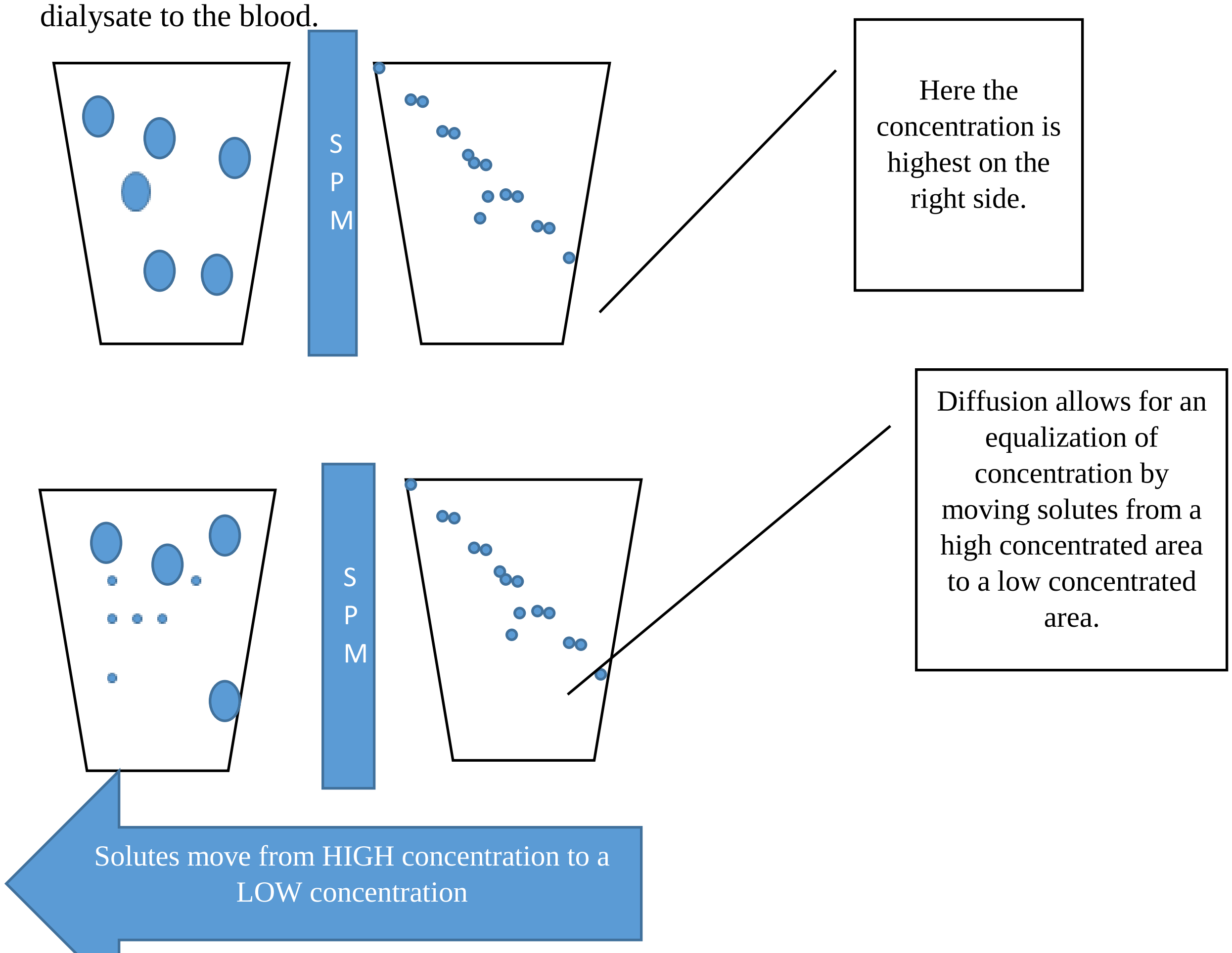


Figure 1.7 Hemodialysis Principles

Factors that can affect the rate of diffusion:

- Particle size (the larger the particles that need to move; the more time diffusion will take).

- The characteristics (surface area, # of pores, thickness) of the semipermerable membrane (SPM). THe higher the surface area, # of pores, and thinness of the SPM will increase the rate of diffusion. If the SMP has a lower surface area, a lower # of pores, and a thick SPM, the rate of diffusion will be increased.
- Temerpature. Higher temperatures allows for more particle movement, which increases diffusion rates.
- Concentration differences: The higher the differences in the concentrations of the two soules the faster the molecules will diffuse.

<u>How is fluid dialyzed?:</u>

The removal of fluid is Ultrafiltration (UF). UF is the removal of water from the blood due to a difference in the pressure gradient between the blood and the dialysate. Water removal follows movement from a low concentration to a high concentration to equalize the pressure gradients between the blood and the dialysate to achieve homeostasis.

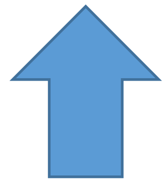
The pressure that propels this push of water from compartment to compartment is the hydraulic pressure (measured in mm Hg). The pressure needed to move water from the blood to the dialysate (to remove fluid) is the transmembrane pressure (TMP).

<u>Ultrafiltration:</u> The removal of fluid from blood.

<u>Hydraulic Pressure:</u> The pressure that moves water from compartment.

<u>Transmembrane Pressure:</u> The pressure that is needed to move water from blood to dialysate.

Hemodialysis Pressures	**Hemodialysis Flows**
<u>Positive Pressure:</u> Is the pressure applied to the blood side to PUSH water from the blood across the semipermeable membrane into the dialysate to remove fluid.	Blood flow: The rate (in mL/min) of how quickly the blood is removed from the body and brought to the dialyzer. ↑ Blood flow ↑ Blood cleaned

	 **<u>Clearance</u>**
<u>Negative Pressure:</u> Is the pressure applied to the dialysate side to create a vacuum (sucking) to p – u – l – l (pull) the water across the semipermeable membrane from the blood into the dialysate.	Dialysate Flow: How quickly (measured in mL/min) the dialysate is delivered to the dialyzer. Default of 500mL/min.

<u>Princlples of Hemodialysi Circuit:</u>

1] Dialyzer: The dialyer is prescribed by the nephrologist and is the artificial kidney that is used as the filetering agent in a hemodialysis treatment. The dialyzer is composed of two separate comonments, one side for the blood, and one side for the patient which is speperated by a semipermerable membrane. The blood and the dialysate NEVER come in cotact and flow countercurrently ↓↑. Each dialyer is composed of hollow fibers compised of bundles of “straw-like” bundles The blood will flow through the hollow fibers whilst the dialysate will flow around the fibers. Below is a diagram of the compoments of the dialyzer.

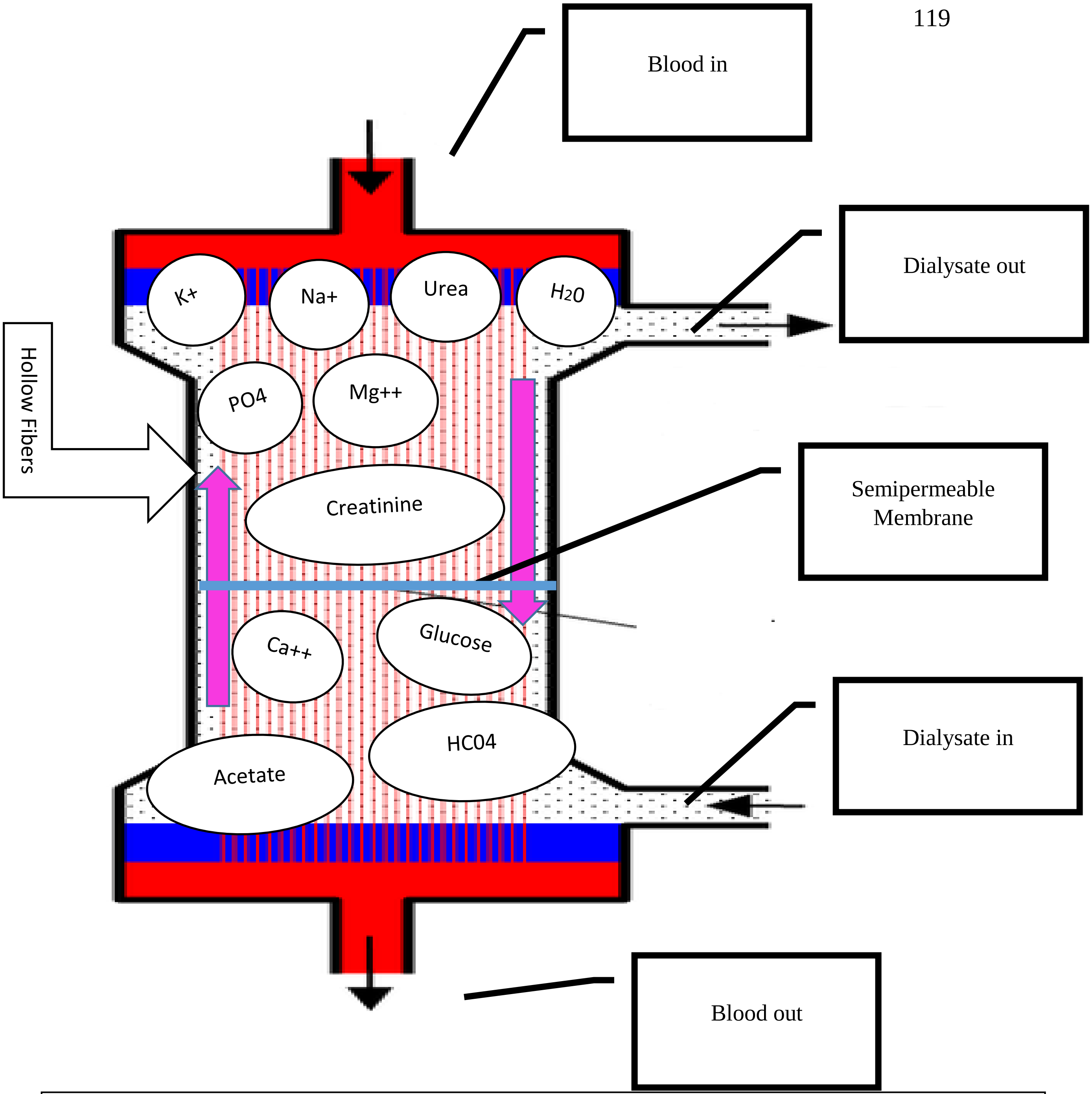


Figure 1.8: Dialyzer

The dialyzer membrane can be composed of varied materials such as polysulfone, cellulose triacetate, and polyamide just to list a few. Furthermore, each dialyzer is sterilized with a sterilizing agent which will vary depending on the dialyzer used. The types of sterilizing agents that are typically used include: steam, gammy ray, and ethylene oxide. It is important to note that a potential complication of hemodialysis includes membrane reaction. This membrane reaction is often contributable to the membrane composition or sterilizing agent used in the prescribed dialyzer. Therefore, it is possible that a patient's dialyzer will have to be changed if a membrane reaction occurs.

Dialyzer factors that can affect hemodialysis performance:

- Surface area: The larger the surface area the better the cleareance.
- Semipermerannle Membrane (SPM): The more porerous the SPM to solutes and waste the better the "clearning" or cleareance.
- Distrubution of the SPM Pores: The larger the pores of the SPM, an increased clearance of large pore solutes occurr (increased clearance).

Currenrly in the hemodialysis unit the typical dialyzers utilized include: Fx 800, Fx 1000, Optiflux 250 NR, and the AN69.

The AN69 is typically only used in patients whom exhibited signs and symptoms of a membrane reaction.

In terms of surface area and increased hemodialysis efficacy the dialyzers range from Fx 800 to Fx 1000 to Optiflux 250NR. Therefore, if a patient was not reciving good clearances with th Fx 800, the nephrologist may order a Fx 1000 or an Optiflux 250 NR.

2] Hemodilaysis Blood Circuit.

Blood Circuit:

In the hemodialysis blood circuit, there are 2 lines.

1. The arterial line is used to bring blood away from the patient.
2. The venous line is used to bring blood back to the patient.

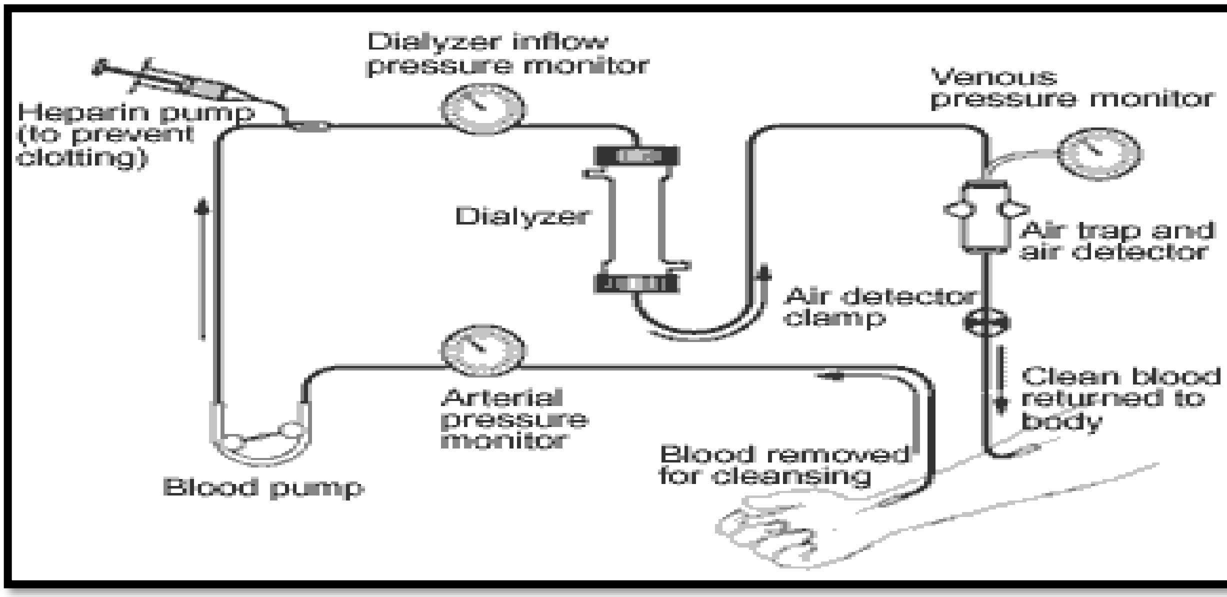


Figure 1.9: Hemodialysis Circuit

3] Dialysate

The dialysate is composted of treated water + acid component (acetate; also referred to as dialysis bath) + base component (bicarbonate) (as buffers), and concetrated electrolytes that will be individually ordered on a patient specific basis. The Nephrogist will order the potassium, calcium, and bicarbonate level for each patient..

Acid Concentrate + Base Concentrate + Treated Water = Dialysate Component

Acid Concentrate	+ Base Concentrate Dialysate	+ Treated Water =
• Sodium Chloride. • Potassium Chloride. • Calcium Chloride. • Magnesium Chloride. • Acetic Acid.	• Sodium Bicabonate powder (650 grams).	

Avalilable concentrations avaialble (withiout any additatives):

1K+ 1.0Ca ++

1K + 1.25 Ca ++

2K + 1.0 Ca ++

2K+1.25Ca ++

3K+1.25Ca++

1K+1.25Ca++ Citrasate

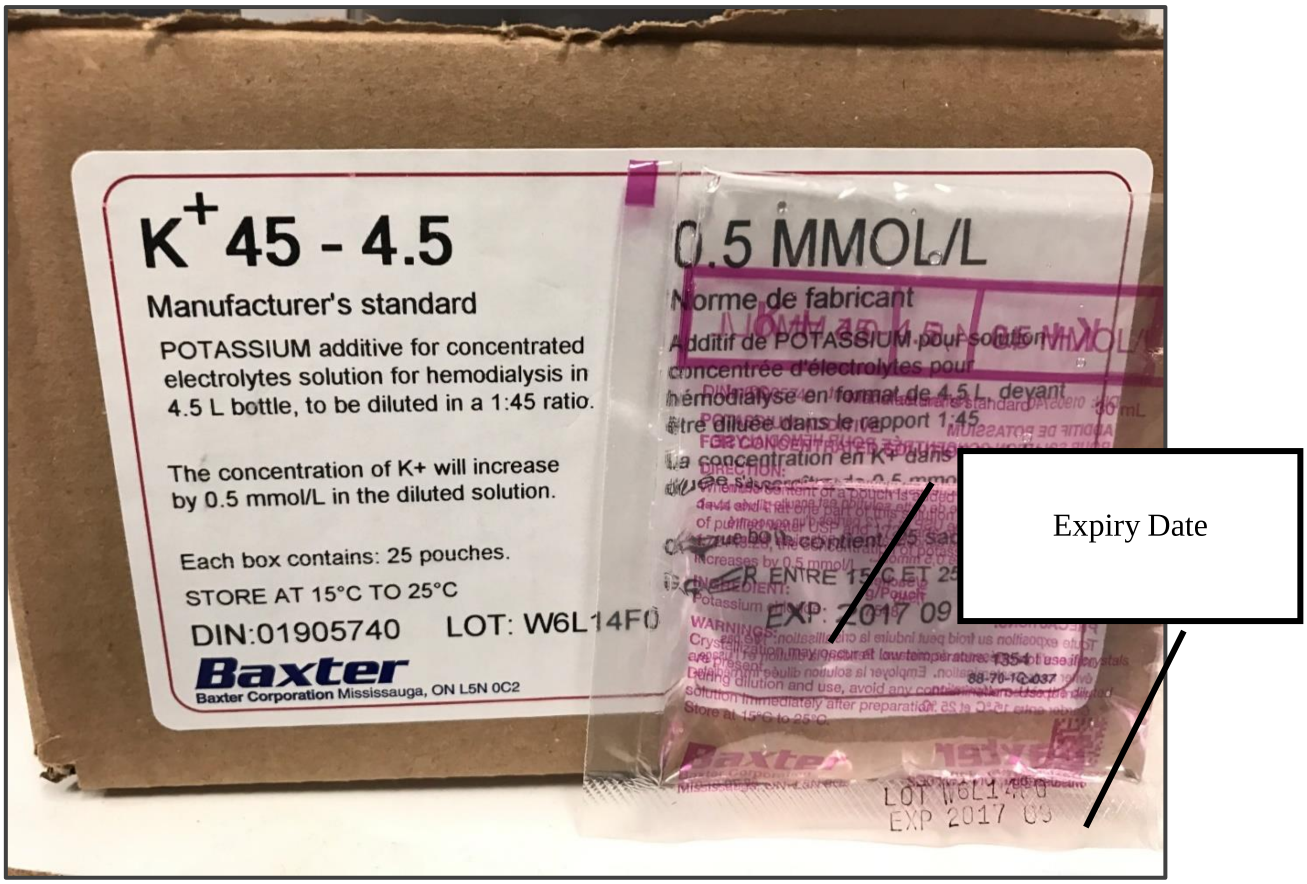
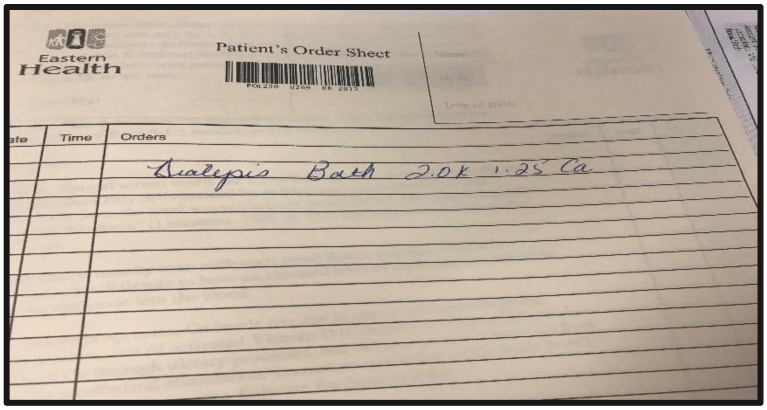


Figure 1.10: Potassium for mixing dialysate

Potassium, is a major intracellular cation. The K+ level of the dialysate can vary. The most common K+ ordered are 1 K+, 2K+, 3K+, and 4K+. The potassium concentrate can be increased in the varying dialysate by adding potassium packages [one package of potassium will increase the K+ of the solution by 0.5 mmol/L] For example:



In this case the Nephrologist has ordered a 2K1.25Ca dialysis bath. There are 2K1.25Ca dialysis bath available. However, if there was NO 2K1.25Ca baths available you can mix one. You can add potassium (2) to a 1.0K1.25Ca bath to make it a 2K1.25Ca

Figure 1.11 Nephrologist orders for dialysate

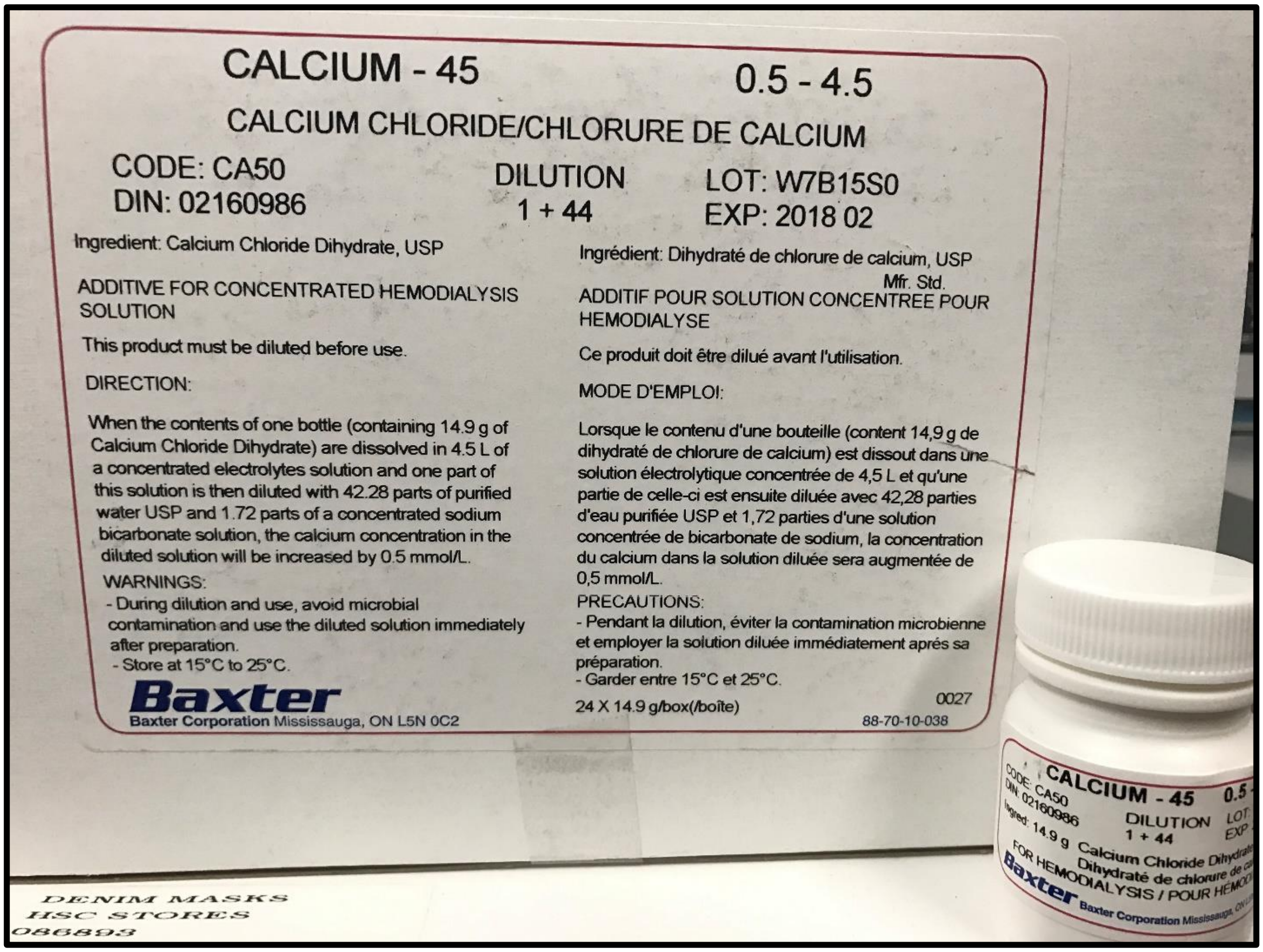
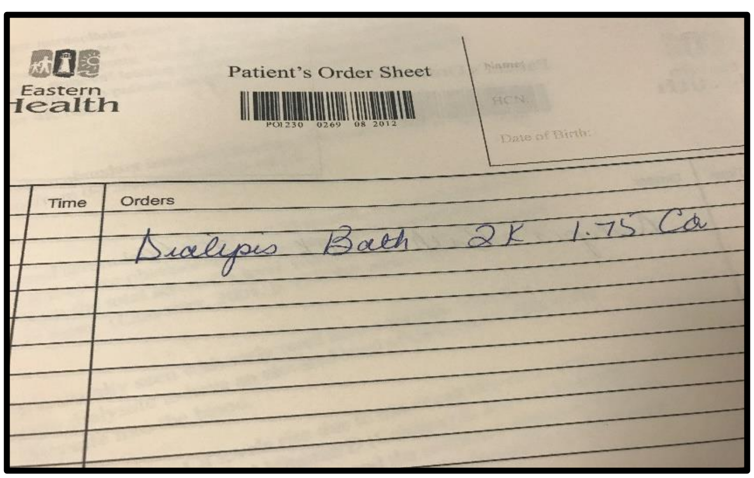


Figure 1.12: Calcium for dialysate mixing

The most abundant mineral in the body. The Ca++ level of the dialysate can vary. The most common Ca++ ordered are 1.25. The calcium concentrate can be increased in the varying dialysate by adding calcium [one bottle of calcium will increase the Ca++ of the solution by 0.5 mmol/L] For example



In this case the Nephrologist has ordered a 2K1.75Ca dialysis bath. There is no 2K1.75Ca dialysis bath available. Therefore, this needs to be mixed to be prepared as per doctor's orders. You would need a 2K1.25Ca bath and one bottle of calcium

2K1.25Ca + bottle Ca (1) = 2K1.75 dialysate

Figure 1.13: Mixing of dialysate

Figure 1.14 Mixing of dialysate

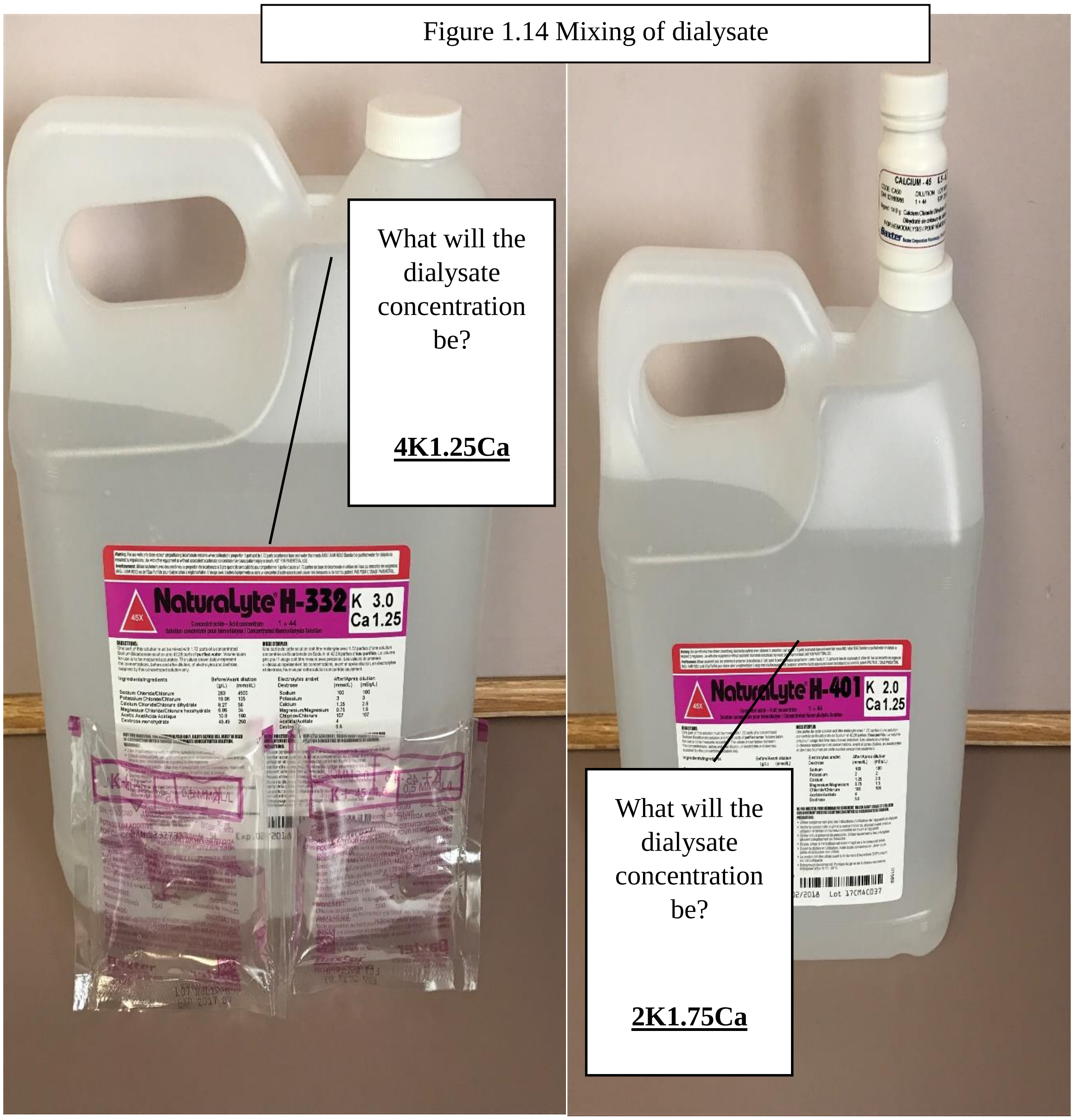


Figure 1.15: Mixing of dialysate

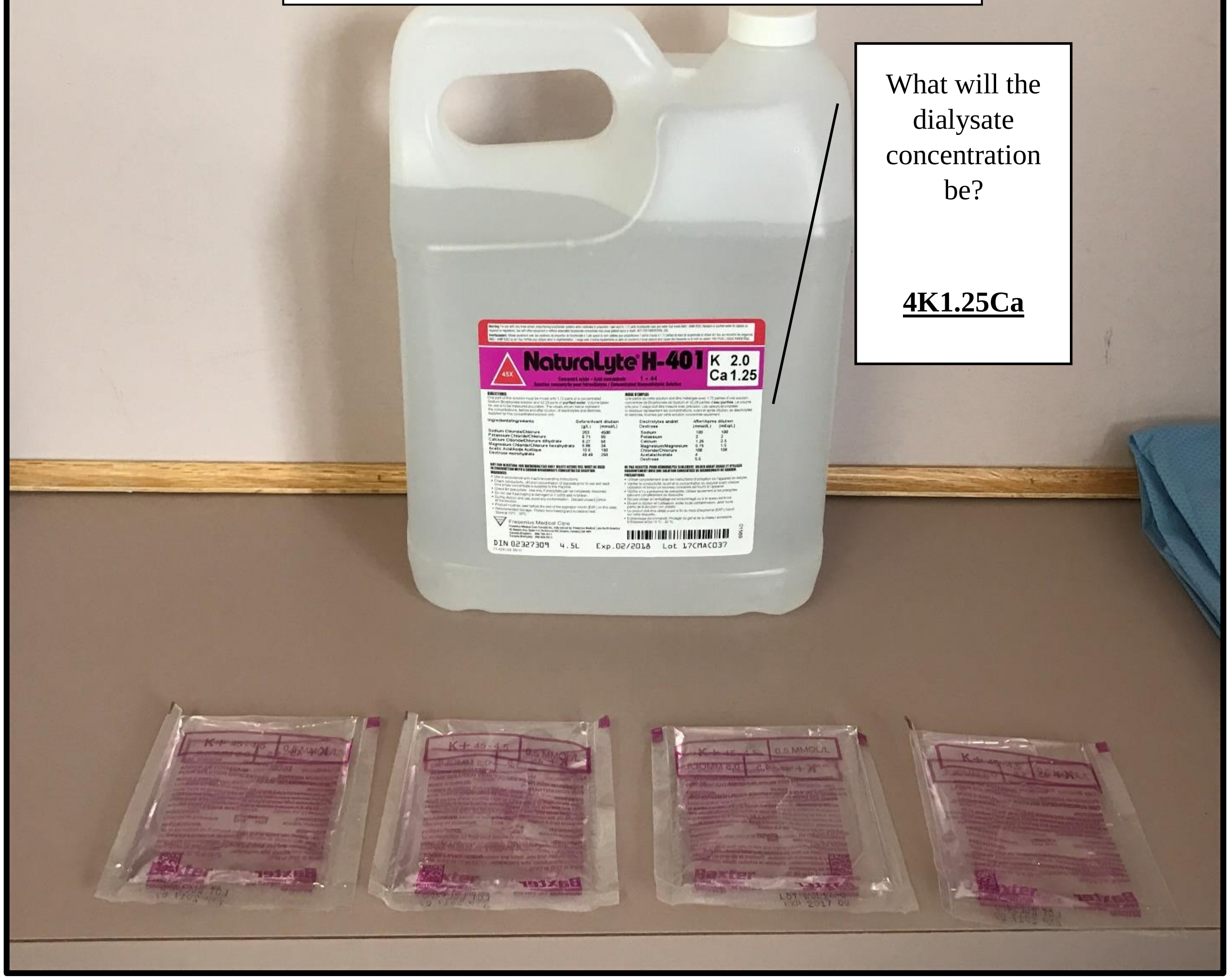
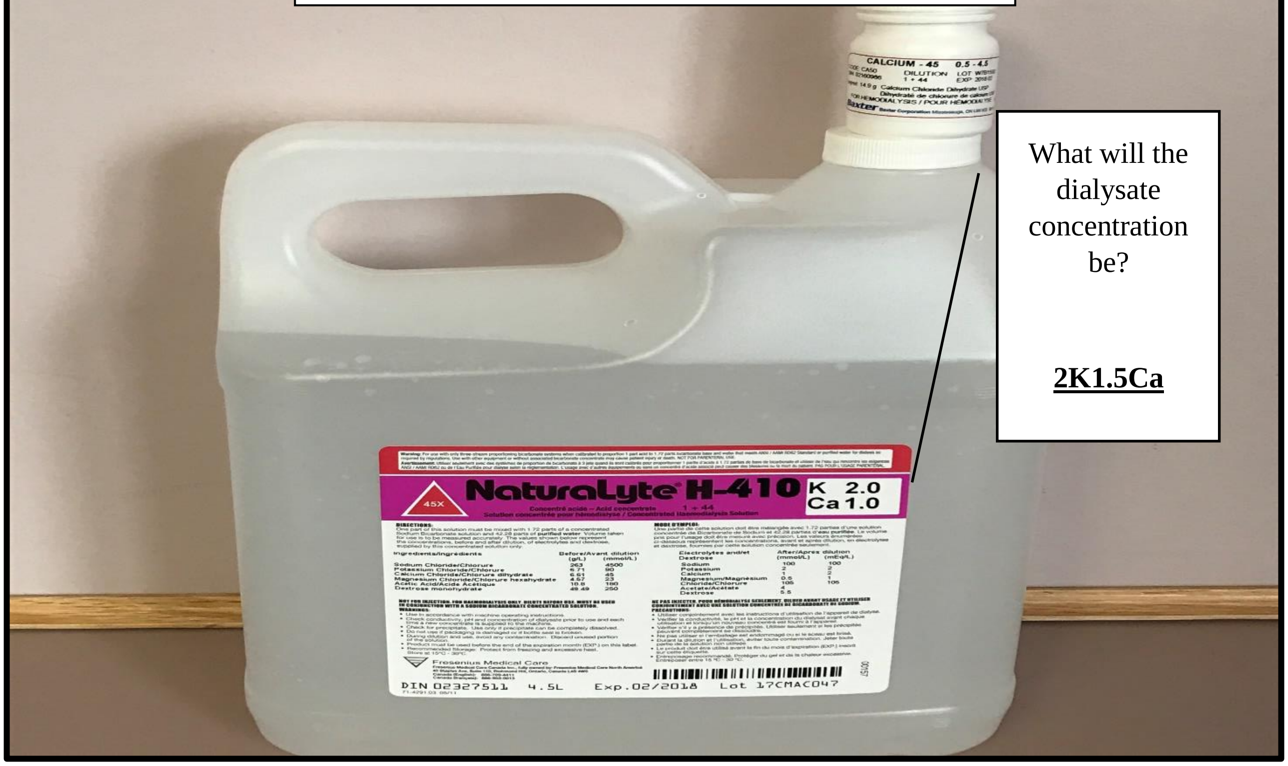


Figure 1.16 Mixing of dialysate

What will the dialysate concentration be?

3K1.75Ca

Figure 1.17: Mixing of dialysate



What will the dialysate concentration be?

2K1.5Ca

Module 1 Evaluation

Chronic Kidney Disease & Hemodialysis Principles

1. Calcium and phosphorous are absorbed at which three sites in the body?
   a) Blood, bone, and kidney
   b) Blood, bone, and intestine
   c) Bone, kidney, and intestine
   d) Bone, intestine, and liver

2. What are the three principles of hemodialysis?
   a) Sodium ramping, fluid removal, and vascular access
   b) Diffusion, reverse osmosis, and total fluid removal
   c) Diffusion, osmosis, and ultrafiltration
   d) Diffusion, osmosis, and hemostasis

3. Which of the following is the biggest potential complication of immunosuppressant usage post renal transplant?
   a) Acute renal rejection
   b) Weight gain
   c) Increased risk of developing cancer
   d) Increased risk of infection

4. What is the most commonly experienced complication that patients on peritoneal dialysis experience?
   a) Peritoneal membrane failure
   b) Hyperglycemia from the dialysate
   c) Weight gain
   d) Peritonitis

5. List how many ways you can mix a dialysate bath to get a 4K+1.25 Ca++ dialysate.
   1. ____
   2. ____
   3. ____

6. ____________ is the functional unit of the kidney
   a) Nephron
   b) Proximal Tubule
   c) Bowman’s Capsule
   d) Cortex

7. There are ___ stages of chronic kidney disease?
   a) 3
   b) 4
   c) 5
   d) 6

8. At a eGFR between 15-29 is what stage of kidney disease
   a) 1
   b) 2
   c) 4
   d) 3

9. Fill in the blanks. At ______________ eGFR a patient will start a renal replacement therapy. This eGFR is classified as stage ____________ kidney disease?

10. A majority of end stage renal disease also are afflicted with what other comorbidity?
    a) Hypertension
    b) Diabetes
    c) Obesity
    d) Congestive heart failure

True or False

1. Renal transplant is a cure for end stage renal disease.	☐True ☐False
2. In the dialyzer the blood and dialysate mix to remove toxins.	☐True ☐False
3. The arterial line takes blood away from the patient	☐True ☐False

4. Acute renal failure is reversible	☐True ☐False
5. Chronic renal failure is reversible	☐True ☐False

References

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Module 2

Hemodialysis Machine and Prescription

Purpose: To provide the patient with an effective hemodialysis treatment the nurse must understand how to use the machine. Once mastered, the nurse must take the individualized patient orders and use the standard procedure for 'putting on', monitoring, and 'taking off' a patient utilizing the hemodialysis machine.

Learning Objectives: After completing this module the learner will complete a post test that will measure the learner's ability to:

- Prepare the hemodialysis machine.
- List the various parts of the hemodialysis machine and their purpose.
- Identify the maintenance and nursing responsibility of the disinfecting of the machine.
- List the components of the hemodialysis prescription.
- Demonstrate the general procedure of 'putting on' a patient on hemodialysis.
- Demonstrate the general procedure of 'taking off' a patient on hemodialysis.

Section 2.1: See 210G-EQU-010 5008 Fresenius Hemodialysis System Preparation below the policy on how to set up the currently tenured hemodialysis machine used in Eastern Health hemodialysis facilities.

Figure 2.1: Policy for hemodialysis machine setup

5008 FRESENIUS HEMODIALYSIS SYSTEM PREPARATION
210G-EQU – 010
Page 1/6

Eastern Health

5008 FRESENIUS HEMODIALYSIS SYSTEM PREPARATION	**Equipment 210G-EQU – 010**
Issuing Authority (sign & date)	**Collette Smith Director of Medicine** Signed by Collette Smith Dated October 31, 2012
Office of Administrative Responsibility	Dialysis Network
Author	Cathy Cake Clinical Educator
Level	Three (III)
Original Approval Date	October 31, 2012
Effective Date	Upon signature
Scheduled Review Date	June 2014
Actual Review Date	
Revised Date(s)	

Overview

The 5008 Fresenius therapy System offers unique therapeutic possibilities including:

- Hemodialysis
- ONLINE Haemodiafiltration
- OCM – Online Clearance Monitoring and plasma sodium measurement
- Ultrapure dialysis fluid
- Na and UF profiles
- Single-Needle Treatment
- Blood Pressure Monitor
- Blood temperature Monitor
- Blood volume Monitor

Background Statements

Hard Key: is a pressure-sensitive, raised pad on the control panel outside of the treatment screen that is used to initiate an action. The 4 LED color function keys are located vertically on the left side of the monitor are:

1. On/Off LED/key (green). When LED light illuminated system is in operation and when LED is flashing, the system is connected to power.
2. Blood system Stop LED/key (red)
3. Blood system Start LED/key (green)

Mute LED/key (red). When LED is illuminated an audible alarm is suppressed and when LED is flashing the audible alarm is active.

Menu Button : Nine (9) Menu buttons

POLICY

- The 5008 Fresenius Hemodialysis machine will be prepared no more than 3 hours prior to the patient's treatment.
- Conductivity and concentrate will be verified no more than 3 hours prior to the patient's treatment.
- Supplies (0.9 % NaCl, IV infusion line, blood lines, prime bag, dialyzer, B-bag) are to be opened just prior to preparing the machine.
- Aseptic technique must be maintained when making or breaking any fluid path connection due to the risk of bacterial contamination.
- Blood lines and dialyzer are sterile if package is not damaged and the protective sterility caps are in place. Do not use if these caps are not in place.
- T1 Test must be completed before priming of the dialyzer with dialysate.

Scope

Registered nurses in dialysis units within Eastern Health on completion of hemodialysis orientation and licensed practical nurses in Eastern Health who are employed and working in LPN positions within Hemodialysis units on completion of specific education and Hemodialysis orientation.

Purpose

- To prepare the 5008 Fresenius Therapy System for hemodialysis.
- To control and monitor the blood flow through the extracorporeal circuit.
- To control and monitor the dialysate flow through the dialysate flow path.
- To maintain a pathogen free pathway.

Procedure

Check expiry date on all supplies

Supplies

- 5008 Fresenius Hemodialysis Machine
- Dialysate concentrate (acid and bicarbonate as prescribed)
- Blood lines
- 1 Litre 0.9% saline
- IV Administration set
- 20 ml syringe
- 21 gauge needle
- Alcohol swab
- Heparin (1000 units per mL)
- Dialyzer as prescribed
- Priming/Drainage bag

- Test strip (citric acid/chloramine free)

Procedure

1. Ensure Fresenius 5008 is connected to:
   - Treated water
   - Drain
   - Appropriate electrical source
2. Verify the main power (at rear of machine) is in the **ON** position.
3. Turn on the machine by pressing the **On/Off** key on the monitor. The green power light comes on; the machine goes into initialization the **Start-up Screen** followed by screen selection options – **Treatment – Heat Disinfection.**
4. Touch **Status** button.
5. Touch **Cleaning Status** to check time, date and disinfection cycle of last disinfection procedure. If downtime greater than 72 hours, a cleaning program must be preformed completely before starting the treatment. If machine has dialyzed a patient prior, then a cleaning program must be preformed completely within 24 hours before starting the treatment.
6. Check for the presence of residual disinfectant, using appropriate test strip.
7. Verify the expiry date on appropriate test strips.
8. If test shows residual disinfectant present start a rinse program by :
   - Touch CLEANING menu
   - Touch **Rinse**
   - Touch **Start cleaning program**
9. Re-check for presence of residual disinfection.
10. Touch the **Treatment** button. The T1 runs parallel with the preparation of the hemodialysis machine and the colour of the header bar is orange for the duration of the T1 test.

Check expiry date

11. Connect the prescribed acid concentrate
    - Push latch upwards
    - Open concentrate flap
    - Place the red concentrate suction tube into the acid container
    - Close the concentrate flap until it clicks in place
12. Connect b-bag
    - Push the latch upwards
    - Open the bicarbonate flap
    - Take B-bag out of it packaging and remove the foil
    - Attach the B-bag and close the bicarbonate flap until it clicks
    - The B-bag must be used for one treatment only and be discarded after 12 hours.

Check that wand is intact by turning b-bag upside

13. Open the doors of the Extracorporeal Blood Circuit Module.
14. Remove arterial bloodline from package and insert the line guide into the blood pump until a signal is heard. The arterial pressure measurement unit is opened. (After closing the doors the pump segment will be automatically inserted into the blood pump.)
15. Insert the arterial blood line into the line holder.

16. Connect arterial blood line to lower port of the dialyzer.
17. Insert the arterial pressure dome into the arterial pressure measurement unit.
18. Insert the arterial blood line into the arterial occlusion clamp.
19. Insert the BVM cuvette into the module, close door.
20. Insert arterial line into arterial BTM and close module.
21. Connect the arterial patient connection of the blood line to the prime/rinse solution bag and tighten all connectors.
22. Insert the venous bubble catcher into the level detector with the bottom resting directly against the locator.
23. Insert the venous line into the optical/air bubble detector. The line must be positioned completely inside the line housing.
24. Insert the venous blood line into the venous occlusion clamp.
25. Insert venous line into venous BTM and close module.
26. Connect the venous patient connection of the blood line to the collection bag.
27. Insert the venous blood line into the line holder.
28. Connect the venous blood line to the upper part of the dialyzer. Position the dialyzer venous end up to maximize air removal.
29. Connect the venous pressure transducer to the venous pressure connector/transducer port. The transducer must be changed if becomes wet. If fluid may have passed the transducer (hydrophobic filter), the system must be checked for contamination after completion of the treatment. If the system is contaminated, it has to be taken out of service and all affected parts disinfected and/or replaced as per manufacturer's instructions.
30. Close the two white clamps on the venous injection ports.
31. Close the doors. (The pump segment is automatically inserted, the arterial pressure measurement unit closes).
32. Attach heparin syringe (see policy 210G-EQU-030 Heparin preparation using the 5008 Fresenius Hemodialysis Machine) or clamps heparin line if heparin –free dialysis.
33. Attach the IV line to the arterial injection port.
34. Spike one saline bag and allow arterial side to prime by gravity then close red clamp on arterial line once saline reaches the rinsing/draining bag.
35. Start the Rinse procedure by:
    - Touch **PREPARATION SCREEN**
    - Message reads - Priming/Rinsing –**Start**
    - Touch the **Start** button or **Blood pump I/O**
36. Start the Circulation procedure by:
    - Message reads – Rinse volume reached – Rinse **Continue** – Circulation **Start**
    - Close white clamp on rinsing/drainage bag
    - Open Red clamp on arterial blood line
    - Touch **Circulation**
    - Increase pump speed to 400mLs/min until all air purged from dialyzer then decrease to 150 mL/min.
37. Connect the dialysate lines after the completion of the T1 tests by:

- Open the shunt door.
- Connect the blue dialyzer coupling to the venous blood outlet side of the dialyzer.
- Connect the red dialyzer coupling to the arterial blood inlet side of the dialyzer.
- Close the shunt door.
- Flip the dialyzer to ensure blue dialyzer coupling is attached to the lower part of the dialyzer. The dialysate should enter the dialyzer at the bottom to efficiently remove the air from the dialysate side of the dialyzer.

38. Enter Treatment Parameters by:

a) Touch DIAYSATE MENU

- Touch the **Concentrate** button.
- Highlight the prescribed concentrate by touching the name. The electrolyte profile of the highlighted selection is displayed on the right column.
- Touch **OK** to save the selection.
- Ensure the machine conductivity alarm limits are set +/- 0.7 on either side of the TCD.
- Select any setting by pressing the name or value , change if necessary and touch **OK**
- Exit the **DIALYSATE MENU** by touching the **BLOOD SYSTEM** button.

Note: The acid and bicarbonate concentrates are being pumped into the proportioning pump. Acceptable conductivity and temperature values should be attained after 5 minutes.

b) Verify the Prescription Sodium and Bicarbonate values are as prescribed. Adjust the values if necessary by:

- Touch the **PREPARATION SCREEN** or **DIALYSATE MENU** Prescription (See **210G-EQU-050 Programming/profiling Sodium using the 5008 Fresenius Hemodialysis Machine)**
- Touch the **Prescription Sodium (Prescr. Na)** and/or **Prescription Bicarbonate (Prescr. Bic)** to set the values as prescribed.
- Touch **OK** to save the selection.

c) Touch **UF MENU (See 210G-EQU-040 Programming/Profiling Ultrafiltration using the 5008 Hemodialysis Machine)**

- Touch **UF goal**
- Enter amount in mLs
- Touch **OK**
- Touch **UF time**
- Enter amount in hours
- Touch **OK**
- Verify correct UF rate

d) Touch **Heparin** menu (see policy 210G-EQU-030 Heparin preparation using the 5008 Fresenius Hemodialysis Machine)

e) Touch **OPTIONS** menu to access the BPM (Blood Pressure

Eastern Health

Monitoring)

- Touch the **BPM** button
- Touch **Interval** to set 30 minutes
- Touch **Bld pres**. to take blood pressure and begin interval timing

f) Touch **OPTIONS** to enter parameters as required with **BVM, BTM** and **OCM**.

Supporting Documents *(References, Industry Best Practice, Legislation, etc.)*

- 5008 Hemodialysis system Operating Instructions, Fresenius Medical care
- Nephrology Nursing Standards of Practice and Guidelines for Care (2005).American Nephrology Nurses' Association
- Contemporary Nephrology Nursing: Principles and Practice (2006), Second Edition-American Nephrology Nurses' Association

Linkages

- 210G- CLP-050 Cannulation of fistula/graft
- 210G-CLP-080 Cannulation of new fistula
- 210G-CLP-121 Accessing central venous catheters using TEGOs
- IPC-150 Hand Hygiene
- PRC-020 Clinical documentation
- PRC-130 Positive Patient Identification
- 210G-TBS-031 Single needle hemodialysis Using the Fresenius Hemodialysis Machine
- 210G-EQU-100 Connecting patient to the 5008 Fresenius Hemodialysis machine
- 210G-EQU-130 Hemodialysis Treatment Monitoring
- 210G-EQU-030 Heparin Preparation using the 5008 Fresenius hemodialysis Machine

Key Words

5008 hemodialysis machine set-up

PRACTICE. *During the week of classroom orientation, opportunity will be given to practice setting up the machine multiple times daily.*

<u>General Machine Setup Steps:</u>

1. Ensure machine is connected to: treated water source, drain, and electrical source.
2. Turn machine on.
3. Check machine for residual (if indicated) and check last cleaning status to ensure machinery cleaning regime was followed.
4. Start T1 test by connecting the concentrates (b-bag and acid concentrate).
5. Gather supplies needed for machine setup.
6. Open the doors of the Extracorporeal Blood Circuit and insert bloodlines as per machinery guidelines.
7. If required, prepare heparin.
8. Attach IV line to prime lines with normal saline.
9. Place the machine in a recirculation.
10. Once T1 test is complete, attach machine couplings to the dialyzer.
11. Program in patient treatment parameters.

Figure 2.2: Hemodialysis machine setup

Section 2.2

<u>Machine Disinfectant Guidelines:</u>

Currently, the machines need to be rinsed in between patient use and disinfected as per machine recommendations.

A heat disinfection is good for 72 hours after it was completed.

The machine needs to be bleached once weekly.

After a bleach, the machine needs to be checked for residual chlorine (see figure 2.5 below).

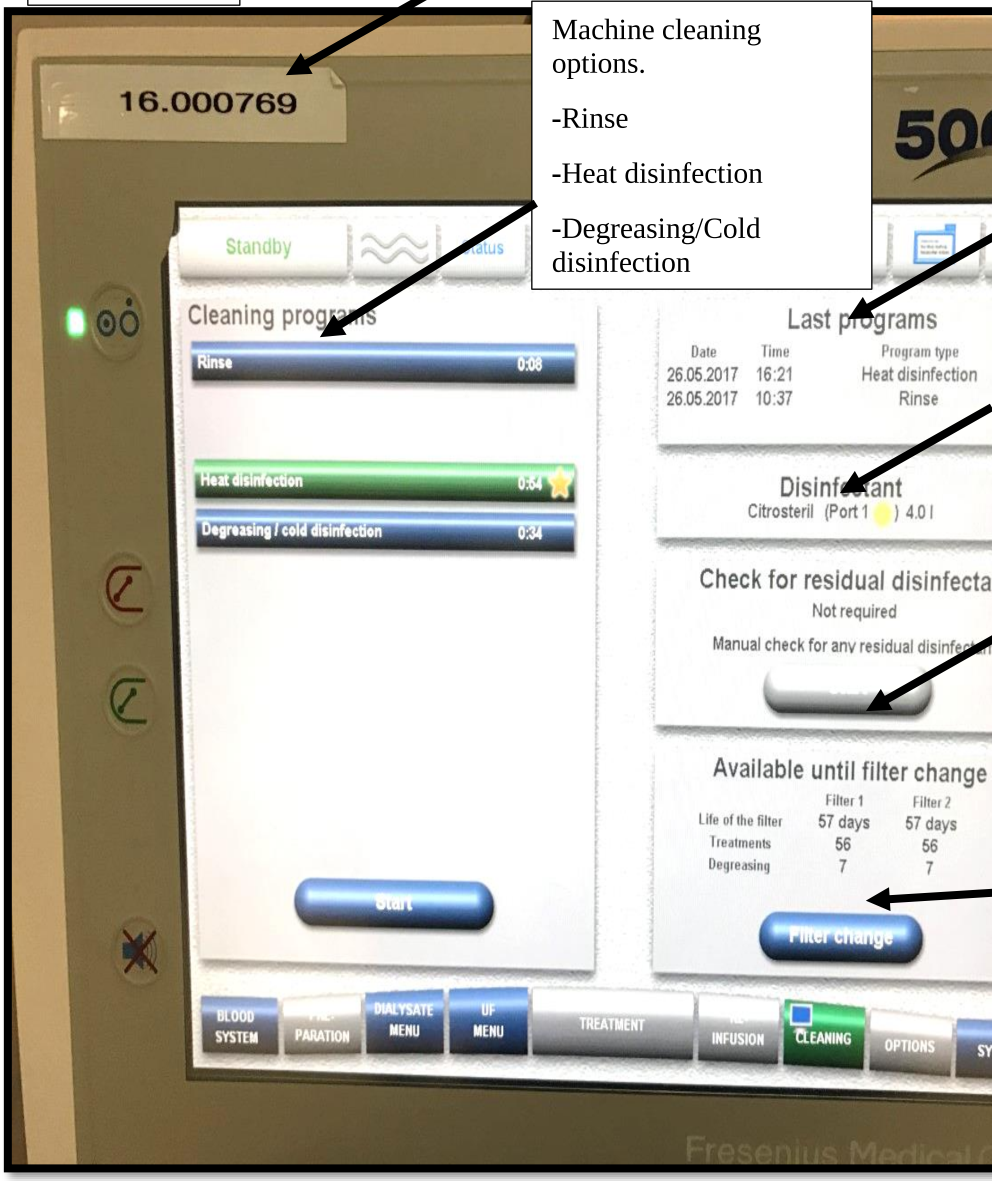
Filters on the machine need to be changed when indicated and depends on the expiry of either (a) life of the filter (b) # of hemodialysis treatments, or (c) # of degreasing.

<u>Figure 2.3</u>

Filters

Figure 2.4: Machine Disinfection Guidelines

Machine #: Last 3 numbers. 769



Machine cleaning options.

-Rinse

-Heat disinfection

-Degreasing/Cold disinfection

Check last time the machine was disinfected. This machine was rinsed last at 10:37 on 26-05-2017. It was last heat disinfected at 16:21 at 26-05-2017

Disinfectant indicator: Shows level left of 20% Citric Acid Solution

Will indicate if residual disinfectant needs to be tested (Only after degreasing)

Filter Change Option

Indicates number of treatments, degreasing, and days of filter life left. Currently the machine can have 57 more days OR 56 more treatments OR 7 more degreasing before they need to be changed.

When new filters are installed the lifespan of the filters are for:

84 days

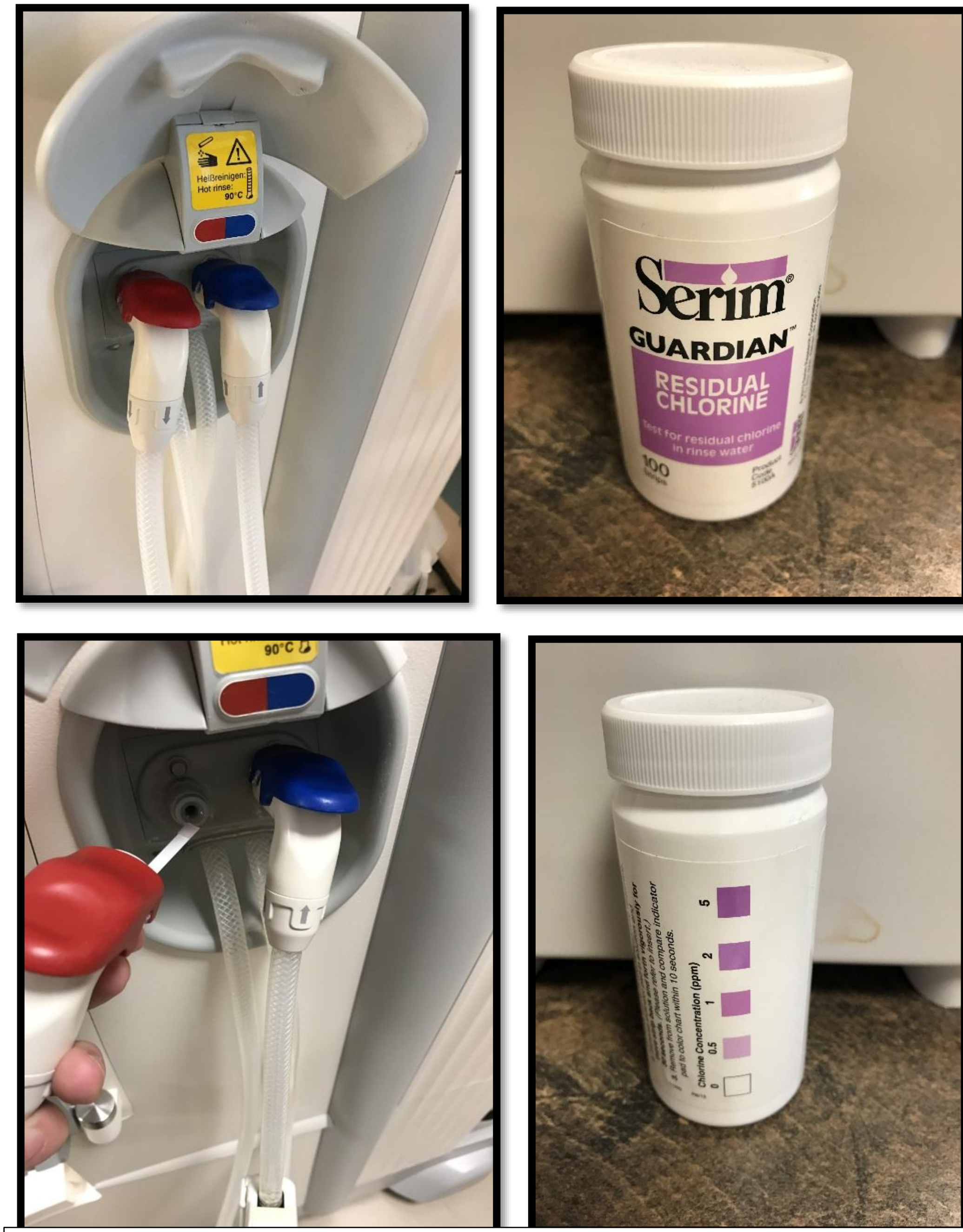
100 treatments

11 degreasings

Whichever of the three happens first.

Checking for Residual Chlorine:

Figure 2.5: Chlorine Residual Steps



Steps:

1. Open shunt interlock.
2. Remove coupling.
3. Take residual chlorine strip (check expiry date).
4. Test inlet coupling with residual stick.
5. If no color change; no residual disinfectant detected. Continue setup.
6. If residual indicated, rinse machine.
7. After the rinse is complete, repeat steps 1-5.

Machines are degreased once weekly. This degreasing is a cold disinfection that utilizes bleach. Prior to using the machine after it has been degreased it needs to be tested for residual chlorine. After testing, the strip should remain white which indicates there is NO residual chlorine present. If the strip indicates the presence of any chlorine concentration (ppm) from 0.5-5.0 then the machine needs to be rinsed and re-checked after the rinse.

It is important that the nurse putting the machine in a heat disinfection or a degreasing/cold disinfection checks to ensure there is enough disinfectant on the machine for the required disinfection. This is located <u>on the back</u> of the machine.

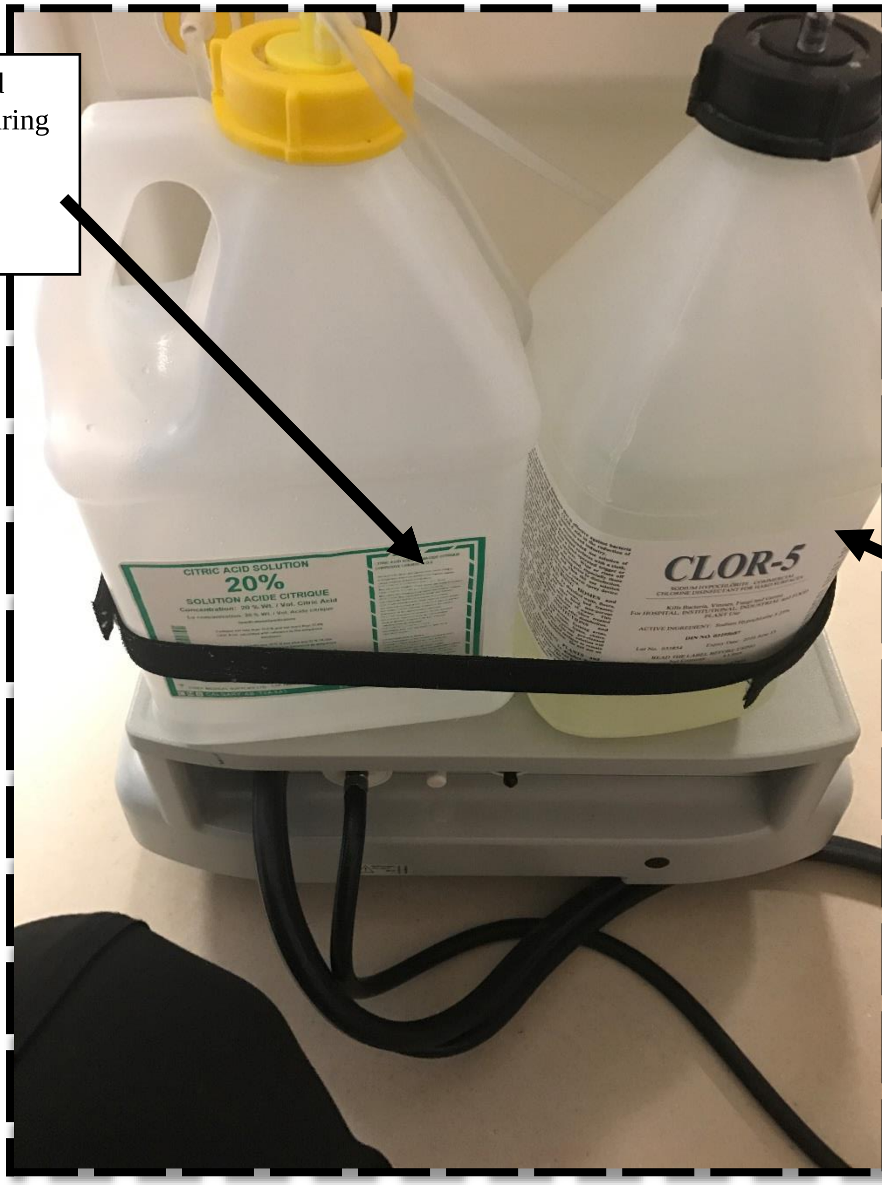
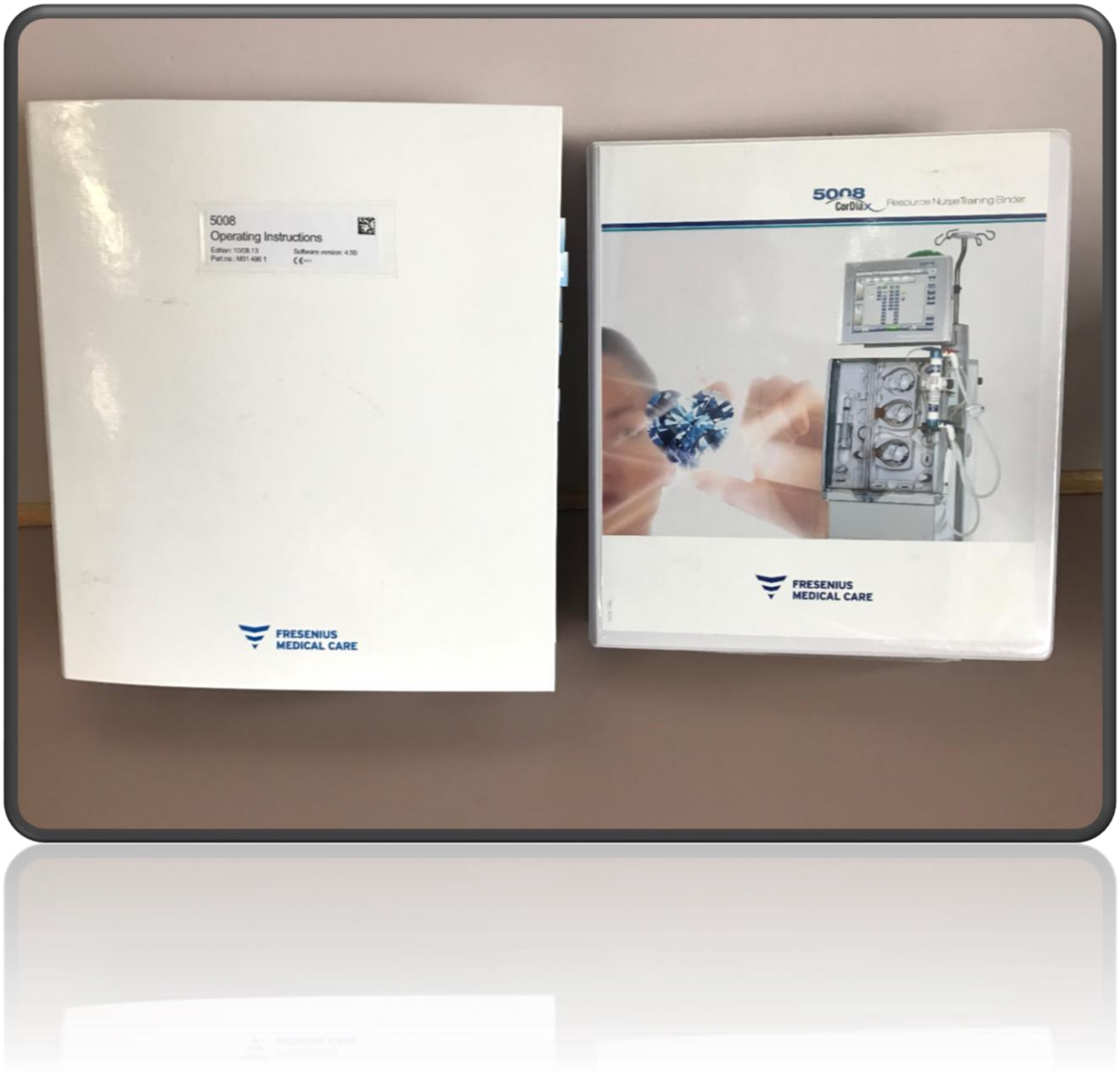


Figure 2.6: Location of machine disinfectant

Section 2.3

Figure 2.8: Machine Manuals



Above are pictures of the manuals of operating instructions of the Fresenius machine. These manuals are resourceful for any machine questions and concerns. These manuals will be in the hemodialysis unit for use by all staff nurses.

Section 2.4

Dialysis Prescription: When a patient is started on hemodialysis the nephrologist will order all aspects of care including but not limited to blood pump speed, net fluid removal, and a prescription. See Figure 2.9.

Figure 2.9:
Physician's Orders

Eastern Health
Diaylsis Unit

Physician's Orders
Initiation Hemodialysis
(Part I)

POI 620 0784 11 2013

Name:

HCN:

Date of Birth:

☐ Isolation__________________

Allergies: ☐ No Known

History:

1. Dialyzer:________________________________
2. Vascular Access: ☐ Fistula ☐ Graft:
   Catheter: ☐ Internal Juguler ☐ Femoral ☐ Tunneled ☐ Non-tunneled Other:__________
3. Dialysate: K^+ ☐ 1 ☐ 2 ☐ 3 ☐ 4 mmol/L Ca^{++} ☐ 1.0 ☐ 1.25 ☐ 1.50 ☐ 1.75 mmol/L Other:__________
4. NA ________ Machine Temp:___________ BiCarb:________________
5. Hemodialysis time________hrs. Frequency __________
6. Heparin dose (IV): ☐ Loading ________________Units
   ☐ Infusion ________units/hr
7. ACT ☐ 100 - 150 ☐ 150 -250 Other:__________________________
8. Fluid removal: ____________L Target Weight:_________ kg
9. Blood Flow Rate:_________mL/min (Dialysis Disequilibrium)
10. ☐ First Dialysis bloodwork
11. ☐ Swab nares for Staphylococcus Aureus - for patients with central venous catheters
12. Medical Directives to be followed: ☐ Muscle Cramping ☐ Hypotension ☐ Oxygen ☐ Thrombolytics ☐ Local Anaesthetic ☐ Dry Weight
13. Medications:
   - ☐ Erythropoiesis Stimulating Agent__________ Dose_________ units
     Route: ☐ IV ☐ Subcut Frequency_________
   - ☐ Iron __________ Dose_________ mg Route: ☐ IV ☐ PO Frequency_________
     ☐ Vitamin Replacement__________________________
   - ☐ Acetaminophen 650 mg , PO every 4h PRN
   - ☐ Dimenhydrinate 25-50 mg IV every 4h PRN X 2
   - ☐ Close CVC line with:____
   - ☐ Other (please specify)____

Physician's Name	Physician's Signature	Date DD/MONTH/YYYY
Nurse's Name	Nurse's Signature:	Date DD/MONTH/YYYY

ch-0784 2013/11

Once a patient is established on hemodialysis, certain aspects of a patient's care become based on nursing assessments and judgements. Below is a list of the prescribed nephrologist orders for hemodialysis versus the nursing assessment/judgments that nurses can make based on patient assessment.

Hemodialysis Orders [Ordered by Nephrologist]	Nursing assessments/judgments [Can be implemented at nursing discretion]
- Treatment Time - Dry weight - Dialyzer - Heparin bolus/infusion - Machine temperature - Dialysate Bath - Bicarbonate - Medications - Sodium Profiling - Sodium	- Net fluid removal - Blood flow rates - The use of UF profiling - The use of BVM monitoring [advanced nursing skill] - The ability to administer or hold heparin

Figure 2.10: Differences in what dialysis prescriptions can and cannot be ordered by a nephrologist

Section 2.5

Dialysis Procedure 'Putting On' a Patient:

1] Once machine is ready gather appropriate supplies needed for patient's vascular access.

2] Do pre-assessment of patient [vital signs, respiratory assessment, and calculation of dry weight]

3] The Fresenius machine employs the use of Nephrocare. Nephrocare transmits patient information from a patient chip card to the hemodialysis machine. These values include: treatment time, dialyzer, heparin bolus/infusion, dialysate bath, bicarbonate, machine temperature, frequency of blood pressure monitoring, and sodium. The card does not transit UF goal, sodium or UF profiling, or Kt/V. Therefore, these parameters must be programmed in each treatment. This card must be inserted into the machine prior to the commencement of the patient treatment for the data to cross over. If there is an issue with Nephrocare, paper charting may need to be employed. There is a derived paper charting document that is used currently in critical care areas where patients are dialyzed that can be used if Nephrocare is down or if the patient card is not properly functioning (*see below for copy*). If there is no card or if another card needs to be made your unit will have trained Nephrocare Superusers whom can perform this. *When you commence work in your workplace identify who these people are*. If the card is not working all parameters need to be entered into the machine manually.

Eastern Health
Medicine Program

Treatment Record (Part I)

FS2870 1434 08 2016

Date: DD/MONTH/YYYY

HCN:

Date of Birth:

HD Orders		Age:	Height: cm
Machine Number:	Site:	Dialysate Flow:	
HDTime:	Start:	Finish:	
Dialyzer:	Acid K/Ca++:	Dialysate Temp:	
Bicarbonate (B):	Prescription Na:	Na Profile:	

Heparin Bolus Units:	Heparin Infusion Units/Hr:	Stop Time:	Low molecular weight Heparin:

Nursing Communications/ Reminders

Blood work:

Report Received From: Name:________________ Time:______ Department:____________

Pre Hemodialysis Assessment

Temperature:	Blood Pressure (BP)
Respirations:	Sitting:
Pulse:	Standing:
	Lying:

History of bleeding since last treatment: ☐ Yes ☐ No

Problem since last treatment: ☐ Yes ☐ No

Normal Fluid Assessment: ☐ Yes ☐ No (See Progress Notes)
BP, Heart Rate, Respiratory rate is within range expected for patients age and condition, No visible signs of respiratory distress noted or expressed by patient in normal breathing status, No evidence of dependant edema (peripheral, facial, sacral, periorbital)

Dry Weight:		Weight worked for:
Pre Weight:		☐ Increase ☐ Decrease
Weight worked for (1.5% - RN 1% - LPN)		☐ Too much fluid ☐ Patient under weight
Net Fluid: (12ml/kg/hr)		☐ See Progress Note
PO:		
Rinse:		
Reinfusion:		
Other:		Type:
Other:		Type:
Other:		Type:
Total:		Fluid Removal Programmed

Blood Volume Monitoring (BVM): +______/ -______

Max BVM Rate: Critical RBV:

Vascular Access

Central Venous Catheter (CVC)

Normal CVC Assessment: ☐ Yes ☐ No (See Progress Note)
CVC Dressing intact, Tegos intact, Clamps intact and working, No visible Dacron Cuff, No visible breaks in CVC integrity, No bleeding, redness, or drainage, both lumens aspirated and flushed easily.

Lumen (Venous)	Lumen (Arterial)	☐ Right ☐ Left

☐ Tunnelled ☐ Temporary ☐ Jugular ☐ Subclavian ☐ Femoral

Connected: ☐ Arterial - Arterial ☐ Venous - Arterial

CVC & Tegos **Day Due:** DD/MONTH/YYYY

Cleansed with:	Swab C&S: ☐ Yes ☐ No
Tegos Date Done: DD/MONTH/YYYY	Initials:
CVC Dressing Date Done: DD/MONTH/YYYY	Initials:

Arterio-Venous: (AV) Fistula / Graft

Normal Vascular Access Assessment: ☐ Yes ☐ No (See Progress Note)
No hematoma, bleeding, redness, hot, drainage, area punctures, large scabs, pain, swelling, numbness, cyanosis/hand pallor, breaks in skin/rash and shiny aneurysms.

AV Fistula: ☐ Brachial-Cephalic ☐ Radial-Cephalic ☐ Brachial-Basilic

AV Graft: Brachial-Cephalic: ☐ Loop ☐ Straight

Fermoral-Femoral: ☐ Loop

☐ Right ☐ Left Aneurysm Present: ☐ Yes ☐ No

Thrill Palpable: ☐ Yes ☐ No Bruit Heard: ☐ Yes ☐ No

Self-Cannulation: ☐ Yes ☐ No Difficulty Cannulation: ☐ Yes ☐ No

Arterial (ART): Needle Gauge/Length:__________
☐ Rope and Ladder ☐ Buttonhole/ Constant

Venous (VEN): Needle Gauge/ Length:__________
☐ Rope and Ladder ☐ Buttonhole/ Constant

Single Needle (SN) ☐ See Progress Note

Print Name:	Signature:	Initials:	Print Name:	Signature:	Initials:

Eastern Health

Vital Signs Record (Adult)

Name:

HCN:

Date of Birth:

Date: ___DD/MONTH/YYYY___

Year ______________ Month ______________

DATE		
TIME		
BP and Pulse	240	240
	220	220
	200	200
	180	180
	160	160
	140	140
	120	120
	100	100
BP •	80	80
Apical Pulse A	60	60
Pulse X	40	40
Pulse		
Respirations		
	40	40
	39	39
	38	38
TEMP. ●	37	37
	36	36
HT. ______	35	35
Temp < 35 - > 40		
Bowel Movement		
WEIGHT		

Ch0190 2015/01

Eastern Health
Medicine Program

Hemodialysis (HD) Downtime Treatment Record (Part II)

FS2870 1434 08 2016

Name:

HCN:

Date of Birth:

Date:______DD/MONTH/YYYY______ **Ultrafiltration (UF) Profile:**______________

Machine Values
Minimum standard : Every hour

Time										
Intravenous Fluids (IV)										
Blood Flow (QB)										
ART (mmHg)/ VEN (mmHg)	/	/	/	/	/	/	/	/	/	/
UF Rate (mL/hr)/ UF Vol (mL)	/	/	/	/	/	/	/	/	/	/
Prescription (Prescr.) Na/Bicarbonate	/	/	/	/	/	/	/	/	/	/
Temp/ Dialysate Flow (ml/min)	/	/	/	/	/	/	/	/	/	/
RBV %										
Heparin Rate (mL/hr)/ Cumulative Volume(mL)	/	/	/	/	/	/	/	/	/	/
Acid K/ Acid Ca++										
* Run Checks										
Initials										

** Run checks to include all above plus total fluid goal, net fluid goal, treatment time, blood levels, dialyzer, saline clamps and vascular access*

Glucometer		ACT		Recirculation Time:	Recirculation Time:
Time	Result	Time	Result	QB (ml/min) %	QB (ml/min) %
				Litres Processed (LP)	Final KT/V
				Initial HCT Value	Final HCT Value
				Initial Hb Value	Final Hb Value

Post Hemodialysis ☐ See Progress Note

Temperature	BP Siting	BP Standing	Lying	Pulse	Respirations

Post Vascular Access

Thrill Palpable: ☐Yes ☐No

Dressing: ☐Gauze ☐ Kling ☐Banaids ☐ Tip Stops
Other:

Hemostasis VEN: Minute
Hemostasis ART: Minute

Post Weight:
Net fluid Removal:

Re-transfusion: ☐ Clear ☐Streaked ☐Clotted

Discharge Summary: ☐Stable ☐Unstable

Mode: ☐ Ambulatory ☐Wheelchair ☐Walker ☐Stretcher

Report given to: Name: ______________________ Time:______Department:______________

Print Name:	Signature:	Initials:	Print Name:	Signature:	Initials:

Eastern Health

Progress Notes

Name:

HCN:

Date of Birth:

Discipline Codes

A - Audiology
AE - Adult Education
CK - Clinical Kinesiology
D - Dentistry
DT - Dietitian
MD -Medical
N - Nursing
OR - Orthotics
OT - Occupational Therapy
PC - Pastoral Care
PH - Pharmacy
PR - Prosthetics
PT - Physiotherapy
P - Psychology
RT - Respiratory Therapy
SLP- Speech Language
SW - Social Work
TR - Therapeutic Recreation

FS2870 1434 08 2016

Date/Discipline	Time	Focus	D = Data A = Action R = Response

Figure 2.11: Treatment Record

4] For AVF/AVG/BHAVF; cannulate as per policy and protocol.

See Vascular Access Module for more detail

- For CVC; access as per policy and protocol.

5] Stop the blood pump. Clamp 6 clamps [2 connected to the drain bag + 2 (1) arterial and (1) venous clamp of the blood lines + 2 normal saline].

6] Connect patient as per policy and protocol for AVF/AVG/BHAVF or CVC.

7] Unclamp 4 clamps [2 connected to the vascular access + 2 (1) arterial and (1) venous clamp of the blood lines.

8]Start the blood pump. Wait until message blood detected appears. Start treatment, repeat blood pressure, give heparin bolus, increase blood flow rate, and perform first run check.

Section 2.6

<u>Dialysis Procedure 'Taking Off' a Patient:</u>

1] When treatment time is complete message will appear treatment compete. Press start reinfusion. *Note: If a patient wants to end their hemodialysis treatment early, press reinfusion to and start if their treatment time is not completed.*

2] Clamp 2 arterial clamps [(1) blood lines + (1) on vascular access].

3] Disconnect arterial line from vascular access and connect arterial line to normal saline port. Note: If using a AVF/AVG/BHAVF attach a 10mL normal saline syringe to the arterial line of the vascular access and flush the remaining blood through the line (to prevent red blood cell loss).

4] Unclamp the arterial clamp of the blood line and open the normal saline roller clamp.

5] Start reinfusion.

6] 300mLs of normal saline is standard for a reinfusion. If no blood is detected prior to the 300mLs infusing there will be a message no blood detected. You can continue the reinfusion to 300mLs.

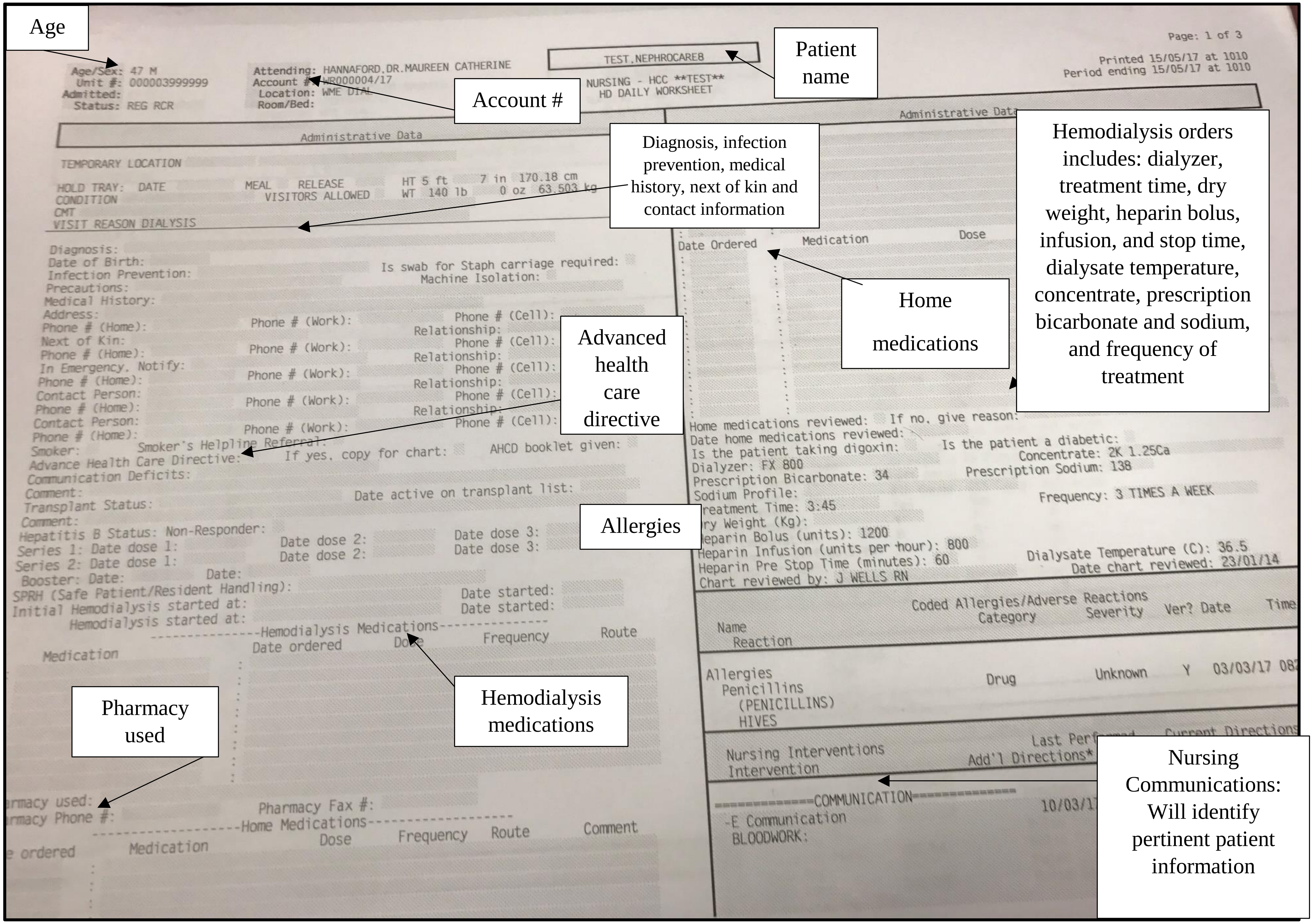
7] After reinfusion sit your patient up (legs down), readjust blood pressure cuff and get vital signs (sitting first then standing). Ask how the patient is feeling. If patient is feeling okay and if vital signs are stable the patient can be disconnected from the machine.

8] Clamp the 2 venous clamps [(1) blood lines +(1) on vascular access].

9] Disconnect venous blood line from the vascular access.

10] Remove needles and hold sites for hemostasis if using AVF/AVG/BHAVF, or if using CVC, close line as per policy. Save patient information.

Figure 2.12: Patient profile sheet and where to find essential hemodialysis information



Page: 1 of 3

Age/Sex: 47 M
Unit #: 000003999999
Admitted:
Status: REG RCR

Attending: HANNAFORD,DR.MAUREEN CATHERINE
Account #: WR000004/17
Location: WME DIAL
Room/Bed:

TEST,NEPHROCARE8

NURSING - HCC **TEST**
HD DAILY WORKSHEET

Printed 15/05/17 at 1010
Period ending 15/05/17 at 1010

Administrative Data

TEMPORARY LOCATION
HOLD TRAY: DATE MEAL RELEASE HT 5 ft 7 in 170.18 cm
CONDITION VISITORS ALLOWED WT 140 lb 0 oz 63.503 kg
CMT
VISIT REASON DIALYSIS

Diagnosis:
Date of Birth:
Infection Prevention: Is swab for Staph carriage required:
Precautions: Machine Isolation:
Medical History:
Address:
Phone # (Home): Phone # (Work): Phone # (Cell):
Next of Kin: Relationship:
Phone # (Home): Phone # (Work): Phone # (Cell):
In Emergency, Notify: Relationship:
Phone # (Home): Phone # (Work): Phone # (Cell):
Contact Person: Relationship:
Phone # (Home): Phone # (Work): Phone # (Cell):
Contact Person: Relationship:
Phone # (Home): Phone # (Work): Phone # (Cell):
Smoker: Smoker's Helpline Referral:
Advance Health Care Directive: If yes, copy for chart: AHCD booklet given:
Communication Deficits:
Comment:
Transplant Status: Date active on transplant list:
Comment:
Hepatitis B Status: Non-Responder:
Series 1: Date dose 1: Date dose 2: Date dose 3:
Series 2: Date dose 1: Date dose 2: Date dose 3:
Booster: Date: Date:
SPRH (Safe Patient/Resident Handling):
Initial Hemodialysis started at: Date started:
Hemodialysis started at: Date started:

--Hemodialysis Medications--
Medication | Date ordered | Dose | Frequency | Route

Pharmacy used:
Pharmacy Phone #: Pharmacy Fax #:

--Home Medications--
Date ordered | Medication | Dose | Frequency | Route | Comment

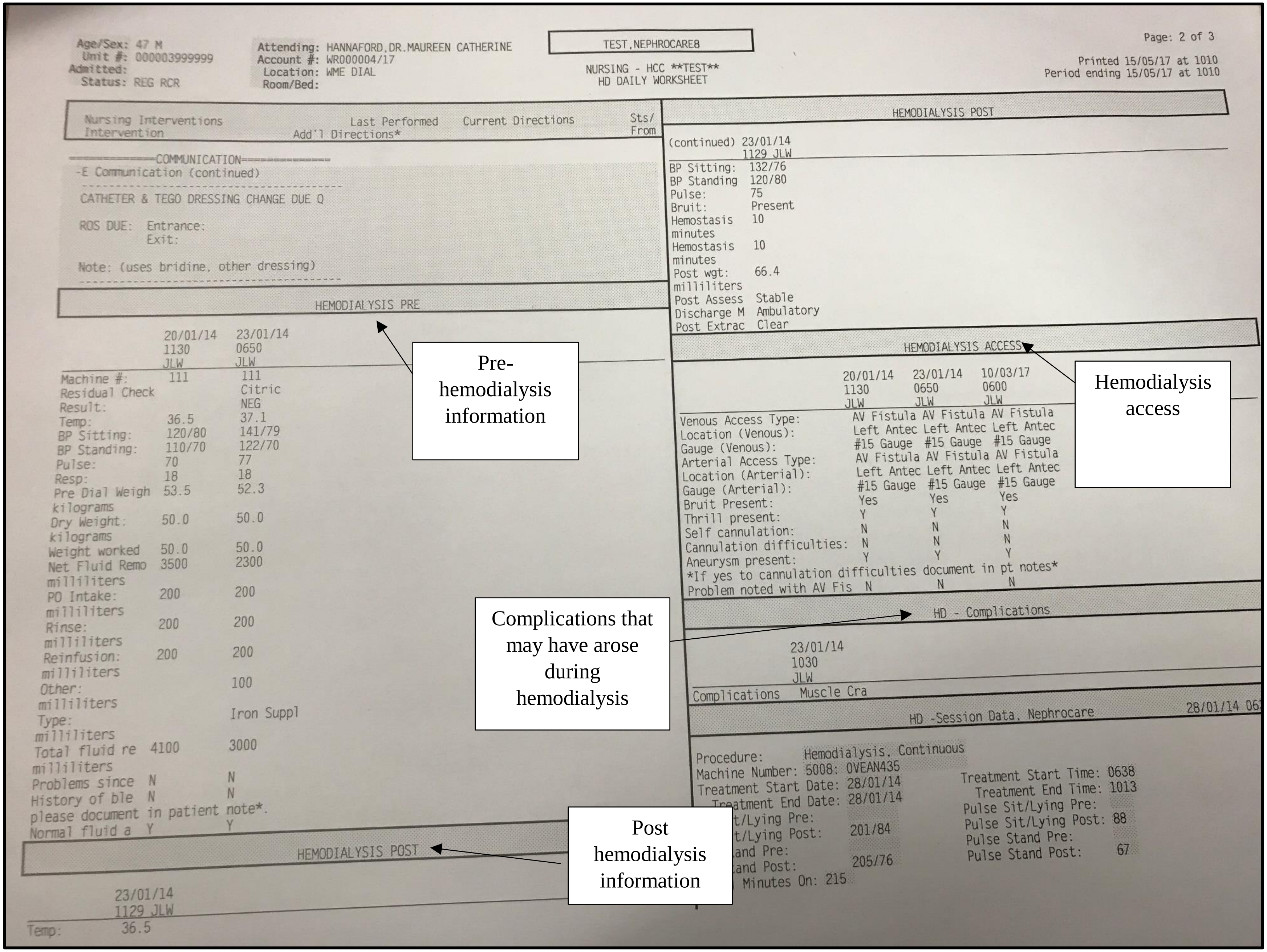
Administrative Data
Date Ordered | Medication | Dose

Home medications reviewed: If no, give reason:
Date home medications reviewed:
Is the patient taking digoxin: Is the patient a diabetic:
Dialyzer: FX 800 Concentrate: 2K 1.25Ca
Prescription Bicarbonate: 34 Prescription Sodium: 138
Sodium Profile:
Treatment Time: 3:45 Frequency: 3 TIMES A WEEK
Dry Weight (Kg):
Heparin Bolus (units): 1200
Heparin Infusion (units per hour): 800
Heparin Pre Stop Time (minutes): 60 Dialysate Temperature (C): 36.5
Chart reviewed by: J WELLS RN Date chart reviewed: 23/01/14

Coded Allergies/Adverse Reactions
Name | Category | Severity | Ver? | Date | Time
Reaction
Allergies
Penicillins (PENICILLINS) | Drug | Unknown | Y | 03/03/17 | 08
HIVES

Nursing Interventions | Last Performed | Current Directions
Intervention | Add'l Directions*

===COMMUNICATION===
-E Communication 10/03/1
BLOODWORK:



Age/Sex: 47 M
Unit #: 000003999999
Admitted:
Status: REG RCR

Attending: HANNAFORD,DR.MAUREEN CATHERINE
Account #: WR000004/17
Location: WME DIAL
Room/Bed:

TEST,NEPHROCARE8

NURSING - HCC **TEST**
HD DAILY WORKSHEET

Page: 2 of 3

Printed 15/05/17 at 1010
Period ending 15/05/17 at 1010

Nursing Interventions Intervention	Last Performed Add'l Directions*	Current Directions	Sts/ From

=============COMMUNICATION=============
-E Communication (continued)

CATHETER & TEGO DRESSING CHANGE DUE Q

ROS DUE: Entrance:
Exit:

Note: (uses bridine, other dressing)

HEMODIALYSIS PRE

	20/01/14 1130 JLW	23/01/14 0650 JLW
Machine #:	111	111
Residual Check		Citric
Result:		NEG
Temp:	36.5	37.1
BP Sitting:	120/80	141/79
BP Standing:	110/70	122/70
Pulse:	70	77
Resp:	18	18
Pre Dial Weigh kilograms	53.5	52.3
Dry Weight: kilograms	50.0	50.0
Weight worked	50.0	50.0
Net Fluid Remo milliliters	3500	2300
PO Intake: milliliters	200	200
Rinse: milliliters	200	200
Reinfusion: milliliters	200	200
Other: milliliters		100
Type: milliliters		Iron Suppl
Total fluid re milliliters	4100	3000
Problems since	N	N
History of ble	N	N
please document in patient note*.		
Normal fluid a	Y	Y

HEMODIALYSIS POST

	23/01/14 1129 JLW
Temp:	36.5

HEMODIALYSIS POST

(continued)	23/01/14 1129 JLW
BP Sitting:	132/76
BP Standing	120/80
Pulse:	75
Bruit:	Present
Hemostasis minutes	10
Hemostasis minutes	10
Post wgt: milliliters	66.4
Post Assess	Stable
Discharge M	Ambulatory
Post Extrac	Clear

HEMODIALYSIS ACCESS

	20/01/14 1130 JLW	23/01/14 0650 JLW	10/03/17 0600 JLW
Venous Access Type:	AV Fistula	AV Fistula	AV Fistula
Location (Venous):	Left Antec	Left Antec	Left Antec
Gauge (Venous):	#15 Gauge	#15 Gauge	#15 Gauge
Arterial Access Type:	AV Fistula	AV Fistula	AV Fistula
Location (Arterial):	Left Antec	Left Antec	Left Antec
Gauge (Arterial):	#15 Gauge	#15 Gauge	#15 Gauge
Bruit Present:	Yes	Yes	Yes
Thrill present:	Y	Y	Y
Self cannulation:	N	N	N
Cannulation difficulties:	N	N	N
Aneurysm present:	Y	Y	Y
If yes to cannulation difficulties document in pt notes			
Problem noted with AV Fis	N	N	N

HD - Complications

	23/01/14 1030 JLW
Complications	Muscle Cra

HD -Session Data, Nephrocare 28/01/14 06

Procedure: Hemodialysis, Continuous
Machine Number: 5008: OVEAN435
Treatment Start Date: 28/01/14
Treatment End Date: 28/01/14
t/Lying Pre:
t/Lying Post: 201/84
and Pre:
and Post: 205/76
Minutes On: 215

Treatment Start Time: 0638
Treatment End Time: 1013
Pulse Sit/Lying Pre:
Pulse Sit/Lying Post: 88
Pulse Stand Pre:
Pulse Stand Post: 67

Module 2 Evaluation

Hemodialysis Machine and Prescription

1. Putting a hemodialysis machine in T1 test involves __________________________.
   a) Connecting the dialyzer couplings
   b) Putting the machine in a rinse
   c) Putting the machine in dialysate bath and bicarbonate
   d) Turning on the machine

2. A rinse should be performed on the hemodialysis machine when_____________ (select all that apply).
   a) In between patient treatments
   b) After a blood leak
   c) After the machine tests positive for residual disinfectant
   d) At the beginning of the shift
   e) At the end of the shift

3. Which of the following cannot be done when a machine is in rinse mode?
   a) Placing the lines in the hemodialysis machine
   b) Priming the lines with normal saline
   c) Putting the machine in dialysate bath and bicarbonate
   d) Connecting the dialyzer couplings
   e) Connecting a patient to the hemodialysis machine

4. A heat disinfect is good for ____ hours if the machine has not been used on patients
   a) 48
   b) 24

c) 36
d) 72

5. The machine is put in a cold disinfect or degreasing ____ times a week
   a) One
   b) Two
   c) Three
   d) Four

6. Which of the following hemodialysis parameters will the nephrologist order on a patient that has been on hemodialysis for 1 year? Select all that apply
   a) Dialysate bath
   b) Treatment Time
   c) Blood flow rate
   d) Net fluid removal
   e) Dry weight
   f) Heparin bolus
   g) Cannulation sites
   h) UF Profiles
   i) BVM monitoring
   j) Dialyzer
   k) Na Profiles

7. Which of the following hemodialysis parameters will the nephrologist order on a patient that is having their first hemodialysis treatment? Select all that apply
   a) Dialysate bath
   b) Treatment Time

c) Blood flow rate
d) Net fluid removal
e) Dry weight
f) Heparin bolus
g) Cannulation sites
h) UF Profiles
i) BVM monitoring
j) Dialyzer
k) Na Profiles

8. Which of the following hemodialysis parameters will the nurse decide regarding a patient that has been on hemodialysis for one year? Select all that apply
   a) Dialysate bath
   b) Treatment Time
   c) Blood flow rate
   d) Net fluid removal
   e) Dry weight
   f) Holding heparin bolus
   g) Holding heparin infusion
   h) Cannulation sites
   i) UF Profiles
   j) BVM monitoring
   k) Dialyzer
   l) Na Profiles

9. When ‘putting on’ a patient how many clamps need to be clamped prior to putting a patient on hemodialysis?
   a) 5
   b) 6
   c) 4

d) 3
e) 2
f) 7

Module 3

Patient Assessment

Purpose: To outline the necessity and importance of the multiple patient assessments needed by nurses to provide effective hemodialysis.

Learning Objectives: After completing this module the learner will complete a post test that will measure the learner's ability to:

- Explain the various body systems that are effected by ESRD.
- Identify what a dry weight is.
- List the signs and symptoms of weight gain in ESRD.
- List the signs and symptoms of weight loss in ESRD.
- Employ the assessments needed pre, intra, and post hemodialysis.

Section 3.1

Patient assessment is vital for proper and effective hemodialysis. It is important to talk and listen to your patients concerns regarding: weight gain, bleeding, how they felt since last treatment, along with any other concerns they may have.

When a patient arrives, it is important that they obtain their weight. This weight is indicative of fluid gain. Every patient will have a nephrologist ordered dry weight. The dry weight is measured in kilograms.

1.0 kg = 2.2 lbs.

The dry weight is the patients normal weight when there is no extra fluid in their body. With ESRD the ability to remove excess fluid from urinary output is non-existent, or inadequate to maintain homeostasis. Without the ability to remove the fluid that accumulates in the body from eating and drinking, this fluid will continue to build and build. The dry weight is used for the RN and LPN as an indicator of how much fluid a patient has on in between dialysis treatments. Due to other co-contributing factors, the dry weight may fluctuate in between treatments. Therefore, it is important for good assessment skills, in addition with collaboration with the patient whom may have helpful insight as to why their dry weight is increasing or decreasing.

Important: It is important to note that once patients initially start hemodialysis it is not uncommon for patients to gain body weight. Once hemodialysis starts, patients typically report feeling better along with increased energy and appetite. Therefore, in this target patient population, it is important to determine if weight gains are contributed to fluid gain, weight gain, or a combination of both.

<u>Calculation of dry weight:</u>

<u>Adjustment of the Dry Weight Medical Directive:</u>

There is a medical directive for hemodialysis patients regarding the adjustment of their dry weight.

<u>**Inclusion Criteria:**</u> All hemodialysis patients with an ordered dry weight with predicted outcomes.

<u>**Exclusion Criteria:**</u> Hemodialysis patients without an ordered dry weight or a patient with unpredicted outcomes.

The directive states that the RN (after successfully competing hemodialysis orientation) can adjust the patient's dry weight by +/- 1.5% of the ordered dry weight based on clinical assessment. This adjustment can be done twice and then consultation with a nephrologist is necessary.

The directive states that the LPN (after successfully competing hemodialysis orientation) can adjust the patient's dry weight by +/- 1.0% of the ordered dry weight based on clinical assessment. This adjustment can be done twice and then consultation with a nephrologist is necessary.

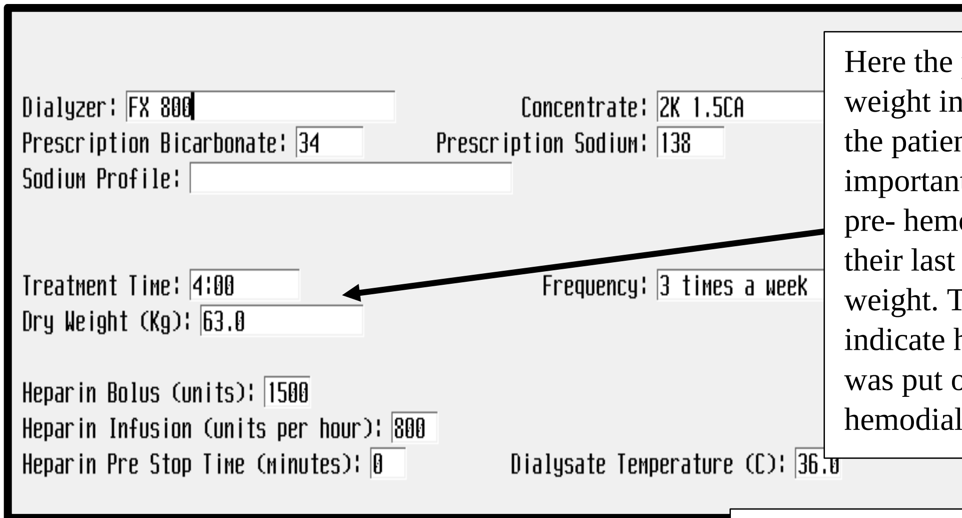
Example: A patient with an ordered dry weight of 60kg arrives to the unit. What is the range of fluid removal that a RN and a LPN can adjust this patient's weight?

RN	**LPN**
Dry weight 60 kg	Dry weight 60 kg
60 x 1.5/100 = 0.9	60 x 1.0/100= 0.6
60 – 0.9 = 59.1	60 – 0.6 = 59.4
60 + 0.9 = 60.9	60 + 0.6 = 60.6
RN can adjust weight between 59.1-60.9	LPN can adjust weight between 59.4-60.6
If clinical assessment shows that the patient needs more of a deviation from these parameters due to fluid gain or depletion a nephrologist must be contacted surrounding theses parameters.	

This medical directive can be found under Eastern Health's Intranet entitled: Dialysis Medical Directive. Adjustment of the dry weight of the hemodialysis patient. 210G-MDI-070

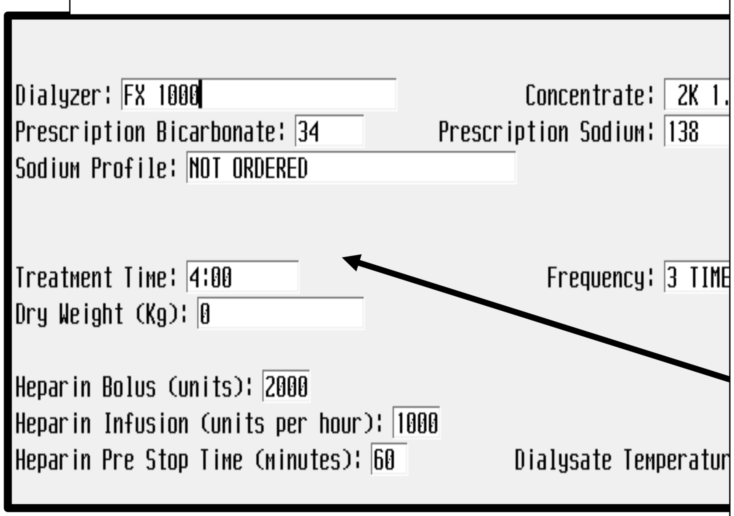
Figure 3.1: Dry weight calculation of the RN versus the LPN

The prescribed dry weight can be found under the admin data in Meditech.



Here the prescribed dry weight in kg is 63.0. When the patient arrives, it is important to compare their pre- hemodialysis weight to their last post hemodialysis weight. This difference will indicate how much weight was put on intra hemodialysis treatments.

<u>Figure 3.2:</u> Dry weight calculation



Here the prescribed dry weight in kg is 0.0 Kg. This can be indicative of a couple of things:

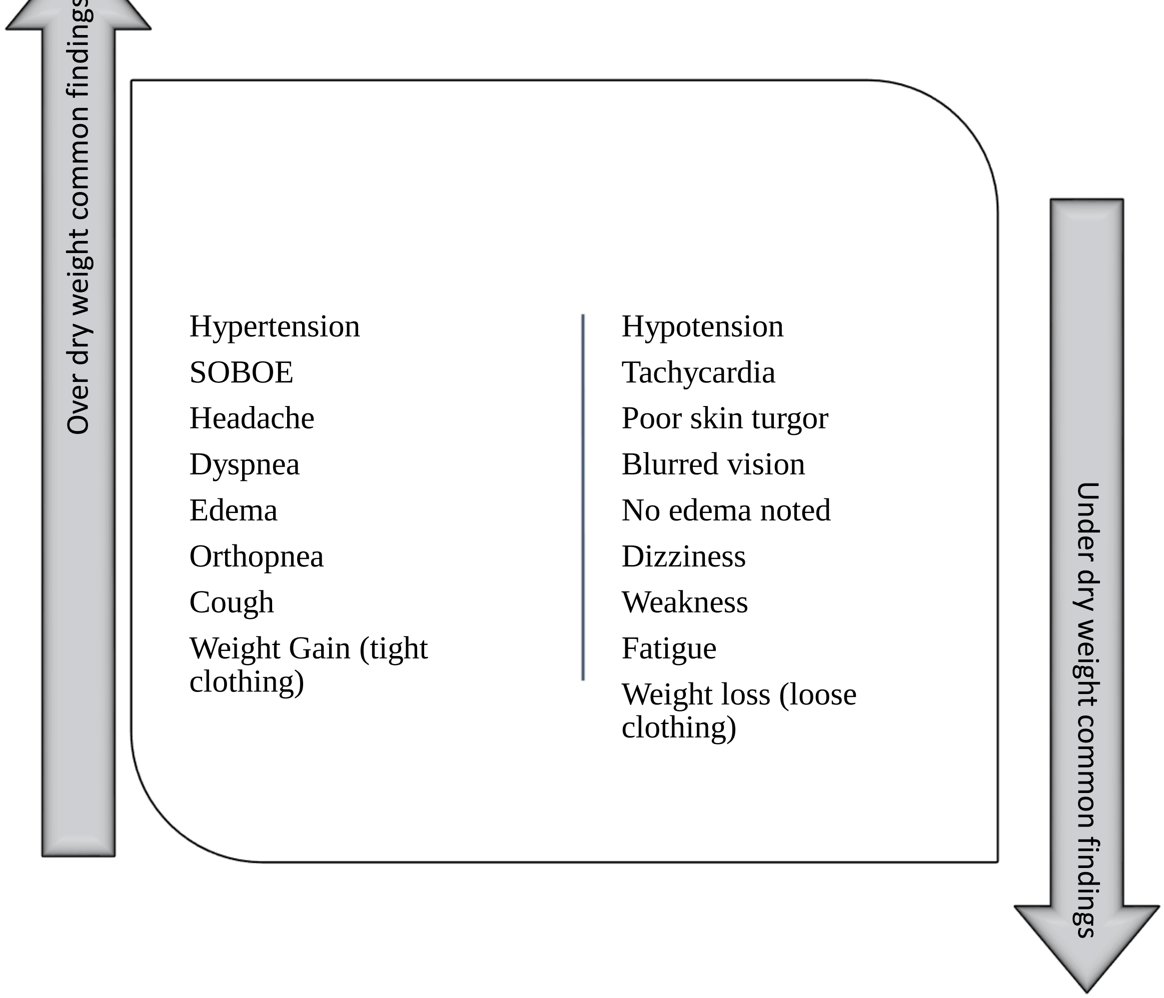
1. The patient is ordered No fluid removal (this patient would still have urinary output).
2. The patient is working towards or working on a new dry weight. In patients where we do not know where their dry weight should be, the nephrologist will sometimes order no dry weight and will order fluid removal until patient is symptomatic of reaching their dry weight.

Deviations from this dry weight may be indicative of other co-contributing conditions such as:

- Weight gain
- Weight loss
- Decrease in appetite

- Increase in appetite
- Constipation
- Diarrhea
- Increase in urinary output
- Decrease in urinary output
- Increase in the weight of clothing worn whilst weighing
- Decrease in the weight of clothing worn whilst weighing
- Weight scale malfunction
- Improper use of the scale (for example not zeroed prior to obtaining weight)

Figure 3.3: Signs and symptoms of patients not at dry weight (over and under)



Knowing what to work a patient for is one of the most common difficulties expressed by new nephrology nurses. Below is an algorithm that can help in the decision-making process. Note: If ever in doubt ask for assistance from a senior nurse.

<u>Figure 3.4:</u> Dry weight calculation flowsheet

Dry weight Assessment (kg)

Typical fluid gains for the patient? Main goal is typical fluid gains for each patient.

Normal fluid assessment (typical for patient)?

Yes

Work for dry weight (in kg)

Higher than the typical fluid gains for the patient?

Observe patient reweighing to ensure accuracy

Is weight accurate?

√ for extra clothing, shoes, wallets, etc.

No

Reassess dry weight

Yes

Patient assessment.

Does the patient appear to have excess fluid on?

Common S&S are:

-Hypertension

-Crackles, ↓ed air entry (lung fields)

-SOBOE

-Headache

-Dyspnea

-Edema

-Orthopnea

<u>Ask: Why is patient weight higher than normal?</u>

-Are they gaining weight?

-Does the weight need to be reassessed?

-Has their urinary output decreased?

- Are they constipated?

-Are they overdrinking?

-Are they overeating?

-Do they need an extra treatment to get fluid off as they cannot take too much off each treatment? [Needs to be ordered by a nephrologist]

Lower than the typical fluid gains for the patient?

Observe patient reweighing to ensure accuracy

Is weight accurate?

Yes

Patient assessment.

Does the patient appear to have no/less fluid on?

Common S&S are:

-Hypotension

-Tachycardia

-Poor skin turgor

-Blurred vision

-No edema

-Dizziness

-Weakness/ fatigue

<u>Ask: Why is patient weight lower than normal?</u>

-Are they unwell (not eating and or not drinking)?

-Are they losing weight (trying to lose weight? Illness? Diet?)

No

Reassess dry weight

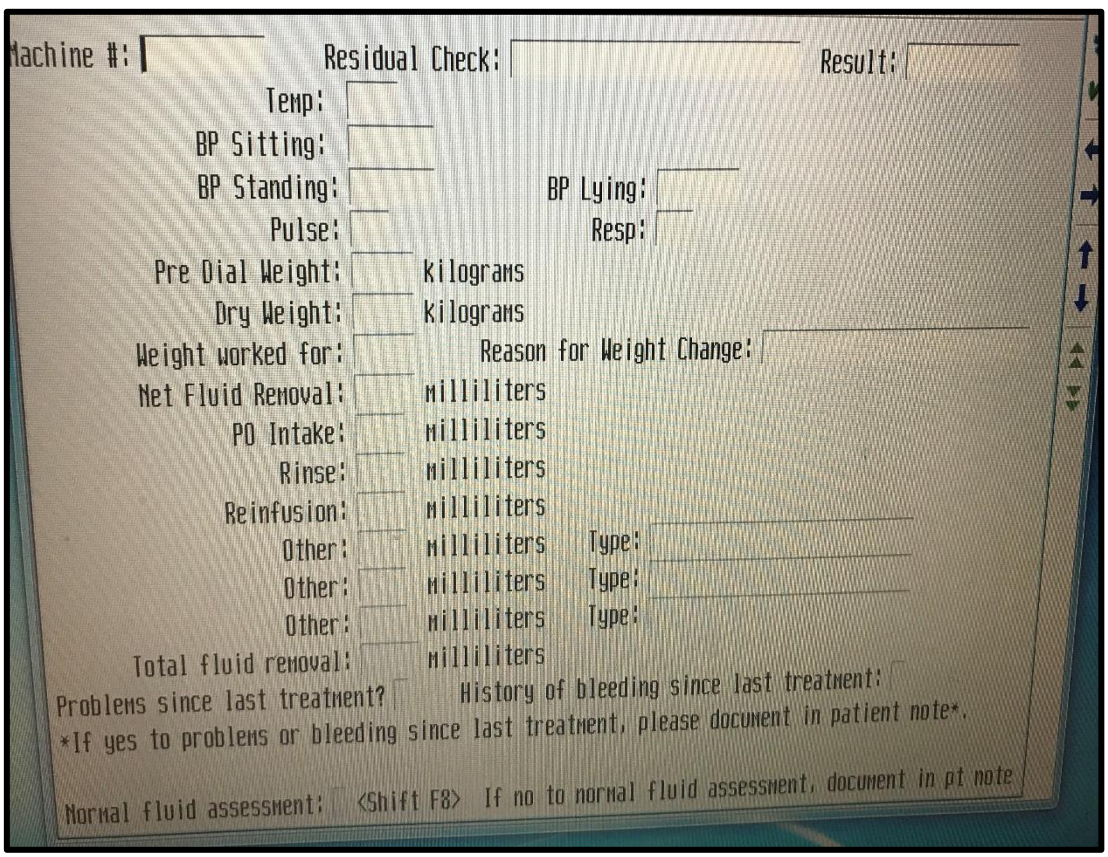
Section 3.2

<u>Net Fluid Removal</u>

After calculating what weight to work a patient for it is important to check to ensure that the amount follows the maximum ultrafiltration formula. The nephrologists of Eastern Health have determined the maximum amount of fluid they believe is safe for a patient to take off each treatment. The net fluid removal is the amount of fluid that is targeted from the patient. It does not include volume calculated from other sources.

When calculating a patient's weight the total weight will be the net fluid removal (from the patient) + 200mLs of prime (for the normal saline that is infused in the beginning of the treatment) + 200mLs of reinfusion (for the normal saline that is reinfused to washback/reinfuse the blood at the end of the treatment) + po intake (if the patient decides to have a drink on the machine) + if there are any antibiotics, blood products, normal saline, etc. *Basically, whatever we give we want to take back.*

Fluid Removal:



<u>Figure 3.5:</u> Net fluid removal

The maximum ultrafiltration amount is 12mL/hours x the treatment time x kg of the patient (dry weight OR weight worked)

For example. For a 60kg patient prescribed a 3:30 hour treatment time, the maximum ultrafiltration would be:

$$12\frac{ml}{hour} \times 60kg \times 3.5\ hours$$

$$=$$

$$12\frac{ml}{\cancel{hour}} \times 60kg \times 3.5\ \cancel{hours}$$

$$=$$

<u>2520 mLs net fluid removal</u>

If the patient shows indications of having more fluid on than what we can remove from the RN 1.5% +/- the dry weight, the LPN 1.0% +/- the dry weight, and/or the net fluid removal equation you must contact the nephrologist. These calculations are used as <u>guidelines</u> for dry weight calculation and fluid removal. We do not want to leave +++ excess fluid on a patient. Therefore, if the patient presents with S&S of fluid overload that is outside the guideline parameters, contact the nephrologist for orders on what to do. The nephrologist can decide if they want to order more fluid removal, increase treatment time, or order an extra treatment to remove the excess fluid.

Section 3.3

<u>Patient Assessment:</u>

The RN/LPN assigned to the patient is responsible for conducting the necessary assessments necessary to provide a safe and effective hemodialysis treatment. Patient assessment occurs in three stages:

1] Pre-dialysis.

2] Intra-dialysis.

3] Post-dialysis.

These assessments include:

-Vital Signs Monitoring

- Pre-Hemodialysis Vital Signs:

Prior to calculating a patient's weight worked and commencing hemodialysis, vital signs should be obtained. Vital signs important to record on these patients include:

-Temperature: Important indicator of infection if febrile.

- Blood Pressure and pulse x 2. The patient is required to complete *first* a sitting blood pressure **then** *second* a standing blood pressure. This blood pressure is a good indicator of how a patient's blood pressure will fluctuate when going from a sitting to standing position. This is important because post hemodialysis when a patient's blood is reinfused (washed back), the patient will perform first a sitting then a standing blood pressure.

  -Respiratory Rate: This rate is a good indicator of fluid status.
- Intra-Hemodialysis Vital Signs:

  -It is a minimum requirement that vital signs be taken and monitored every 30 minutes. Vital signs are an important indicator of fluid status and how well a patient is tolerating the treatment.
- Post-Hemodialysis:

  After hemodialysis is complete, post hemodialysis vital signs are important as a sign of patient well-being. Temperature can be obtained within the last 30 minutes of treatment. Elsewise, the patient is required to do a sitting and *then* a standing blood pressure. It is important to do a standing blood pressure especially if the patient is walking and/or driving as orthostatic hypotension and hypotensive episodes are common post hemodialysis. If a patient is hypotensive it is important to correct the hypotension prior to disconnecting the patient from the machine to ensure patient well-being.
- Fluid Assessment
- Dry weight calculation (as above).
- Edema: (Sinha & Rajiv, 2009).

  Assess for pitting edema by pressing firmly on the tibia-shin for 5 seconds. The depth of the depression indicates the amount of fluid and can range from 1 + to 4 +. The greater the depression, the more fluid a patient is carrying.

  Important to Note: Although typically a patient will carry excess fluid on their extremities, other usual places where patients will carry their fluid is in

Figure 3.7: Assessing for pitting edema

their lungs, and in the periorbital area (Rahgoshai, Rahgoshai, Khosraviani, Nasiri, & Solouki, 2010).

- Respiratory assessment (SOB, SOBOE, auscultate lung sounds).
- Vital Signs monitoring (as above).
- Vascular Access Assessment (See Vascular Access Assessment module)
- Renal System: It is important to always assess urinary output with the patient. At first, most patient's with ESRD will have urine output. This output will generally decrease with time, therefore to ensure to prevent inaccurate dry weight calculations it is important to assess for volume and frequency of urinary output.
- Integumentary System:

  The kidneys excrete a pigment responsible for skin color. This is important to assess in patients.

  Since diabetes is a predisposing contributing factor for ESRD, it is important to assess for wounds, and compromised skin integrity.

  If patients exhibit hyperphosphatemia, crystals deposit in the skin causing sever itchiness.
- Muscoskeletal System:

  Assess for bone/joint pain (calcium and phosphorous imbalances/ increased parathyroid hormone, or gout from increased uric acid).
- Coping Ability: Patients with ESRD face difficulty with coping with their diagnosis and with the transition to hemodialysis (Gill, Rose, Pereira & Tonelli, 2007; Keshin & Engin, 2011). Once hemodialysis is initiated, patients self-reported high rates of both depression and suicidal ideation, related to the inability to cope with the immense amount of change and barriers faced medically, socially, and economically (Keshin & Engin, 2011). In the reviewed literature, the most thematic barriers to coping for ESRD patients included: lack of social support, increased stressors, loss of control, psychological impact of being on hemodialysis as a palliative life sustaining measure, and lack of knowledge (Hardwood et al., 2005; Martchev, 2008).

  Stressors experienced include:

  1.Physiological Stressors: Fatigue, muscle cramps, pruritus, restless legs.
  2.Psychosocial Stressors: Role change, financial concerns.
  3.Lifestyle Changes: Restrictions (activity, fluid, dietary).
  4.Medication Changes: Strick compliance with medication regime.
- Nasal Swab: (if required). A nasal swab for staphylococcus aureus is due q 6 weeks (with bloodwork regime) for patients that are not being treated and have:
    - A button hole arteriovenous fistula.
    - A central venous catheter

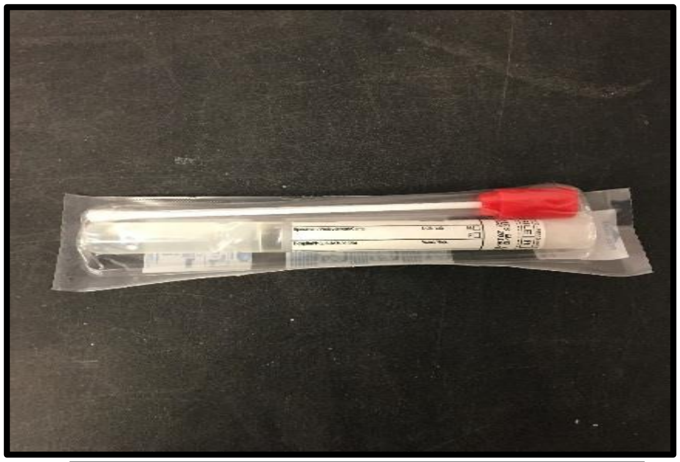


Figure 3.8: Culture swab used for staphylococcus aureus

The swab involves swabbing both nares of the patient with the above vascular access to test for the presence of staphylococcus aureus. Generally, staphylococcus aureus is unharmful to the general population. Due to the increased infection rates of the central venous catheter and button hole arteriovenous fistula however, untreated staphylococcus aureus can cause bacteremia, endocarditis or osteomyelitis (Centers for Disease Control and Prevention, 2011).

If staphylococcus aureus is present, the patient will be treated with a nasal ointment (mupirocin) 5 days a month. Once the patient is treated, the need for repeated swabs is unnecessary if the patient continues the monthly regime. Therefore, only patients that are not being treated are swabbed. Once a patient is identified as a carrier, they will be treated and no longer swabbed (Van Rijen, Bonten, Wenzek, & Klutmans, 2010).

- Bloodwork (if required)

Laboratory monitoring in the hemodialysis population is important for accurate assessment of hemodialysis efficacy and patient well-being. Unless otherwise indicated after initially starting hemodialysis a patient will have standard bloodwork drawn every 6 weeks. Otherwise, bloodwork will be completed quarterly and yearly. The nephrologist and clinical pharmacist will monitor bloodwork results.

<u>Bloodwork Regime:</u>

Initial Hemodialysis (New Start)	Every 6 weeks	Quarterly	Annually
Complete Blood Count (CBC): **<u>Includes:</u>** • Leukocytes • Erythrocytes • Hemoglobin • Hematocrit • Mean Corpuscular Volume	CBC	Digoxin (for patients prescribed digoxin)	Hepatitis B Screen **<u>Includes:</u>** • Hepatitis B Surface Antigen • Antibody to Hepatitis B Surface Antigen

• Mean Corpuscular Hemoglobin • Red Blood Cell Distribution Width • Mean Platelet Volume • Differential lymphocytes, monocytes, neutrophils, eosinophil, basophil			• Antibody to Hepatitis B Core Antigen
Renal Screen **<u>Includes:</u>** • Urea • Sodium • Potassium • Chloride • CO2 • Glucose • Creatinine • eGFR • Aspartate Aminotransferase • Alanine Transaminase • Inorganic Phosphorus • Calcium • Total Protein • Albumin	Renal Screen	Glycosylated Hemoglobin (HbA1C) [for diabetic patients]	Hepatitis C Screen **<u>Includes:</u>** • Antibody to Hepatitis C Virus
Hepatitis B Screen **<u>Includes:</u>** • Hepatitis B Surface Antigen • Antibody to Hepatitis B Surface Antigen • Antibody to Hepatitis B Core Antigen	Transferrin Saturation	Ferritin	

Hepatitis C Screen **Includes:** • Antibody to Hepatitis C Virus	Nasal Swab (to test for staphylococcus aureus on all patients being dialyzed via CVC or BHAVF).		
Transferrin Saturation			
Parathyroid Hormone			
Nasal Swab (to test for staphylococcus aureus on all patients being dialyzed via CVC or BHAVF).			

Figure 3.9: Bloodwork Regime

- Important Laboratory Values: (Lancaster, 2011).

Although all diagnostic tests that are performed are important, there are specific laboratory values that are monitored in those afflicted with ESRD. These include:

Urea- Urea is a product of protein breakdown that is typically excreted by the kidneys. In those with ESRD, urea is not easily excreted and a patient will depend upon hemodialysis for excretion. A high blood urea nitrogen implies that a patient is not receiving enough hemodialysis to clear the urea in the blood.

Creatinine- A product of muscle breakdown in the body. Increased creatinine is seen with progressing levels of ESRD and inadequate hemodialysis.

Hemoglobin- Patients with ESRD have less of an ability to make red blood cells due to the lack of erythropoietin. Low hemoglobin levels will indicate if patients need an increase in medication dosage, frequency, or both, and if a blood transfusion is needed to replace blood volume.

Potassium- Potassium levels are monitored to ensure the patient is not hypo or hyperkalemic. A patient may be hypokalemic if +++ nausea and vomiting or hyperkalemic if consuming a diet high in potassium. Both hypo and hyperkalemia can cause fatal abnormities in heart rhythms.

Calcium & Phosphorous- Both are monitored as they play a role in the secretion of PTH hormone. Compliance plays a role in high phosphorus levels and in taking prescribed phosphate binders with meals.

Parathyroid Hormone- Parathyroid hormone (PTH) begins to increase with ESRD. With ESRD progression or non-compliance, vitamin D and calcium decrease, allowing for leaching of calcium from the bones to compensate for low plasma levels, increasing secretion of PTH. Often, patients must have a parathyroidectomy (removal of parathyroid glands) for ESRD secondary hyperparathyroidism (Passalidou & Karapavlidou, 2010).

Transferrin Saturation & Ferritin: (National Kidney Foundation, 2015).

- Iron is needed to make red blood cells. Most ESRD patients are anemic and need help to maintain iron store levels.

-Transferrin Saturation (TSAT) measures how much stored iron can be used to make red blood cells. TSAT should be at 20%.

-Ferritin measures how much iron is stored in the body. The ferritin level should be at 200mg/mL.

- Medication Reconciliation: "The process of creating the most accurate list possible of all medications a patient is taking- including drug name, dosage, frequency, and route- and comparing that list against the physician's admission, transfer, and/or discharge orders, with the goal of providing correct medications to the patient at all transition points within the hospital" (Patricia & Foote, 2016, p.1). It is often difficult to keep track of a hemodialysis patient's medications as often they will have multiple doctors (nephrologist + family doctor + specialists). Due to the multiple doctors in the patient's care it is important to maintain accurate medication records. At the beginning of each month, the patients are asked to do a "brown bag review" whereby they bring in all medications (prescribed and over the counter) that they are currently taking. Once the medications are brought in, it is important to ask the patients how they are taking the medication (what dose, how often, what times) to ensure the most detailed list possible. This list then should be updated and any concerns addressed to the clinical pharmacist and/or nephrologist.

- Hemodialysis Adequacy:

The adequacy of a hemodialysis patient is measured using the online clearance monitoring (OCM) to calculate the Kt/V. A quantitate empirically-derived equation, when calculated, the Kt/V will determine if the dialysis; frequency, and adequacy are appropriate (Sternby & Daugirdas, 2015). Although the hemodialysis Fresenius 5008

Machine does all the mathematical calculations it is important to understand what factors affect the Kt/V (Alayoud et al., 2012).

Calculation Broken Down:

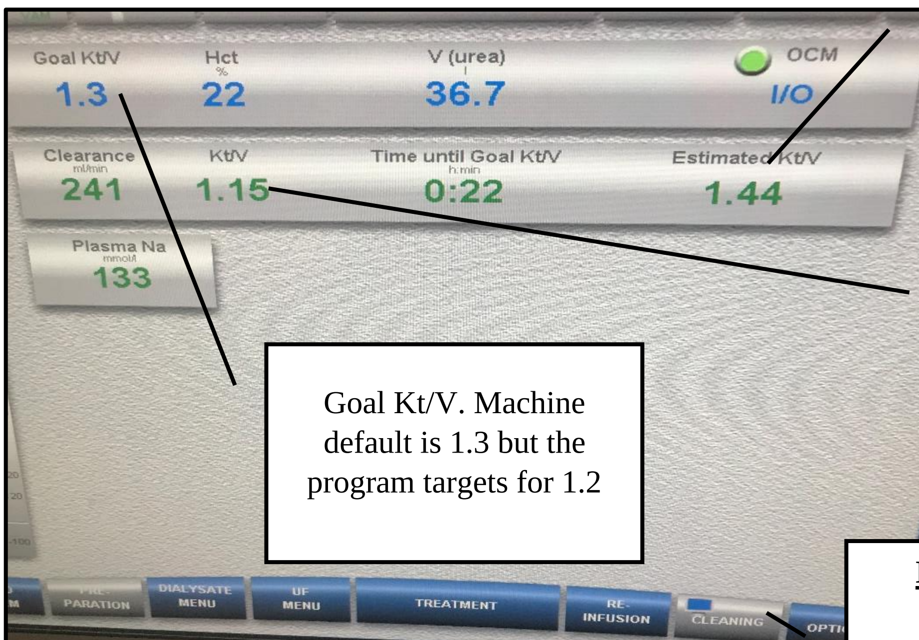
Kt/V

K: Dialyzer urea clearance (mL/min)

t: Length of treatment (minutes)

v: volume of urea (calculated as the difference in the measured pre-urea (beginning of the treatment) versus the post urea (end of the treatment)).

When programmed into the Fresenius 5008 Machine, a Kt/V will be produced.



This is the estimated Kt/V that will be achieved if the patient does their full treatment time

This is the current Kt/V. The machine tells us that this will be achieved in 22 minutes of treatment time despite the patient having 60 minutes of treatment time left.

Goal Kt/V. Machine default is 1.3 but the program targets for 1.2

Figure 3.10: Calculating Kt/V

How to program the Kt/V parameters.

-Press options

-Press OCM

- Press volume unknown

-Press calculate

-Enter patient's age, gender, height (in meters) and weight (in kg)

The goal is to achieve a Kt/V of 1.2. The machine will calculate a current Kt/V and an estimated Kt/V. The Kt/V that is shown above is the current Kt/V if the patient were to terminate the treatment. It shows that the patient will achieve this goal in another 22 minutes of hemodialysis treatment. Despite this, the patient has another 60 minutes left of hemodialysis treatment, therefore their end Kt/V is estimated to be 1.44.

According the National Kidney Foundation (2001), the minimum Kt/V of a dialysis treatment should be 1.2 although K/DOQI recommends that the prescribed dose should be 1.3. Our current program protocol is to target a minimum of 1.2.

There are three ways in which the Kt/V can be increased. This can be achieved by manipulating the variables responsible in the calculation. To increase a patient's Kt/V:

- Increase treatment time (Needs to be ordered by a nephrologist).
- Increase the surface area of the dialyzer (Needs to be ordered by a nephrologist).
- Increase the amount of blood being processed by increasing the blood flow rate (if the vascular access will allow).

What is required pre, intra, and post dialysis? Brief outlay of nursing responsibility

	Pre-Dialysis	**Intra-Dialysis**	**Post-Dialysis**
Vital Signs	-Temperature. -Blood pressure (standing then sitting). -Respiratory Rate. -Pulse.	**<u>FREQUENCY:</u>** vital signs at a minimum should be taken every 30 minutes (they can be taken more frequently if indicated).	-Temperature (can be taken in the last 30 minutes). -Blood pressure (sitting then standing). -Pulse. -Respiratory Rate.
Patient Assessment	-Weight calculation. -Respiratory status. -Edema. -Any bleeding? -Ask if any patient concerns?	Monitor for V/S, and patient reports of subjective well-being.	Ensure patient feels okay and is stable before disconnecting patient from the machine. -Get patient's post hemodialysis weight (If patient weight discrepancy noted (for example if patient +++ over weight, have doctor assess to determine need for extra treatment).

				If patient is over or under the weight worked by more than 500mLs a note needs to be written.	
Vascular Access	CVC -Check TEGO®. -Check dressing. -Change TEGO® if indicated. -Monitor for S&S of infection.	AVF/AVG -Check for bruit. -Check for thrill. -Monitor for S&S of infection.	Vascular access should be checked with the run check every 30 minutes. -Check to ensure needles are still taped and secure. -Check to ensure blood lines are still connected to CVC.	CVC -Close line with ordered anti - thrombolytic. -Ensure dressing is intact. -Ensure TEGOs® are on tight. -Ensure CVC clamps are closed.	AVF/AVG -Check for bruit. -Check for thrill. -Ensure hemostasis is achieved.
Hemostasis				Typically, an AVF/AVG/BHAVF needs to be held for 10 minutes to achieve hemostasis. After 10 minutes, check the sites to ensure that bleeding has stopped.	
Machine Monitoring	-Machine to be set up as per policy. Check all parameters prior to connecting patient.		**<u>FREQUENCY:</u>** Every 60 minutes a "run check" is needed ***<u>Included in the run check is:</u>*** -Blood flow rate -ART pressure -Venous pressure -UF Rate -UF Volume -Prescription Na -Prescription bicarbonate -Temperature -Dialysate flow -Heparin rate	Blood lines of machine to be removed post dialysis as per policy. If reusing machine for another patient a rinse cycle needs to be performed. If at the end of the night; a heat disinfection or a degreasing/cold disinfection needs to be performed (depending on unit protocol). Typically, there is one degreasing/cold disinfection per week (Tuesday).	

		-Heparin cumulative volume -Dialysate bath -Weight worked -Vitals (blood pressure & pulse; to be done q 30 minutes minimum) -Vascular access *** Recirculation to be checked after first 30 minutes once patient is connected.*	
Kt/V	Program Kt/V in the machine prior to starting the treatment.	Monitor the estimated Kt/V with the run checks. If estimated not equal to or greater than ≥1.2 try to increase Kt/V.	-Check Kt/V at end of hemodialysis treatment. Goal: 1.2.
Nephrocare	Ensure card is in and reading.		Ensure to save patient information.

Figure 3.11: Pre, intra, and post hemodialysis nursing responsibilities

- Once every 6 weeks, when bloodwork results are returned, interdisciplinary rounds will be completed on the patient. Below is a checklist of what to assess on assigned patients.

<table>
<tr>
<td>Patient Name:
________</td>
<td><u>Patient Education</u>
□When did patient start hemodialysis?
____
Patient education needed surrounding?
□ PRI
□ Nutrition
□ Fluid monitoring
□ Medications
□ Access</td>
<td rowspan="2"><u>Vascular Access</u>
□ AVF
□ AVG
□ Cannulation Issues?
□ Rotating Sites?
□ Swelling/ bruising of access
□ Have the arterial or venous pressures increased in the past month?
□ Infections?
□ Hemostasis time? ________
Has this increased? □ Yes
□ No
□BHAVF
□ Cannulation Issues?
□ Swelling/ bruising of access
□ Have the arterial or venous pressures increased in the past month?
□ Infections?
□ Swab for staph carriage needed?
□ If positive are they being treated?
□ Hemostasis time? ________
Has this increased? □ Yes
□ No
□ CVC
□ Swab for staph carriage needed?
□ If positive are they being treated?
□ Infections?
□ Trouble with CVC?
□ Cathflo® Protocol used?
□ Cathflo® used to close?

□ Average recirculation?
____
□ Average blood flow?
________</td>
<td><u>Dialysis Adequacy</u>
□Kt/V
□Less than 1.2
□ More than 1.2

□ Is this value ↑ or ↓from last month</td>
</tr>
<tr>
<td><u>Transplant Status</u>
□Assessing
□ Not a candidate
□ Active
□Unknown
□ Update in Admin data

________</td>
<td><u>Dry Weight/ Fluid Control</u>
□ Patient getting to prescribed dry weight?
□ Yes
□ No
□ Weight gain removed each treatment? ______
□ New dry weight needed?
□ Yes
□ No
<u>□ Systolic BP</u>
□ greater than 160 mm/Hg post dialysis?
□ less than 160 mm/Hg post dialysis?

<u>□Diastolic BP</u>
□ greater than 160 mm/Hg post dialysis?
□ less than 160 mm/Hg post dialysis?</td>
<td><u>Current Dialysis Prescription</u>
□ Treatment Time? _____
□Bath? _____
□ Heparin bolus? ______
□ Heparin infusion? _____
□ Stop time __

<u>Medication Review Complete?</u>
□ Yes
□ No (why not)?
____
Chart Review Complete?
□ Yes
□ No (why not)?
________</td>
</tr>
</table>

Figure 3.12:

Interdisciplinary Rounds Checklist

- <u>Documentation:</u> Adequate documentation is necessary as it plays an integral part in providing quality patient care.

	<u>Pre-Hemodialysis</u>	<u>Intra Hemodialysis</u>	<u>Post Hemodialysis</u>
For **<u>ALL</u>** patients, the following should be charted	1] E -Communication 2] HD Access 3] HD Pre-HD 4] HD Run Check	1] HD Run Check [Every hour]	1]HD Post HD 2]HD Kt/V
On an individualized treatment basis, the following may need to be charted:	• HD Connector-Tego Change [If Tego change due] • HD Catheter Flow Problems/Actions [If CVC needed to be reversed or if catheter flow is sluggish and Cathflo® protocol needs to be employed] • HD Secondary Access [If patient has secondary access (for example a new AVF) you will chart on that access even if cannulation has not started]	• E Glucometer Reading (Dialysis) [For diabetic patients]. • HD Catheter, DSG Change [Once weekly for CVC] • If patient has any complications: HD N/S Bolus HD UF Goal Temporarily Reduced HD Complications During • When/if UF resumed chart HD UF Foal Resumed. • If any issues with a CVC during hemodialysis and if the CVC needs to be flushed, reversed, or if Cathflo® protocol needs to be implemented chart HD catheter flow problems/actions. • E Oxygen therapy and monitoring (dialysis) • HD ACT • HD Blood Leak • HD Extracorporeal Blood System Change	• HD sites held by nursing staff

		• HD Single Needle • HD Circulation • HD Switch to Single Needle Click-clack	

Figure 3.13: Documentation required pre, intra, and post hemodialysis

Module 3 Evaluation

Patient Assessment

1. 1 Kg is equal to ____ lbs.
   a) 2
   b) 1.1
   c) 2.2
   d) 1

2. The LPN and the RN can adjust the dry weight of a hemodialysis patient by ____ and ____ percent.
   a) 2% & 5%
   b) 1 % & 2%
   c) 1 % & 1.5%
   d) 0.5% & 2%

3. By using the percentages that a LPN can adjust a patient's dry weight by, what weight can a LPN work a patient with a dry weight of 58.0kg for?
   a) 56.54 to 57.44
   b) 57.42 to 58.58
   c) 57.13 to 58.87
   d) 57.55 to 58.32

4. By using the percentages that a RN can adjust a patient's dry weight by, what weight can a RN work a patient with a dry weight of 58.0kg for?
   a) 56.54 to 57.44
   b) 57.42 to 58.58
   c) 57.13 to 58.87
   d) 57.55 to 58.32

5. Deviations in dry weight can be contributed to? Select all that apply

a) Weight gain
b) Weight loss
c) Decrease in appetite
d) Increase in appetite
e) Constipation
f) Diarrhea
g) Increase in urinary output
h) Decrease in urinary output

i) Increase in the weight of clothing worn whilst weighing
j) Decrease in the weight of clothing worn whilst weighting
k) Weight scale malfunction
l) Improper use of the scale

6. If a patient is under their dry weight what are common signs and symptoms a patient may exhibit? Select all that apply
a) Hypotension
b) Hypertension
c) SOBOE
d) Tachycardia
e) Poor skin turgor
f) Blurred vision
g) Orthopnea
h) Headache
i) No edema noted
j) Dizziness
k) Dyspnea
l) Edema
m) Weakness
n) Fatigue
o) Weight loss (loose clothing)
p) Cough
q) Weight Gain (tight clothing)

7. If a patient is over their dry weight what are common signs and symptoms a patient may exhibit? Select all that apply
a) Hypotension
b) Hypertension
c) SOBOE
d) Tachycardia
e) Poor skin turgor
f) Blurred vision
g) Orthopnea
h) Headache
i) No edema noted
j) Dizziness
k) Dyspnea
l) Edema

m) Weakness
n) Fatigue
o) Weight loss (loose clothing)
p) Cough
q) Weight Gain (tight clothing)

8. The Kt/V measures ___________________________
   a) The adequacy of hemodialysis
   b) The adequacy of fluid removal
   c) The adequacy of the vascular access
   d) The adequacy of the heparin to prevent clotting

9. The targeted Kt/V is __________________________
   a) 1.1
   b) 1.2
   c) 1.3
   d) 1.4
   e) 1.5
   f) 1.6

10. You can increase the Kt/V by ________________ (select all that apply)
   a) Increasing treatment time
   b) Increasing surface area of the dialyzer
   c) Increasing blood flow rate
   d) Increasing the ultrafiltration rate

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Module 4

Vascular Access

Purpose: The purpose of this module is to provide an overview of the types of vascular access that hemodialysis patients currently dialyze with in hemodialysis.

Learning Objectives: After completing this module the learner will complete a post test that will measure the learner's ability to:

- Describe the 3 common hemodialysis accesses and the creation, maintenance, accessing, and nursing care of the access.
- Explain the potential complications of arteriovenous fistula/ arteriovenous graft;
- Recognize the potential complications of the central venous catheter (CVC);

For hemodialysis to be started, a patient must have a vascular access (surgically created or inserted) for hemodialysis use. Currently, the types of vascular access being utilized are:

Arteriovenous Fistula (AVF)

Arteriovenous Graft (AVG)

Central Venous Catheter (Temporary and Tunneled)

(National Kidney Foundation, 2015)

Section 4.1

Arteriovenous Fistula: (Canadian Association of Nephrology Nurses and Technologists, 2015)

A vascular surgeon will surgically connect an artery to a vein. When the artery and vein are joined (or anastomosed) together the vessel with time will grow in strength, blood flow, and diameter to allow for cannulation for hemodialysis purposes.

Figure 4.1: Surgical creation of an AVF

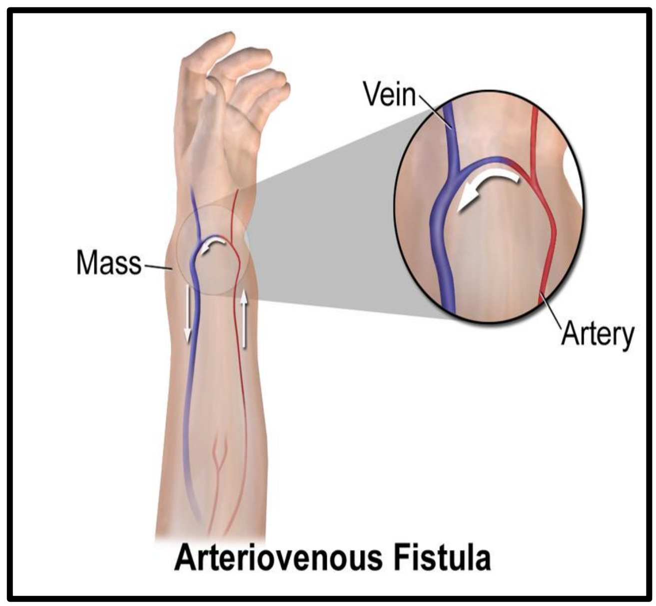


Figure 4.2: Anastomosis of artery with vein

The two most common sites for artery and vein anastomosis are the:

1] Radial artery to the cephalic vein (placement: mid-forearm)

2] Brachial artery to the cephalic OR basilica vein (placement: upper arm)

In a patient that has a fistula created there will be a faint incisional scar noted to be the anastomosis (where the artery and the vein were joined together).

Note: *The AVF, can be placed in the forearm, upper arm, or in the thigh if vascular access option sites are limited.*

When a patient is in Stage 4 ESRD (eGRF 15-30mL/min) vein preservation should begin. This means protecting the arm from: venipuncture, intravenous catheters (IV), blood pressure monitoring, tight occlusive clothing/jewelry, subclavian vein catheter, and peripherally inserted central catheters (PICC) lines.

The vascular surgeon may see the patient for physical examination of arm veins and venous mapping prior to the creating of the AVF.

Pre-Operative Education:

Prior to AVF creation, the patient should receive information and education surrounding the creation of the AVF and recommendations that they need to follow to increase AVF maturation success. Patients should receive information about:

Patient Education Needed	
What is a AVF? What does the surgery involve?	• A AVF if the lifeline needed for hemodialysis treatment. Placing needles in the AVF allows for access to the body's blood which can be filtered in the hemodialysis machine for cleaning (the removal of waste products) and for the removal of fluid.
Why is it needed?	• It is needed to provide access to the body's blood.
How to increase changes of surgical success?	• Pre-operative isometric hand exercises to increase handgrip should be employed (such as squeezing a ball) to increase blood flow to increase vein maturation.

How long with the AVF last?	• This will vary. Some AVF will never progress to be used. Others can last 15 + years.
How to know if the access is working?	• The AVF should be assessed for a thrill (buzzing feeling) and a bruit (whooshing sound).
When will it be used?	• The AVF should be created 6 months prior to its intended use to maximize success rate but can be used 6 weeks after creation.
How will it be used?	 • The use of the AVF will vary if you have a CVC or not. There is a protocol to use for new AVF without existing CVC and another protocol for a new AVF with an existing CVC. Initially cannulation will start with 17 gauge 1 inch needles and gradually move up in gauge size if no complications are encountered.
What are the risks? /Complications	• The risks of AVFs include but are not limited to: -AVF failure (does not mature). -Bleeding (from fistula). -Pain. -Infection. -Steal syndrome.
What blood work is needed?	• Prior to having AVF created, pre-operative bloodwork will need to be completed. This includes: CBC (Complete Blood Count), PTI (Prothrombin time/International Normalized Ratio), T&S (Type and Screen), & RENFUP (Renal Function Panel) and electrolytes to be drawn post hemodialysis (for patients currently on hemodialysis.

Post-Operative Education:

Post-operatively the patient should be made aware that is it normal for the AVF site to be swollen and tender and due to this, mobility and use of AVF arm may be limited. Nursing interventions/ education included in the post-operative care of a AVF creation include:

- Elevating AVF arm to decrease swelling.
- Ensure dressing is not occlusive. Occlusive dressings will compress the blood flow going throughout the AVF which may potentially clot off the access.
- Monitor blood pressure and maintain over 100mm/Hg systolic. Inadequate blood flow (low blood pressure), decreases AVF perfusion which may increase potential clotting.
- Observe for bleeding. Although a scant amount of old dried blood may be present post-surgery there should be no active bleeding from the AVF site.
- Nurses can auscultate for bruit (whooshing sound). Every AVF should have a bruit. If there is no bruit contact the Vascular Access Nurses/Nephrologist to report findings.
- Palpate for the thrill (buzzing sensation). Every AVF should have a thrill. If there is no thrill contact the Vascular Access Nurse/ Nephrologist.
- The patient education about vein perspective should be reinforced: to never have venipuncture, intravenous catheters (IV), blood pressure monitoring, tight occlusive clothing/jewelry, subclavian vein catheter or peripherally inserted central catheters (PICC) lines in their AVF arm.
- Patient should be advised to avoid sleeping on AVF fistula arm as compression may clot off access.
- The patient should be taught to listen and feel for the bruit and thrill also. They can listen by bringing AVF arm to opposite ear (for example if there is a right arm AVF, listen with left ear). They can feel for the thrill with their hand opposite to the AVF arm. This should be done routinely each day. If any issues are noted they should be instructed to contact their dialysis unit. If the unit in not opened they should go to Emergency to be seen.
- Approximately 2 weeks post operatively healing should be complete and patients again would be encouraged to perform isometric hand exercises to increase handgrip and blood flow should be employed.
- Dressing changes should be performed on newly created AVF using normal saline and covered with a gauze dressing (ensuring the dressing is not tight).

Advantages Versus Disadvantages of AVF over CVC

Advantages	**Potential Complications and disadvantages**

Increased vascular access longevity.	AVF does not develop (cannot be used). Can be contributed to: • Inadequate access flow. • Small vessel size. • Venous Stenosis.
Increased blood flow (better dialysis cleaning).	Infection. Can be contributed to: • Improper postoperative care. • Patient hygiene practise. • Nursing practices (handwashing, cleansing of AVF, cannulation technique).
Lower infection rates from vascular access dysfunction.	AVF thrombosis (clotting). Can be contributed by: • Hypotension. • Tight clothing/jewelry. • Sleeping on AVF site. • Restrictive bandages/dressings. • Stenosis in AVF outflow. • Increased coagulation state (monitor patients taking anticoagulants).
Lower risk of mortality contributed from vascular access dysfunction	Pain due to cannulation. Unsuccessful cannulation or infiltrations cause lead to: • Hematoma. • Aneurysm formation. • Infection. • More than 2 needles needing to be inserted.
	• Steal Syndrome: Steal syndrome occurs when the blood flow is shunted away from the distal extremity (fingers/hand) into the fistula. Due to inadequate blood flow to the extremity along with poor tissue perfusion patients experience: pain, coldness to extremity, and often tissue death due to poor perfusion. If steal syndrome is noticed contact your vascular access nurse/nephrologist immediately. Most cases the AVF can no longer be used

	due to risk of ischemic limb therefore the patient would need a different vascular access surgically created/inserted and the old AVF would be ligated.  Figure 4.3 *Steal Syndrome noted in AVF from cannulation.*

<u>Cannulation:</u> Cannulation of an AVF is a unique skill that would not be typically learnt or mastered unless practiced in Nephrology nursing. For hemodialysis to occur it is necessary to have access to blood supply that will facilitate a good blood flow for optimized blood cleansing. When using an AVF the optimal treatment involves cannulation with 2 large bore needles (15 gauge 1 inch). One needle acts as the arterial needle. The arterial needle brings blood away from the patient (A for away). Once the blood is removed from the patient it circulates into the dialysis machine, passes through the dialyzer where blood cleaning happens, and returns (cleansed) back to the patient in the venous needle.

Figure 4.4: Supplies needed for AVF cannulation

<u>Special Considerations:</u>

-The goal is to optimize blood flow to increase the amount of blood cleansed.

-A new fistula will not use 15 gauge 1 inch needles at first. There is a new fistula protocol that is followed to ensure a slow steady fistula development.

-Cannulation of a new or a deemed "difficult" AVF is an advanced nursing skill and should only be attempted by an expert cannulator.

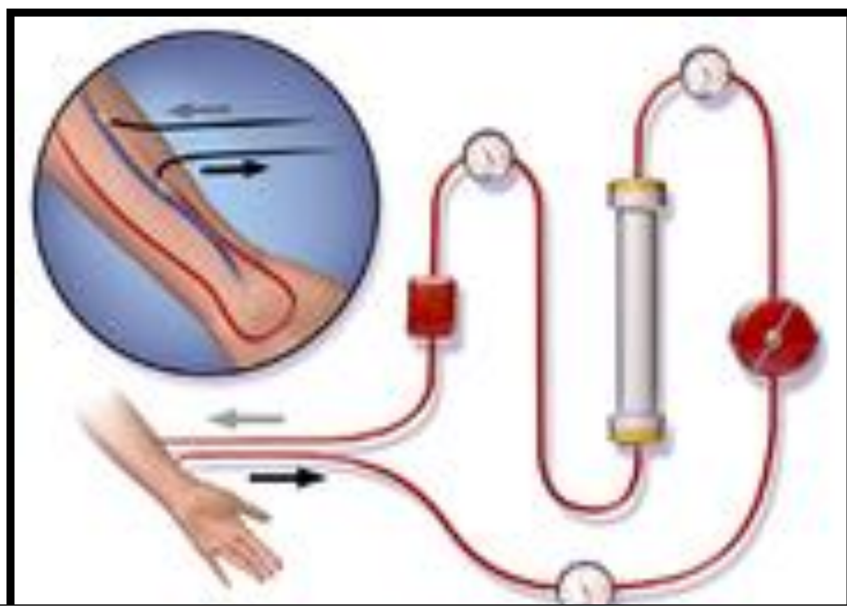


Figure 4.5: Direction of blood flow from AVF cannulation to hemodialysis machine

- Cannulation will typically be done with “dry” needles however it can be done with “wet” needles. Wet needle cannulation involves priming the AVF needles with normal saline prior to the insertion. Wet needle cannulation can help decrease AVF clotting and may be beneficial for a patient that has increased thrombus or clotting with their AVF.

- The vascular access nurse will decide on when a AVF is ready to start cannulation. Ultrasound [advanced nursing skill] is available to measure size, depth, blood flow, and position of the AVF.
- Any issues that are noted with a AVF should be brought the attention of the vascular access nurse.

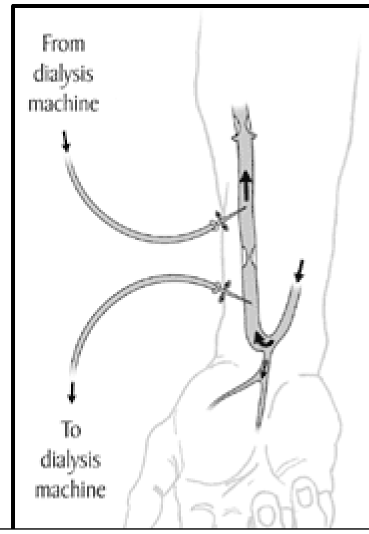


Figure 4.6: Cannulation of AVF

WHEN IS AN AVF READY FOR CANNULATION?

-RULE OF 6’S : THE AVF SHOULD BE 6 MM DIAMETER, LESS THAN 6 MM DEEP, AT LEAST 6 WEEKS OLD, AND BLOOD FLOW GREATER THAN 600ML/MIN

Figure 4.7: Protocol for AVF development

Protocol for new AVF development

THIS IS NOT A PERMANENT RECORD

Cannulation guidelines for AV fistula (without existing catheter)

Week	Needle Gauge	Maximum Arterial Pressure	Maximum Pump Speed
Week 1	2 x 17 gauge	< or = - 200	200
Week 2	2 x 17 gauge	< or = - 200	250
Week 3	2 x 16 gauge	< or = - 250	250
Week 4	2 x 16 gauge	< or = - 250	300
Week 5	2 x 15 gauge	< or = - 250	350

Cannulation guidelines for AV fistula with existing hemodialysis catheter

Week	Needle Gauge	Maximum Arterial Pressure	Maximum Blood Flow Rate	Arterial or Venous supply?
Week 1	1 x 17 gauge	< or = - 200	250	Arterial
Week 2	1 x 17 gauge	< or = - 200	250	Venous
Week 3	2 x 16 gauge	< or = - 250	250	Both
Week 4	2 x 16 gauge	< or = - 250	300	Both
Week 5	2 x 15 gauge	< or = - 250	350	Both

Cannulation guidelines for cannulating new AV fistula

Date:	**Needle gauge**	**Maximum Arterial Pressure**	**Maximum Pump Speed**	**Problems?**
Date:				
Date:				

Figure 4.8: Initiation of hemodialysis using the AVF as a vascular access

Gather Supplies:

-Gloves -Gauze - 2 needles (15 gauge) - Tourniquet

-2 10 mL syringes (to attach to AVF needles) - Tape

-Vacutainer and blood tubes (if needed)

-AVF cleansing agent (Recommended: chlorohexidine. Alcohol can be used if chlorohexidine sensitivity noted). Drying time 30 seconds.

Assess for appropriate needle sites (Note: Novice cannulator only to cannulate AVF with no issues noted with 15 gauge needles).

***Important:**

-Rotate needle sites.

-Avoid needling aneurysms.

-Area to cannulate must be at least 1 inch in length to accommodate the needle.

-Needles should be 1.5 -2 cm from the anastomosis.

-Needles should be 4-5 cm apart hub to hub if needles in same direction.

-Needles should be 2.5 cm apart hub to hub if needles in opposite direction.

-Arterial Needle (A; brings blood Away) can be inserted antegrade (toward blood flow) UP or retrograde (against blood flow) DOWN.

-Venous Needle (returns blood) MUST be antegrade inserted UP.

The arterial needle is always below or distal to the venous needle.

Patient to wash their access arm prior to coming to dialysis chair. *Wash off topical anesthetic cream if used

Nurse to wash hands or use alcohol based handsanitizer

Observe AVF. 1 Minute

LOOK, LISTEN, and FEEL (inspection, auscultation, and palpation).

No Issues Noted?

Issues Noted?

* See below

No bruit and or No Thrill?

No Needle; Contact your vascular access nurse/ nephrologist

Cleanse AVF using friction in a circular motion. Allow to dry

Apply tourniquet (To engorge and stabilize vein).

Forearm AVF: Location of application: Elbow.

Upper arm AVF: Location of application: Below the axilla.

Hold AVF needle by wings. Remove protective cap.

Secure and stabilize AVF site by holding sides or by pulling it tight and down.

Insert AVF needle at 25-degree angle. Slowly advance needle. Once flashback (blood is observed level the needle and thread it along the vessel.

Secure and tape your needle. Check blood flow. Blood should flow freely upon aspiration from the 10mL syringe. Blood should flow nicely into the AVF without issue. The patient should have no pain. You should feel a whoosh when you return blood into the AVF

If: no flashback, if patient has pain, if blood flow tight upon aspiration;

DO NOT PUSH IN.

Have someone assess your needle.

If no issue: insert second needle following same procedure. Attach needles to the blood lines as per protocol and initiate hemodialysis.

*Inspection (Look):

- Expose entire AVF arm. Compare AVF arm to non-access arm to assess for swelling.
- Look for signs of infection (redness, swelling, warmth, or discharge).
- Look for signs of bruising (avoid cannulation in these areas).
- Assess skin integrity (note presence of rash, scabs, or if any bleeding noted).
- Assess distal extremity for signs of steal syndrome.
- Identify last cannulation sites. It is important to use rope and ladder technique each cannulation to avoid aneurysms and shiny white thin areas noted along the fistula. These areas are at an increased risk for rupture which can place the patient at risk for exsanguination.
- Identify cannulation sites and what gauge needles will be used. Again, a new fistula will follow a protocol starting with 17 gauge 1 inch needles. Novice AVF cannulator should only cannulate AVF with no noted issues (no new AVF, no AVF with charted issues, no AVF needing 17 gauge 1 inch or 16 gauge 1 inch needles).
- Advanced Nursing Skill: There is an ultrasound machine that can be utilized to visualize the AVF fistula and can be used to cannulate. This is an expert advanced nursing skill. If ultrasound is needed, consult with an expert cannulator or the vascular access nurse.
- **LPN scope of practice:** Cannulation should be performed on designated good AVF. It will be noted in the nursing communications which AVF are difficult to, or need expert nurses to cannulate.

*Auscultation (Listen):

- Use a stethoscope to listen for bruit along the entire length of the AVF, starting at the anastomosis. Should be heard to be the loudest whoosh at the anastomosis.
- Press gently with stethoscope; if compression is too great the thrill and bruit will be compressed and not felt/ heard.
- There should be a systolic and diastolic component of the bruit noted.
- If there is an increased pitch heard it could be indicative of a stenosis or blockage in the AVF. If this is noted have it checked by an expert nurse cannulator and if still noted consult vascular access nurse and/or nephrologist.

*Palpation (Feel):

- Palpate the entire AVF length gently. Hard palpation will compress the AVF and will lessen the thrill.
- Feel for temperature of AVF arm. Compare this temperate to the non-AVF arm.
- If the thrill feels more like a pulse than a vibration it could be indicative of an obstruction (i.e. clotting or thrombus) or a stenosis. If this is noted have it checked

by an expert nurse cannulator and if still noted consult vascular access nurse and/or nephrologist.

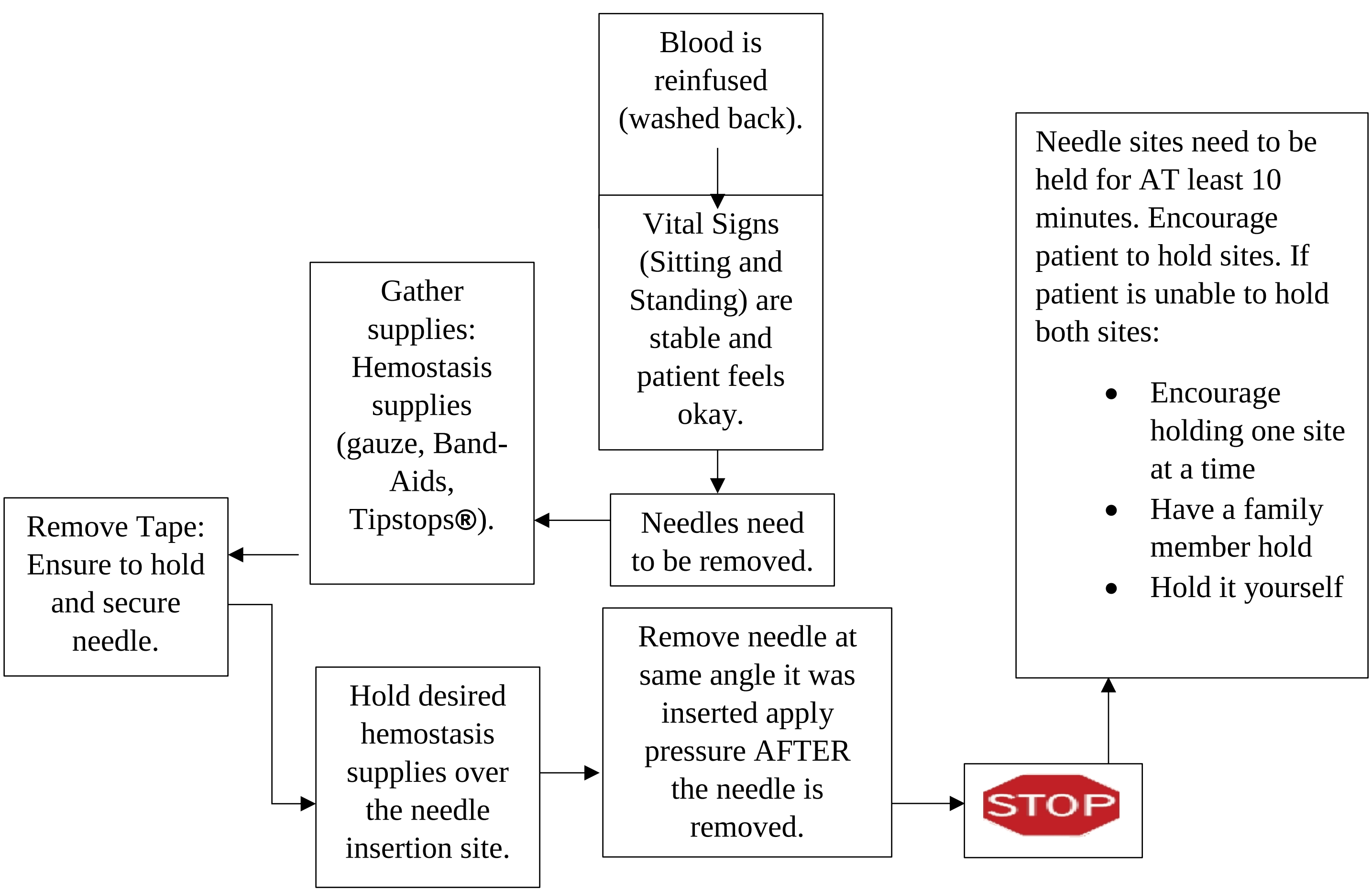
- If the thrill is noticed to be weak this is indicative of a stenosis. If this is noted have it checked by an expert nurse cannulator and if still noted consult vascular access nurse and/or nephrologists.

No needle should be inserted if:
• ? infection
• No bruit
• No thrill
• Pulse is felt instead of a thrill
• You cannot feel direction or where to place the needle

<u>Termination of Hemodialysis:</u>

When the patient has completed their prescribed treatment time the patient will have to be removed from the hemodialysis machine and their blood that is currently circulating will need to be reinfused (washed back) with normal saline. Once blood is reinfused and patient's vital signs (sitting and standing) are completed and stable; the AVF needles need to be removed and hemostasis achieved.

<u>Figure 4.8:</u> Termination of hemodialysis using the AVF as a vascular access



Patient Education:

Patient education on how to take care of the AVF is imperative to AVF longevity and success.

According to current guidelines all patients should know how to:

- Stop AVF bleeding if it occurs at home → Compression.
- To be hygienic over AVF → Wash access arm with soap and water prior to cannulation.
- To recognize AVF problems/changes;
  1. Feel for thrill (with the palm of their hand).
  2. To listen for bruit (AVF arm to opposite ear).
  3. To recognize infection → Redness/warmth/drainage.
- To exercise AVF with isometric exercises to increase vein strength/blood flow.
- No sleeping on AVF arm.
- Avoid tight clothing/jewelry.
- Report any changes to hemodialysis staff. If urgent and hemodialysis unit is not open, to go to Emergency department.
- Not to move their arm during cannulation or when on the hemodialysis machine when needles are still inserted.

Buttonhole Cannulation: (Canadian Association of Nephrology Nurses and Technologists, 2015)

Buttonhole cannulation involves the insertion of BLUNT AVF needles into a tunneled track. This track should be developed by the SAME cannulator. Creation of the track involves the insertion of a sharp AVF needle by/at the SAME:

- Cannulator
- Site
- Insertion depth
- Insertion angle

Note: It is okay for 2 cannulators to create the BH track if they discuss site, depth, and angle in which the BH needle is to be inserted.

Figure 4.9: Supplies needed for buttonhole cannulation

It takes typically 6-10 treatments of needling with sharp AVF needles before a blunt AVF needle can be used in the tunneled track.

Once the tunneled track is developed the scabs of the BH tracks need to be removed prior to each cannulation. Cleaning of the BHAVF involves a 10 second circling method followed by a 20 second dwell contact time (total contact 30 seconds). Remove the scab using tweezers ensuring all scab is removed. If not removed entirely from the BHAVF, there is a potential to have old unremoved scab to be pushed into the BH track increasing risk of infection. After the scab is removed fully cleanse the BH site with an encircling scrub.

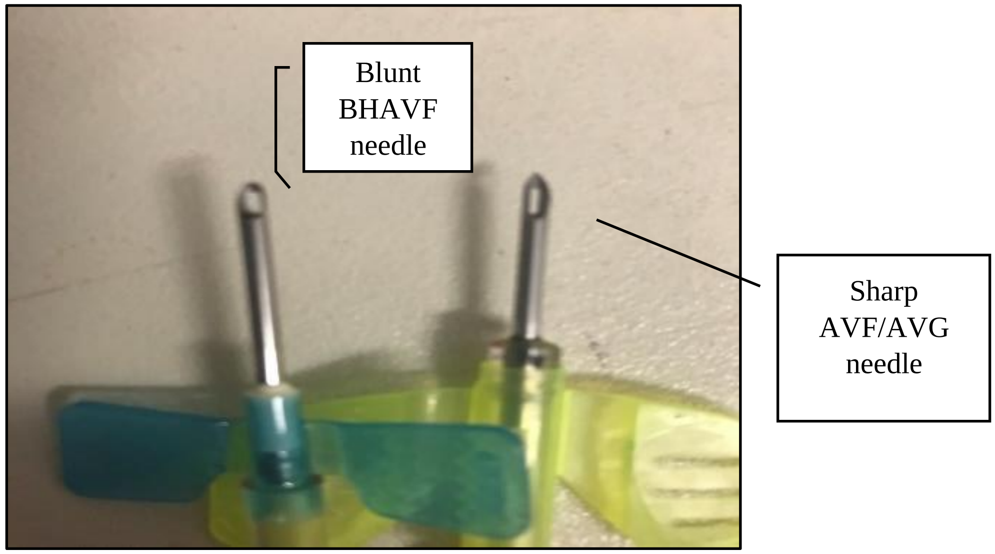
Once the BHAVF is formed, cannulation can be performed with blunt BH needles a sharp needle should NEVER be inserted into the BH track. The insertion of a sharp needle into a BH track may alter or damage the track. If a sharp needle needs to be used it should be used in a new site at lease 20mm away from the BH track.

There are eligibility criteria for patients that are recommended for BH creation as it is not suitable for every patient. These include:

Inclusion	Exclusion
• **Limited areas for rope and ladder cannulation (leading to same site cannulation with sharp needles leading to ⇧ aneurysm development).**	• Any patient with a valve (risk of infection) or prosthetic material that will increase risk of infection (i.e. pacemaker, AV graft).
• **Difficult to cannulate.**	• Patients that are immunocompromised (failed transplant, lupus).
• **Frequent infiltration.**	• Unhygienic patient practices. It is important that the patient be hygienic to reduce risk of infection .

<u>Advantages & Disadvantages of BHAVF:</u>

Advantages	Disadvantages
• **Easier to needle.**	• Increase in infection rate.
• **Decrease in risk of aneurysm formation.**	• Not indicated for every patient.
• **Decrease in pain.**	
• **Decreased infiltrations.**	
• **Easier for patient self cannulation.**	
• **Less risk of bleeding.**	



<u>Figure 4.10:</u> Comparison of sharp AVF versus blunt BHAVF needle

Figure 4.11: Initiation of hemodialysis using the BHAVF as a vascular access

Patient to wash their access arm prior to coming to dialysis chair. *Wash off topical anesthetic cream if used

Nurse to wash hands or use alcohol based handsanitizer

Observe BHAVF. [1 Minute]

LOOK, LISTEN, and FEEL (inspection, auscultation, and palpation).

Issues Noted ?

No bruit and or No Thrill?

No Needle; Contact your vascular access nurse/ nephrologist.

No Issues Noted?

If BHAVF assessment okay the scabs on the BH sites need to be removed.

1]Clean scabs in a circling scrub method for 10 seconds.

2] Leave antiseptic swabs on scabs for 20 seconds

* Step 1 + Step 2 = 30 seconds of cleaning

3] Remove scabs with tweezers (pickers). Ensure all scab removed prior to attempting cannulation.

4] After scabs are removed clean BH insertion sites with circling scrub method for 10 seconds.

Gather Supplies:

-Gloves - 2 blunt needles (15 gauge)

-Tourniquet -Tape -Gauze

-2 10 mL syringes (to attach to BHAVF needles)

-Tweezers (pickers)

-Vacutainer and blood tubes (if needed)

-BHAVG cleansing agent (Recommended: chlorohexidine. Alcohol can be used if chlorohexidine sensitivity noted). Drying time 30 seconds

Hold BHAVF blunt needle by wings. Remove protective cap.

Apply tourniquet (to engorge and stabilize vessel). Secure and stabilize BHAVF site by holding sides or by pulling it tight and down.

Insert blunt needle at 25-30-degree angle. Slowly advance needle. Once flashback (blood is observed, level the needle and thread it along the vessel.

Secure and tape your needle. Check blood flow. Blood should flow freely upon aspiration from the 10mL syringe. Blood should flow nicely into the BHAVF without issue. The patient should have no pain. You should feel a whoosh when you return blood into the BHAVF.

If: no flashback, if patient has pain, if blood flow tight upon aspiration;

DO NOT PUSH IN

Have someone assess your needle.

If no issue: insert second needle following same procedure. Attach needles to the blood lines as per protocol and initiate hemodialysis.

Section 4.2

Arteriovenous Graft (AVG): (Canadian Association of Nephrology Nurses and Technologists, 2015). An AVG is made from a synthetic polytetrafluoroethylene (PTFE) material. This synthetic vessel is inserted between an artery and a vein. The AVG may be indicated over the AVF in patients with poor vein mapping results, those that have had multiple failed AVF attempts, and these with poor tissue perfusion (elderly patients, patients with diabetes, patients with peripheral vascular disease).

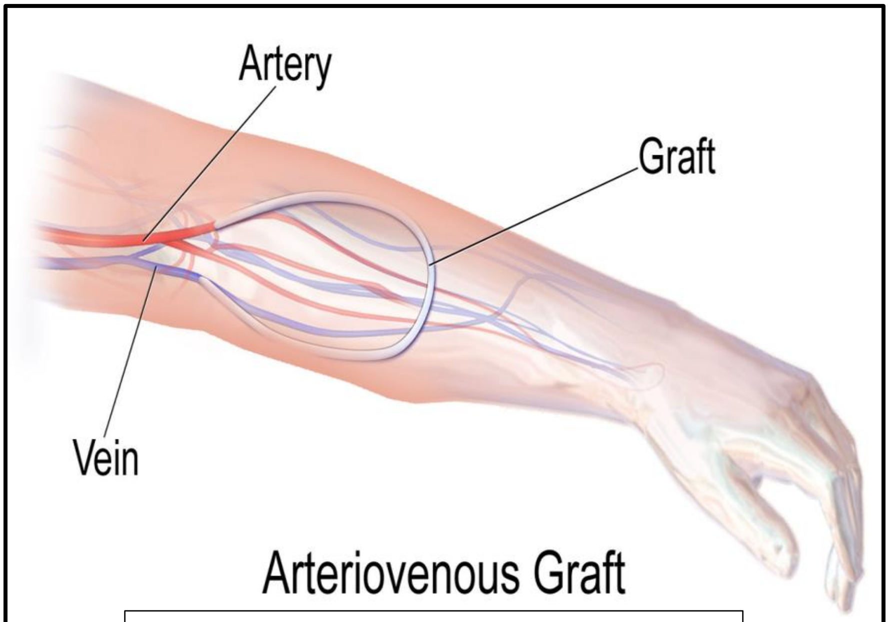


Figure 4.12: Visualization of arteriovenous graft

Location: The AVG can either be looped or straight, depending upon graft placement.

Looped Graft: Graft placed between brachial artery and basilica vein.

Straight Graft: Graft placed between radial artery and basilica vein.

Note: As with the AVF, the AVG can be placed in the upper arm or thigh if vascular access option options are limited.

Pre -Operative	Post -Operative
- Similar to AVF	- Can be utilized 2 weeks post insertion.
	- Can start cannulation using 16 gauge needles.

Cannulation of the AVG:

Cannulation of the AVG is like the process of the cannulation of a AVF with a couple of differences to note which include:

- Angle of cannulation should be 45 degrees.
- Tourniquet should NOT be used.
- If resistance is found when trying to thread and advance the needle, withdraw slightly, reposition, and re-advance. Since the graft is a synthetic material it is less niche and fragile when compared to a AVF.
- Blood flow is determined by auscultation. To determine which side of the AVG is the Arterial versus the Venous side the graft should be slightly occluded mid graft. When the graft is occluded midway the nurse should auscultate on either side. The side with the loudest bruit is the arterial side.
- Blood flow can always be determined by the Operation report if available.

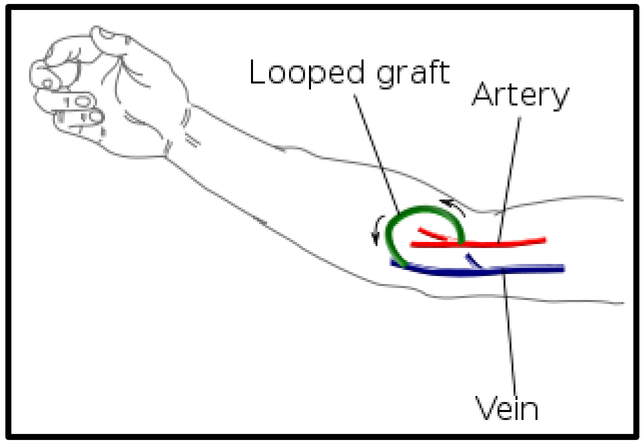
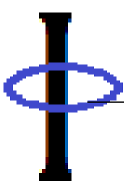


Figure 4.13: Visualization of arteriovenous graft

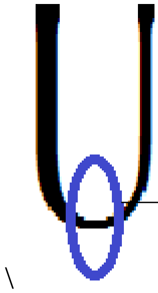
Figure 4.14: Determining arterial and venous aspects of an AVG



If a patient has a straight AVG occlude the AVG mid graft. Auscultate with the stethoscope on either side of the AVG. The side that has the loudest bruit it is the arterial side.

Option: Blood flow can be determined by the Operative Report

Occlude straight AVG mid graft



If a patient has a loop AVG occlude the AVG mid graft. Auscultate with the stethoscope on either side of the AVG. The side that has the loudest bruit it is the arterial side.

Option: Blood flow can be determined by the Operative Report

Occlude loop AVG mid graft

Figure 4.15: Visualization of arteriovenous graft

Gather Supplies:

-Gloves - 2 needles (15 gauge) - Tape -Gauze

-2 10 mL syringes (to attach to AVG needles)

-Vacutainer and blood tubes (if needed)

-AVG cleansing agent (Recommended: chlorohexidine. Alcohol can be used if chlorohexidine sensitivity noted). Drying time 30 seconds.

Cannulation of AVG:

Assess for appropriate needle sites (Note: Novice cannulator only to cannulate AVG with no issues noted with 15 gauge needles).

Important:

-Rotate needle sites.

-Needles should be 4-5 cm apart hub to hub if needles in same direction.

-Needles should be 2.5 cm apart hub to hub if needles in opposite direction.

-Arterial Needle (A; brings blood Away) can be inserted antegrade (toward blood flow) UP or retrograde (against blood flow) DOWN.

-Venous Needle (returns blood) MUST be antegrade inserted UP.

-Blood flow is determined by auscultation. To determine which side of the AVG is the Arterial versus the Venous side, the graft should be slightly occluded mid graft. When the graft is occluded midway the nurse should auscultate on either side. The side with the loudest bruit is the Arterial side.

The arterial needle is always below or distal to the venous needle.

Patient to wash their access arm prior to coming to dialysis chair. *Wash off topical anesthetic cream if used.

Nurse to wash hands or use alcohol based hand sanitizer. Apply Gloves.

Observe AVG. [1 Minute]

LOOK, LISTEN, and FEEL (inspection, auscultation, and palpation).

No Issues Noted?

Issues Noted?

No bruit and or No Thrill?

No Needle; Contact your vascular access nurse/ nephrologist

Cleanse AVG using friction in a circular motion. Allow to dry.

Hold AVG needle by wings. Remove protective cap.

Secure and stabilize AVG site by holding sides or by pulling it tight

Insert AVG needle at 40-degree angle. Slowly advance needle. Once flashback (blood is observed level the needle and thread it along the vessel.

Secure and tape your needle. Check blood flow. Blood should flow freely upon aspiration from the 10mL syringe. Blood should flow nicely into the AVG without issue. The patient should have no pain. You should feel a whoosh when you return blood into the AVG.

If: no flashback, if patient has pain, if blood flow tight upon aspiration;

DO NOT PUSH IN

Have someone assess your needle

If no issue: insert second needle following same procedure. Attach needles to the blood lines as per protocol and initiate hemodialysis.

Monitoring of Arteriovenous Fistula, Buttonhole, and Graft Pressures:

- Pressures on the hemodialysis machine should follow a 2:1 rule. The pressure of the arterial and the venous needle should be ½ the pump.
  Note: Needle pressures are dependent upon needle gauge. The bigger the needle the higher the blood flow rate that can be obtained.

Examples:

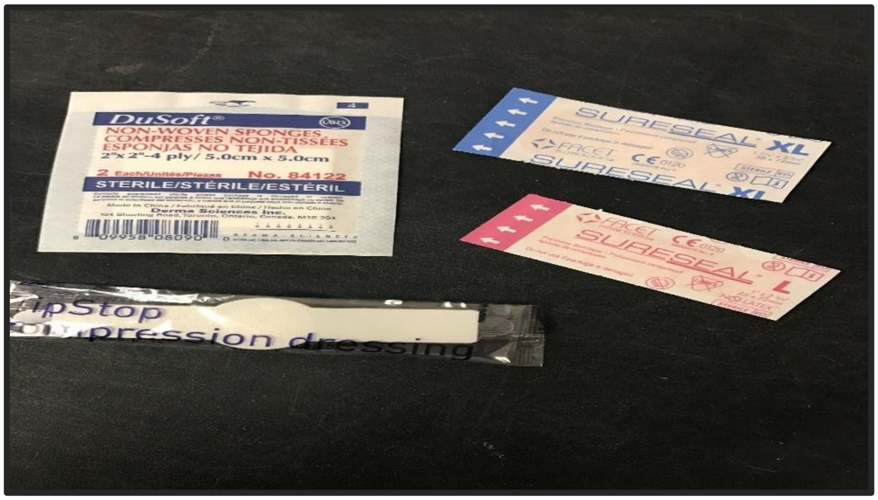
Blood flow rate 400mL/min: Maximum pressures are ½ (400): 200mmHG.

Blood flow rate 350mL/min: Maximum pressures are ½ (350): 175mmHG.

- Maximum arterial and venous pressures that are accepted are 250mmHG for both the arterial and venous needle. If pressures rise above this, troubleshooting of the needle is warranted.
- The arterial needle is always going to be a negative pressure (-ve). This is because the arterial needle pulls blood away from the body to circulate in the blood lines of the extracorporeal circuit (A for Away).

Hemostasis:

-After hemodialysis is complete the AVF, BHAVF, and AVG need to be compressed once the needles are removed to stop blood flow. Currently patients can use gauze, band aids, and TipStops® to compress their vascular access.



Important:

1] All hemostasis supplies should be removed 4-6 hours after application.

2] Patient’s with BHAVF should not use TipStops® (prevents scab from forming and closing over the tunneled track).

3] A patient that uses Tipstops® must remove in 4 hours post needle removal.

4] Patients should be educated on what to do if their vascular access starts to bleed post dialysis at home and should always have hemostasis supplies in their vehicle and at home.

5] It is important that too much compression is not applied to the vascular access post dialysis. Too much compression with hemostasis supplies may cause the access to decompress and places the access at risk for clotting.

Troubleshooting of Arteriovenous Fistula, Buttonhole, and Graft:

Cannulation Troubleshooting	Intradialytic Troubleshooting
- **If unable to palpate or auscultate thrill and bruit: Seek assistance from expert cannulator** **NO bruit NO thrill → NO Needle**	- Increased arterial and or venous pressures: ↓ blood pump speed, use ultrasound to check needle position, adjust tape, use gauze to “cushion” or “lift” needle.
- **If unable to palpate or identify appropriate cannulation sites: Seek assistance from expert cannulator.**	- Stop blood pump. Clamp 4 hemodialysis clamps (2 from machine + 2 from needles). Disconnect patient from machine to check needle patency using 10mL syringe (If blood flow is sluggish attempt to reposition needle).
- **If infiltration (needle blow) occurs with cannulation: Remove needle and apply pressure to site to achieve hemostasis. Apply ice to site. Instruct patient to apply ice for 24 hours for 20 minute cycles (20 minutes on: 20 minutes off). After 24 hours of icing, patient should apply heat compress for 20 minute cycles. After 1 failed attempt: Seek assistance from an expert cannulator.**	- Reposition needle: Apply tourniquet and slightly withdraw needle and attempt to rethread needle along the vessel.
- **If bruising or hardness is noted in the vascular access: Seek assistance from expert cannulator.**	- If unable to obtain adequate blood flow or unable to decrease pressures to acceptable range (less than 250 mm HG) seek assistance from expert cannulator.
- **If blood flow is absent or sluggish upon needle insertion**	

DO NOT flush or instill blood/normal saline. Seek assistance from expert cannulator.	

If cannulation difficulties arise there are options that can be employed for hemodialysis via the single needle (SN) option. SN hemodialysis is useful when there are difficulties in establishing two (2) working cannulation areas for whatever reason. SN hemodialysis can be either started from the beginning of the treatment (if there are known issues; using SN blood lines), or can be initiated during a double needle dialysis (if needed; using double needle blood lines by using Click-Clack). The use and monitoring of SN hemodialysis is similar but not the same as monitoring for double needle hemodialysis monitoring and is an **advanced nursing skill.** During orientation you will be shown, and will have to demonstrate how to set up a SN setup. The monitoring, utilization, and switching of double needle to SN hemodialysis using Click-Clack is an **advanced nursing skill** which takes time for mastery and comprehension.

SN Options:

1] Single Needle Blood Line Set Up (from the beginning): The hemodialysis lines are labelled. Ensure you have the proper lines when a SN setup is needed.

2] Click-Clack: Using a Y connecter, a double needle blood line system can be switched to a SN setup using the Click-Clack option.

Figure 4.16: Y-Connecter (used for cannulation for SN setup)

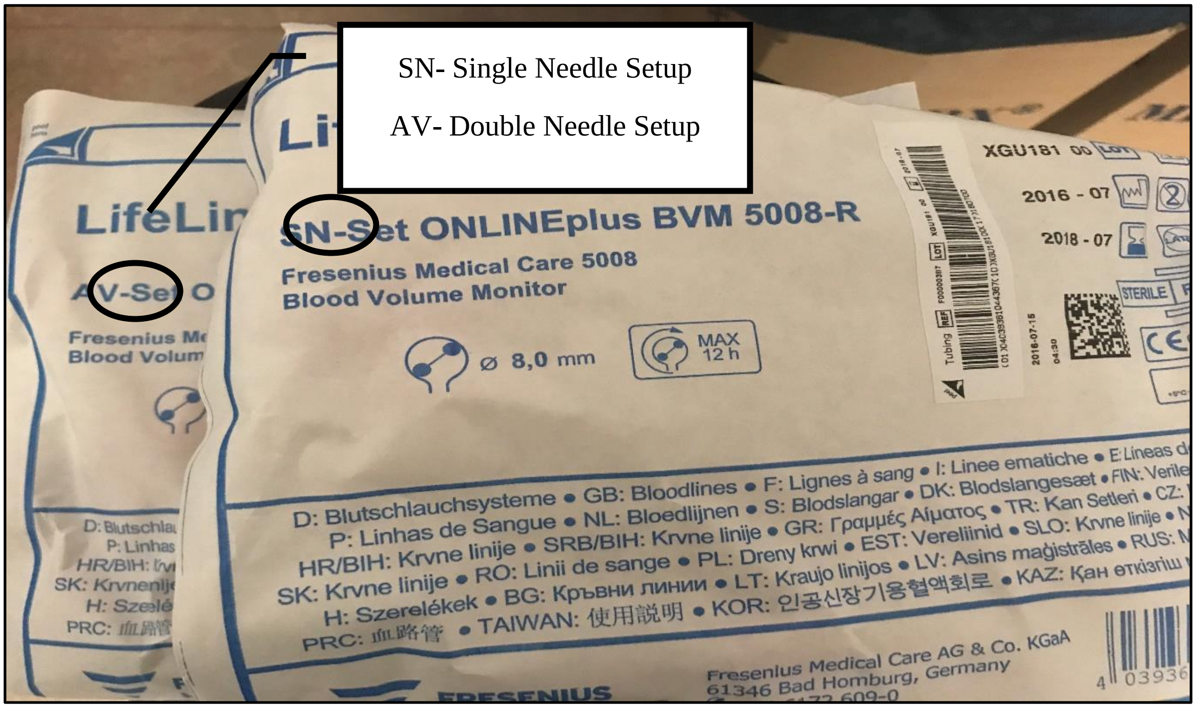


Figure 4.18: The differences in double needle and single needle setups

Notes:

- *SN hemodialysis is not ideal for a number of reasons. Higher recirculation, the use of once site for both the arterial and the venous vascular access site, and lower blood flow rates, will diminish the amount of blood that can be cleaned in the treatment time thereby decreasing hemodialysis efficiency*

Important
➢ Cannulation of an AVF, BHAVF, or AVG is a learned skill that is gained in proficiency with years of practice and experience. ➢ A common feeling expressed by new nephrology nurses (both novice and experienced nurses) is fear and anxiety with cannulation (Broscious & Castagnola, 2006; Hardwood, Locking-Cusolito, Spittal, Wilson & White, 2005). ➢ If ever in doubt during cannulation do not hesitate to seek assistance. The vascular access is a patient's lifeline for life sustaining treatment. It is better to be safe when uncertainly occurs.

Section 4.3

Central Venous Catheter (CVC): (Canadian Association of Nephrology Nurses and Technologists, 2015)

A CVC is a catheter that is inserted into a major vein which provides immediate access to the circulatory system. There are multiple reasons why a patient would have a CVC opposed to a AVF or AVG which include:

- Patient preference.
- Acute renal failure (immediate start).
- Vascular access issues (i.e. poor veins).
- Fistula failure.

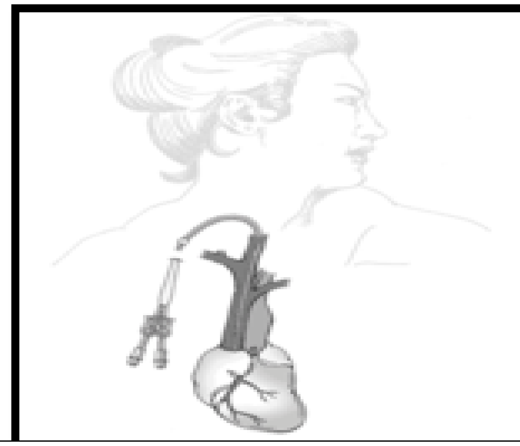


Figure 4.19: Position of a central venous catheter

Common insertion sites include subclavian, jugular, and femoral veins. The most desired site of insertion is the internal jugular vein.

For a patient that is going to need long term hemodialysis a tunneled CVC is needed. A tunneled CVC is tunneled through the skin prior to the insertion site in the vein, decreasing the risk of infection. When tunneled into the track, the Dacron cuff of the CVC can attach and adhere to the tissue along the track increasing CVC stability and denoting the need for a long indwelling suture. Once inserted the patient will have 2 sutures. The entrance site suture needs to be removed 7 days post insertion. The exit suture needs to be removed 14 days post insertion.

Note: Insertion of the CVC into the femoral or subclavian are avoided if possible. A subclavian CVC can cause a stenosis in the same side which limits the patient's future vascular access (for example a patient may not be able to have a right arm fistula created after having a right subclavian CVC if stenosis occurred. A femoral CVC is generally avoided due to increased rate of CVC failure and CVC infection.

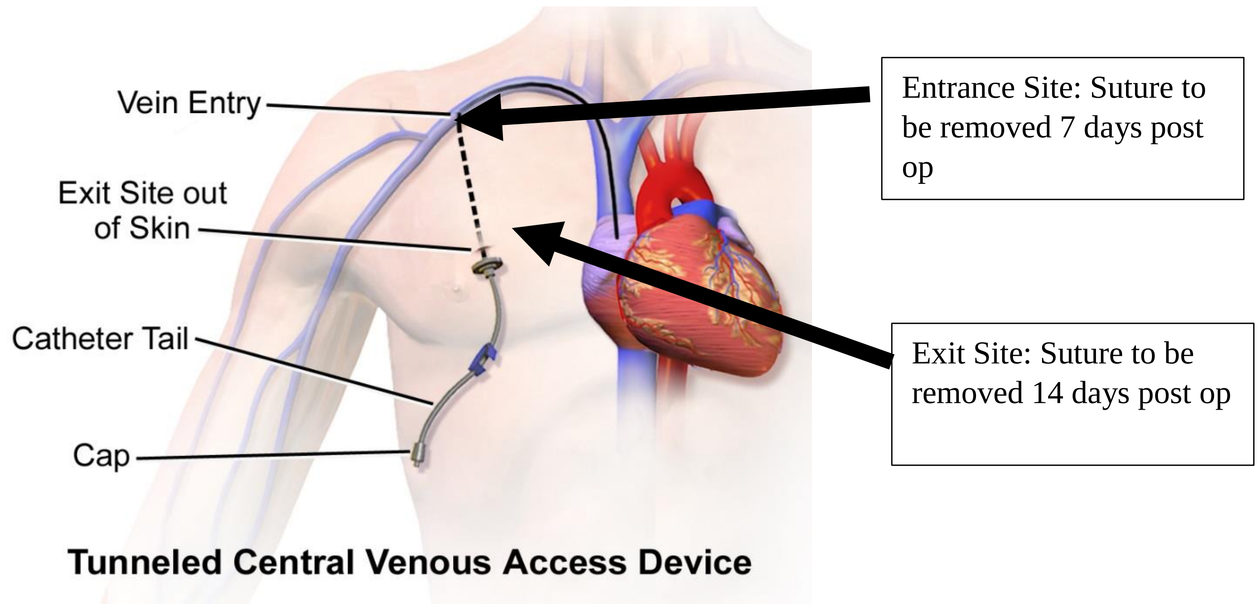


Figure 4.20: Central venous catheter positioning depicting the entrance and exit site.

For patients that have acute renal failure a temporary line may be inserted. The insertion of this line involves one puncture site that feeds directly into the vein of insertion. Temporary lines host an elevated risk of infection when compared to a tunneled CVC. Central venous catheters within the hemodialysis population have been directly associated with increased rates of morbidity, mortality, and increased hospitalization costs. Within this population, infection is contributed to be the most common cause of morbidity and the second most common cause of death. Catheter related infections include but are not limited to exit site infections, tunnel infections, and bacteremia all of which have the potential to lead to blood sepsis. Bacteremia accounts for approximately 75% of all infectious deaths and health care costs for the treatment of such have been estimated to be between 60-460 million dollars annually (Bakke, 2010). This is important within a Canadian context as the use of central venous catheters is at an all-time high at 33% (Harwood, Wilson, Thompson, Brown, & Young, 2008).

Pre-Operative Education:

Prior to a CVC insertion the patient should receive information and education surrounding the procedure. They should be aware that the CVC will be inserted in the chest and if long-term dialysis is indicated it will be a permanent access until another access is established (tunneled CVC).

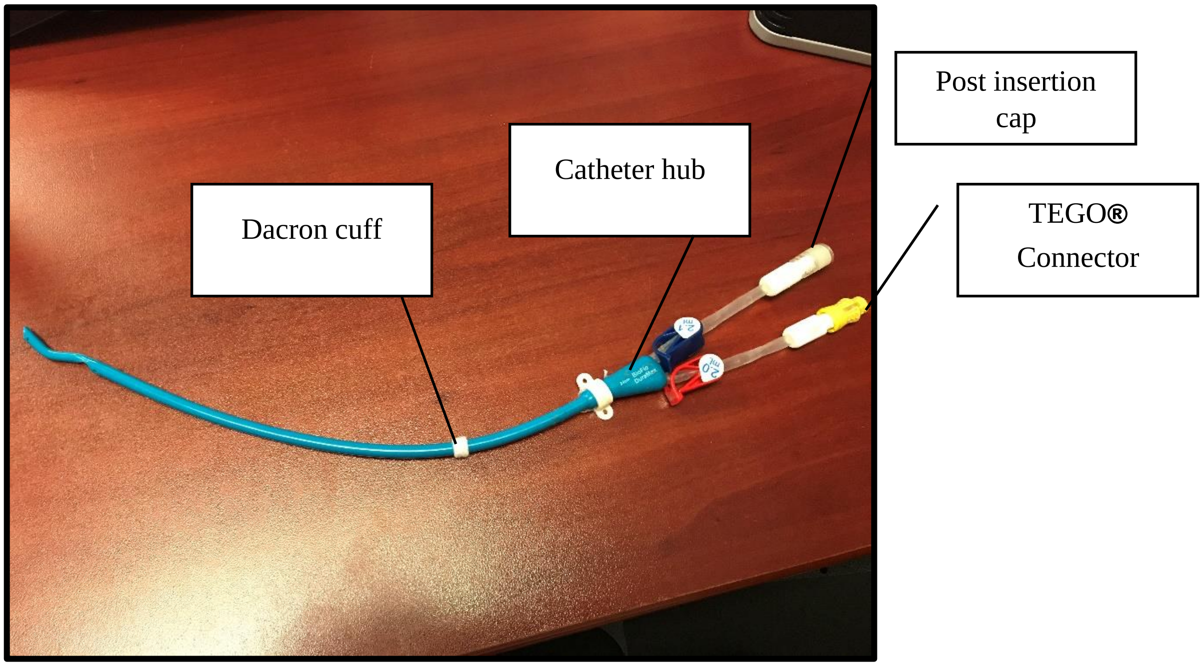


Figure 4.21: Central venous catheter depicting the catheter hub and dacron cuff

<u>Post -Operative Education:</u>

Postoperatively before the line can be used an X-ray must be performed to verify correct placement. Also, the patient will not have a TEGO® connected to the CVC, rather a cap (see Figure 4.21 above). You will need to change this cap to place on a TEGO® connector prior to starting hemodialysis.

Patient Education Requirements	Nurse Care Responsibilities
➢ **To ensure occlusive dressing is intact.**	➢ To access CVC each treatment as per unit policy.
➢ **To avoid getting occlusive dressing wet (no swimming, baths preferred over showering).**	➢ To assess CVC site each treatment for signs and symptoms of infection.
➢ **To ensure to maintain good hygienic practices to prevent infection.**	➢ To change TEGO® connectors once weekly with aseptic technique (or when otherwise indicated).
➢ **To ensure two clamps on the CVC are always clamped (and is aware on how to clamp them).**	➢ To change CVC dressing once weekly with aseptic technique (or when otherwise indicated).

➢ **To ensure patient is aware to not used sharp objects around CVC (i.e. broaches).**	➢ To maintain and monitor CVC patency and to implement thrombolytic protocols if necessary **(RN only).**
➢ **To ensure patient is aware of what to do if line is bleeding (compression).**	

Figure 4.22: Steps of accessing a central venous catheter

Nurse to wash hands or use alcohol based hand sanitizer.

<u>Inspect site for:</u>

Integrity of clamps, TEGOS®, and dressing.

S&S of infection

Bleeding

Edema

Normal assessment findings.

Are there any abnormalities noted?

If issues noted with clamps, TEGOS®, or dressing: replace. If S&S of infection noted. Contact nephrologist.

TEGOS® due to be changed? [Due once weekly] Aseptic technique

Gather supplies. Pull curtains around patient to minimize traffic. Don mask (patient as well). Open supplies in sterile dressing tray, then don sterile gloves.

Place sterile field under CVC.

Use sterile forceps to stabilize lumen and cleanse TEGO® catheter + lumen in a back and forth motion. [Repeat for second lumen]

Pick up lumen with sterile gauze, make sure clamp is on and remove TEGO®. Clean threads of lumen with chlorhexidine/alcohol and replace new TEGO® connector to lumen. [Repeat for second lumen]. Once TEGOS® are changed follow steps 1 -4. Employ the clean hand dirty hand technique.

TEGOS® not due to be changed?

Gather supplies. Pull curtains around patient to minimize traffic. Open supplies on sterile field, don sterile gloves. Clean hand dirty hand.

Place sterile 4 x 4 gauze under CVC

1 Swab TEGO® connecter for 3 seconds with antiseptic swab [chlorohexidine or alcohol].

2 Attach 10mL syringe, unclamp CVC clamp and withdraw 5mL of blood [to remove anticoagulant used to close CVC post hemodialysis] and clamp CVC. If blood sampling is indicated, swab TEGO®, connect vacutainer, unclamp CVC, and collect sample. [Repeat for second lumen]

3 Attach 10mL normal saline syringe, unclamp CVC clamp and instill the normal saline pushing in and pulling out to check blood flow pull and return of the CVC, once done clamp CVC clamp. [Repeat for second lumen]

4 The side of the line that allowed for the best pulling of blood will be the arterial side (the other will be the venous side). Connect patient to machine as per policy and initiate hemodialysis.

If unable to aspirate blood from either lumen try changing patient position (lean forward, cough, lay back). If still no blood flow obtained from either lumen follow Medical Directive for Cathflo [**RN only**].

Note: If one lumen can aspirate blood and maintain blood flow this is okay. If the other lumen cannot aspirate blood but is easily flushed you can commence hemodialysis. [one lumen with good blood flow and one that can flush well is needed].

Supplies needed for TEGO® change	Supplies needed for straight on (no TEGO® change needed OR TEGO® change already completed)
- 2 masks - Dressing tray - 2 swab sticks (chlorhexidine) - 2 chlorhexidine swabs - Sterile gloves - 2 TEGO® connectors - 8 chlorohexidine swabs - Sterile gloves - 2 pre-filled saline syringes - 2 10mL syringes - 2 4X4 sterile gauze	- 8 chlorohexidine swabs - Sterile gloves - 2 pre-filled saline syringes - 2 10mL syringes - 2 4X4 sterile gauze

Notes:

- When doing a straight on (no TEGO® change), employ the clean hand dirty hand technique. In this method one hand is used to hold and manipulate CVC clamps whilst the other hand maintains sterile. Sterility is important for syringe tip to TEGO® tip.
- The TEGO® needs to be swabbed before every accessing.
- After the TEGOS® have been changed (using strict sterile technique) the patient can remove their mask and the clean hand dirty hand technique can be employed.

After the completion of hemodialysis, it is important the CVC be locked or closed to prevent thrombosis. Currently there are two utilized catheter locking solutions:

1] 4 % Sodium Citrate

2] Cathflo **[RN only]**

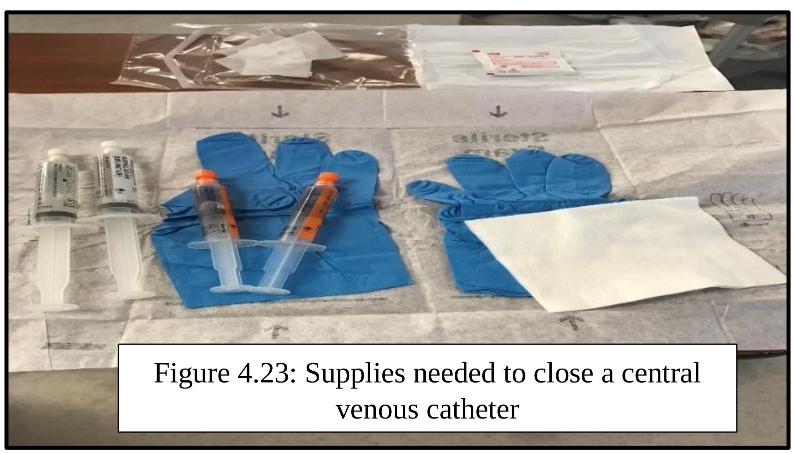


Figure 4.23: Supplies needed to close a central venous catheter

Figure 4.24: The termination of hemodialysis and locking of a central venous catheter

When hemodialysis is complete reinfuse (washback/rinse back) patient as per policy

Check patient vital signs in this order:

Temperature (can be taken last 30 minutes of treatment)

Sitting blood pressure and pulse

Standing blood pressure and pulse

If patient is feeling okay, and if VS are stable their line needs to be flushed and locked before they leave.

Check order for what the patient is ordered to be closed with.

Patient ordered to be closed with cathflo? [RN ONLY].

Gather supplies:

-Sterile gloves

- 6 chlorhexidine swabs

-2mg Cathflo

-Vial of sterile water

- 2 Sterile 4x4 gauze

- 3 (3) mL syringes

-2 21 gauge needles

-3 prefilled 10mL normal saline

Prepare cathflo as per policy. 2.2 mL of sterile water to reconstitute. Swirl don't shake. Then follow step 1

Prepare cathflo. Draw up with sterile technique 1 mL into each 3mL syringe. Then fill syringe to lumen length with + 0.2mL overfill. If 1.6 lumen length there will be 1mL of cathflo + 0.8 of normal saline = 1.8 ml in total . Then follow step 2

Cleanse TEGO® with chlorhexidine. Attach cathflo + normal saline syringe. Unclamp CVC clamp and instill. Clamp CVC clamp, remove syringe and cleanse TEGO. Repeat for second lumen.

Patient to be closed with 4% sodium citrate

Gather supplies:

-Sterile gloves

- 6 chlorhexidine swabs

-2 prefilled 4% sodium citrate syringes (5mL)

- 2 Sterile 4x4 gauze

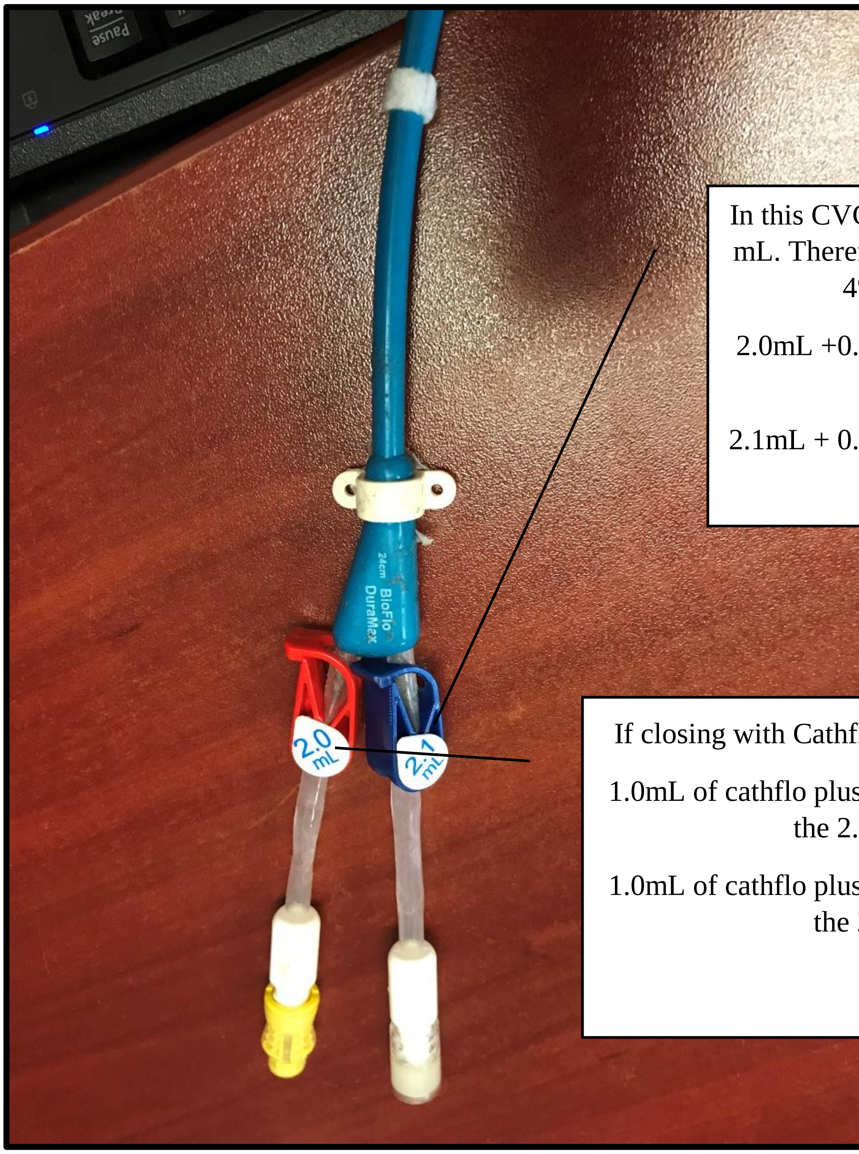
-2 prefilled 10mL normal saline

Wash hands or use alcohol based hand sanitizer. Open sterile field and add supplies. Check lumen lengths of CVC. Don Sterile gloves. 1

2 Place 4x4 sterile field under CVC. Cleanse TEGO® with chlorhexidine (3 seconds circular scrub). Attach saline syringe un clamp CVC clamp and flush the blood that is currently in the lumen so that the line clears then re clamp CVC and remove syringe. Repeat for second lumen

Prepare 4% sodium citrate for a 0.2mL overfill of the CVC lumen length. For example, if lumen length 1.6 ;1.8mL of 4%sodium citrate is needed.

Cleanse TEGO® with chlorhexidine. Attach 4% sodium citrate. Unclamp CVC clamp and instill. Clamp CVC clamp, remove syringe and cleanse TEGO. Repeat for second lumen.



In this CVC, the lumen lengths are 2.0mL and 2.1 mL. Therefore, when we go to close the line with 4% sodium citrate it would be:

2.0mL +0.2mL = 2.2mL of 4% sodium citrate for the 2.0 mL lumen and

2.1mL + 0.2mL = 2.3mL of 4% sodium citrate for the 2.0mL lumen.

If closing with Cathflo [**RN ONLY**] it would be

1.0mL of cathflo plus 1.2mL of normal saline for the 2.0 mL lumen

1.0mL of cathflo plus 1.3mL of normal saline for the 2.1 lumen.

Figure 4.25: Central venous catheter

<u>Dressing Change of CVC:</u>

The dressing of the CVC is transparent to allow for exit site assessment each hemodialysis treatment. The dressing is due to be changed once weekly or when otherwise indicated (for example if the patient has no dressing insitu, or if the dressing is falling off). The dressing should be completed under sterile technique.

<u>Supplies needed:</u>

-2 masks.

-Dressing tray.

-Sterile gloves.

-Clean gloves.

- 2 dressings (IV 3000 unless otherwise indicated).

-2 chlorhexidine swab sticks (if patient cannot use chlorohexidine due to sensitivity or allergy 2 bridine sticks can be used instead).

-Hand disinfectant.

Procedure:

1] Wash hands.

2] Pull curtains around patient to minimize traffic.

3] Don mask (self and patient).

4] Open sterile dressing tray and add supplies.

5] Don clean gloves and remove dressing.

6] Assess site.

7] Remove gloves; use hand disinfectant and don sterile gloves.

8] Place sterile towel under CVC using sterile gauze to lift CVC.

9] Use one side of swab to cleanse exit site using a back and forth motion to cleanse down toward CVC lumens.

10] Flip swab to use the unused side of swab to cleanse skin above the exit site in a back and forth motion.

11] Use sterile forceps to lift CVC to clean exit site on underside of the catheter using a back and forth motion to cleanse down toward CVC lumens.

12] Use swab to cleanse skin below exit site in back and forth motion.

13] Allow skin to dry.

-If using chlorohexidine 2 minutes.

-If using bridine 5 minutes.

14] Sandwich IV 3000 dressing on CVC (one on back and one on front ensuring exit site and CVC catheter hub are covered).

Note:

-If family members present during TEGO® or dressing change they should be asked to either (1) wear a mask or (2) step away for a second while the procedure is being performed. Every time the TEGO® or dressing is removed, so is the infection protective barrier. Therefore, maintaining stile technique is paramount.

A mnemonic to remember a way to care for a CVC stands in the I SAVE That Line where SAVE stands for:

S	A	V	E
Scrupulous hand hygiene	Always disinfect TEGO® prior to access	Vein preservation	Ensure patency. There is a protocol when the blood flow rate is unable to maintain 250mL/min without multiple alarms or with arterial or venous pressures of -250mmHg or 250mmHg called the **Cathflo Protocol**. This protocol is an advanced nursing skill and is to be performed by RNs only.

Cathflo Protocol [RNs only]:

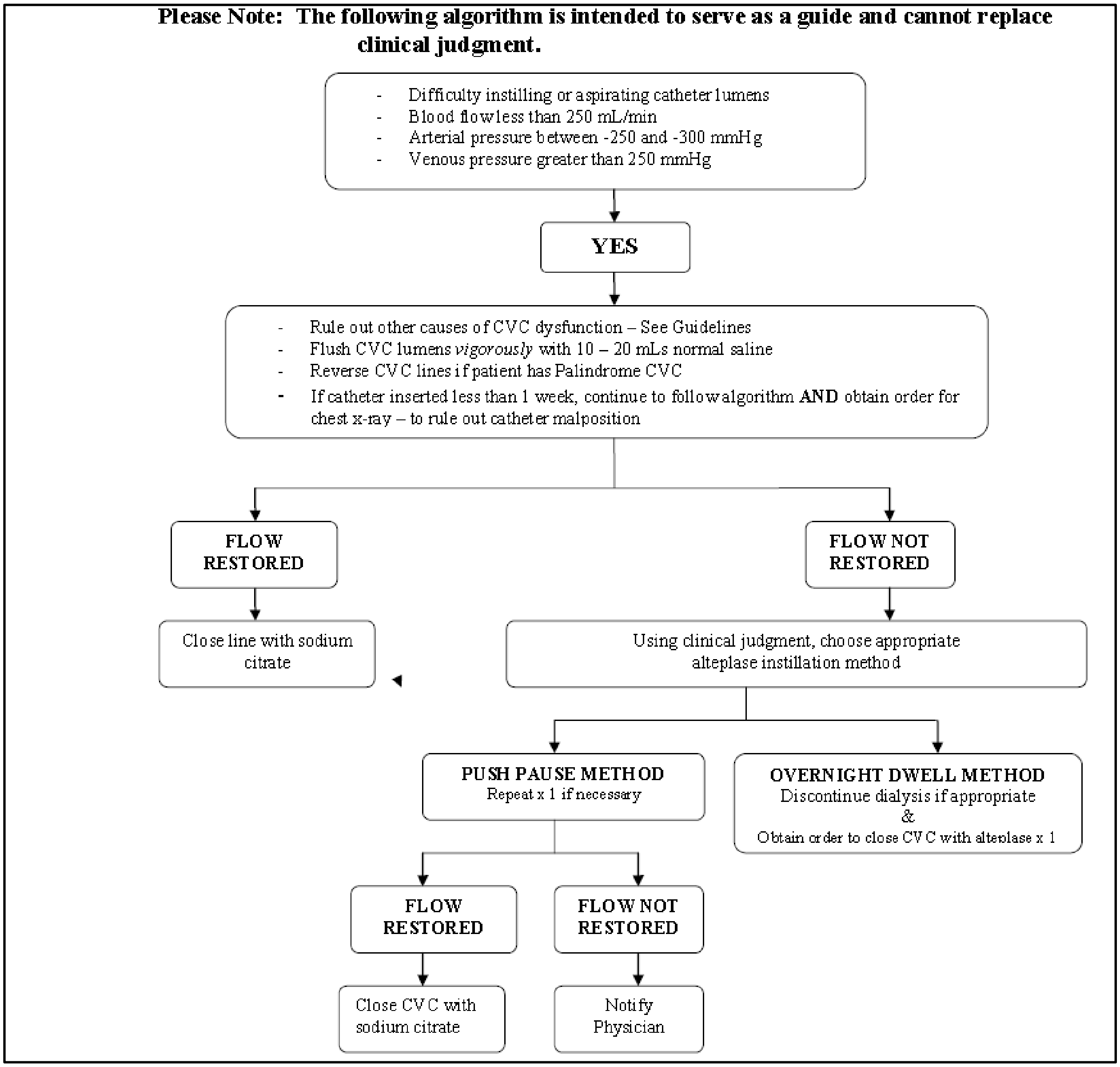
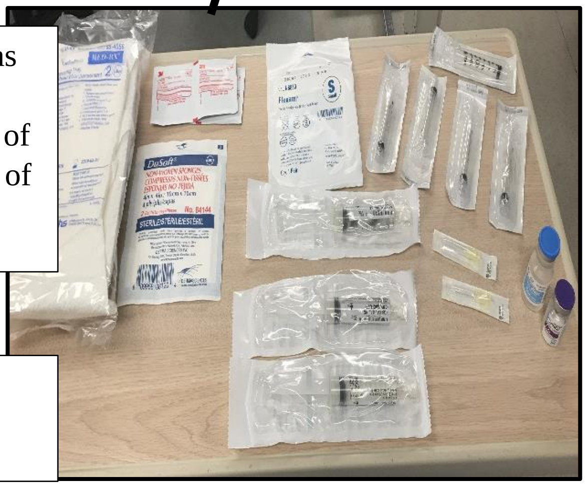


Figure 4.25: Cathflo® Protocol (Initiation guidelines)

Figure 4.26: Cathflo® Protocol Step by Step

Cathflo® Protocol to be implemented (ensure old locking solution is removed and lines are cleansed of blood) ***Procedure takes 30 minutes***

Supplies needed



Prepare Cathflo® as per manufactures suggestions [2.0mL of sterile water to 2mg of Cathflo]

Open supplies on sterile field.

Don sterile gloves

Prepare medication

Draw up 1.0mL of Cathflo® into each 3mL syringe (with 1.0mL of Cathflo® each)

Draw up normal saline. In 2 separate 3mL syringes. This amount will vary depending on the patient's CVC lumen length. Enough normal saline is needed to fill to the lumen tip (with the 1.0 of Cathflo included) and 0.4mLs extra. For example: in a patient with a 1.6mL CVC; (1.0mL Cathflo + 0.6mL normal saline = 1.6mLs to fill to the tip) + 0.4mLs = 1.0mLs of normal saline to be drawn up in the 3mL syringe (need 2 syringes).

If lumen length 1.9: need 1.3mLs of normal saline (0.9 to fill to lumen length [after the 1.0mL of Cathflo is added] + 0.4mLs)

If lumen length 2.2: need 1.6mLs of normal saline

If lumen length 2.1: need 1.5mls of normal saline . . . and so forth.

Administer 1.0mLs of Cathflo® to each lumen

Fill CVC to lumen length with normal saline (amount depends on lumen length; 1.0mls of Cathflo® + x = lumen length.

Wait 10 minutes

After 10 minutes advance 0.2mLs of normal saline

Wait 10 minutes

After 10 minutes advance 0.2mLs of normal saline

Wait 10 minutes

After complete, remove Cathflo® from lines (5mL discard), check flow with 10mLs of N/S [to both lumens]

Flow Restored?

Yes

HD

No

Repeat procedure x 1 [Standing order to do Cathflo® prn x 2]

Flow Restored?

Yes

Initiate hemodialysis

No

Repeat Cathflo **®.** If no flow post contact doctor

Push Pause Method:

1] Fill CVC lumen with 1.0mL of Cathflo®. Fill remainder of the CVC to lumen length with normal saline. For example; if a patient's CVCs lumen length measures 1.6mL; 1.0mL of Cathflo® + 0.6 of normal saline = 1.6 total. Allow to dwell for 10 minutes.

2] After 10 minutes advance 0.2mLs of normal saline. Allow to dwell for 10 minutes.

3] After 10 minutes advance 0.2mLs of normal saline. Allow to dwell for 10 minutes.

4] After 3 dwells (30minute duration) remove all excess Cathflo® from both lumens. Check blood flow with 10mLs of normal saline. If blood flow unchanged repeat Cathflo® protocol.

Recirculation:

Recirculation is noted in a percentage of the return of dialyzed blood to the dialyzer without equilibration with arterial systemic circulation. It measures the percentage of blood that is brought back to the dialyzer that has already been cleansed. Therefore, it measures the amount of blood that is constantly being recleaned in a cycle. The Fresenius hemodialysis machine measures recirculation through temperature changes in the dialysate using the blood temperature monitor. The temperature change seen in the dialyzer will be detected though the venous measuring device and will be compared to the arterial temperature. Recirculation will only be performed using: double needle dialysis, in an alarm-free system, with blood flow over 100mL/min.

Recirculation measurements are performed every treatment and should be monitored each treatment. The recirculation measurement will be performed at the beginning of the treatment, it normally takes 6-8 minutes to complete, and is done in the first 30 minutes of the treatment. If it is noted that the recirculation is not taken touch BTM and the Recirculation I/O.

It is the nurses' responsibility to ensure the recirculation measurement is performed and interpreted. If the recirculation is low less than 10% there is no further action required. If the recirculation is high (above 20%) check the access (ensure needles are positioned and connected correctly, ensue no kinks in the blood lines, check circulation with CVC line reversal). If the recirculation stays the same (above 20%) the patient may have a high cardiopulmonary recirculation. To determine if the recirculation is contributed from cardiopulmonary recirculation or due to access recirculation decrease or increase the blood flow rate by 100mLs/min and repeat the circulation. If the recirculation remains unchanged (or has a minimal change) with the fluctuating of blood flow, this is indicative of cardiopulmonary recirculation. If the change in recirculation is greater than 10% the recirculation is indicative of access recirculation (Lopot, Svara, & Polakovic, 2006).

Acceptable Recirculation %: 0-20%.

If recirculation is above 20%, troubleshooting/ repeating/consultation with vascular access nurse/ nephrologist needed.

Conclusion:

The vascular access is the patient's lifeline needed for life sustaining hemodialysis treatment. Hemodialysis staff and patients need to be aware of the importance of the monitoring, care of, and preservation of the vascular access.

Important: If vascular access dysfunction is noted it is important to consult the nephrologist and the vascular access nurse. There are interventions that can be employed to aid in the salvaging of the vascular access.

For any AVF/AVG/BHAVF, a venogram (fistulagram) can be performed to view the vascular access. If any issues like stenosis are noted the access can undergo angioplasty. If clotting is noted, a thrombolytic can be infused to break up clotting.

For any CVC, a line can be rethreaded into another vessel or a new line can be inserted.

These procedures will be completed in interventional radiology. Bloodwork needed prior to the intervention include CBC and PTI. If additional bloodwork is required, preadmission with give the patient a bloodwork requisition slip.

Module 4 Evaluation

Vascular Access

1. _______________ is the best vascular access (least amount of complications)

a) Arteriovenous fistula

b) Arteriovenous graft

c) Arteriovenous button hole fistula

d) Tunneled central venous catheter

e) Temporary central venous catheter

2. The dressing and Tego® of a central venous catheter should be changed _______ often

a) Every treatment

b) When integrity is compromised

c) Once a week

d) Once a month

3. The entrance and exit suture of a central venous catheter should be removed after _____ and _______ days

a) 4 and 7

b) 7 and 14

c) 14 and 7

d) 1 and 5

e) 7 and 4

f) 5 and 1

4. When changing a central venous catheter if using bridine you need to allow it to dry for ___________ minutes, if using chlorohexidine you need to allow it to dry for _____________ minutes.

a) 5 minutes and 2 minutes

b) 2 minutes and 2 minutes

c) 3 minutes and 5 minutes

d) 2 minutes and 5 minutes

5. If creating buttonholes it is important that they be created with: (select all that apply)

a) Same cannulator

b) Same cannulation areas

c) Same angle of depth

d) Same needle gauge

6. Prior to having an arteriovenous fistula created, vein perseveration will begin. This involves saving the veins by avoiding ______________ in the arm that is to have the fistula created (select all that apply)

a) Blood Pressure

b) Pulse

c) Bloodwork

d) PICC lines inserted

e) IV insertion

f) Pulse oximetry readings

7. It normally takes approximately ____ minutes of compression for the fistula to achieve hemostasis post hemodialysis

a) 2 minutes

b) 5 minutes

c) 10 minutes

e) 15 minutes

8. What is the maximum arterial and venous pressures that are acceptable to dialyze with for any developed vascular access?

a) -200/+200

b)-195/+195

c)-230/+230

d)-250/+250

9. If no thrill was felt during prior to cannulation, it is important to:

a) Initiate hemodialysis as a life sustaining treatment

b) Use a smaller gauge needle for cannulation

c) Attempt cannulation and contact vascular access nurse

d) Notify nephrologist/vascular access nurse

10. If no bruit was heard during prior to cannulation, it is important to:

a) Initiate hemodialysis as a life sustaining treatment

b) Use a smaller gauge needle for cannulation

c) Understand that sometimes a bruit will not be present

d) Notify nephrologist/vascular access nurse

11. If a patient is unable to maintain at least a _____ blood flow rate __________is the appropriate nursing intervention?

a) 200mL/min: flushing and reversing of central venous catheter lines

b) 220mL/min: decreasing blood flow rate (decreasing pump speed)

c) 250mL/min: Cathflo® protocol

d) 200mL/min: patient readjustment/ repositioning

12. A new arteriovenous fistula will start the new fistula protocol using ____________ gauge needles

a) 14

b) 15

c) 16

d) 17

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Module 5

Hemodialysis Medications

Purpose: A variety of medications are indicated in use in the ESRD population in order to replace the functioning of the now non-functional kidneys. Medication regimes for patients are individualized and dynamic and change often in duration, frequency, and dosage based on patient's subjective feelings and bloodwork results. Due to this, medication regimes are continuously assessed and adjusted by both the physician and the clinical hemodialysis pharmacist. The purpose of this module is to introduce the medications commonly administered during hemodialysis.

Learning Objectives: After completing this module the learner will complete a post test that will measure the learner's ability to:

- Describe the role of the kidney in medication absorption and excretion.
- Identify the medications commonly administered during hemodialysis.
- Explain how to administer mediations intravenously through the hemodialysis machine
- Demonstrate how to administer medications intravenously though the hemodialysis machine.

Administration of Medications to Patients with End-Stage Renal Disease:

The kidneys play a key role in the metabolizing and excretion of medications. With ESRD, the production of drug-metabolizing enzymes, and drug transporters available in the normal functioning kidney is decreased, consequently leading to a decrease in the level of drug metabolism and excretion (Yeung, Shen, Thummel, & Himmelfarb, 2014). With an inability to remove medications taken at the rate of a normal functioning kidney, ESRD patients are at a risk for drug toxicity if medication metabolites are not excreted from the body. Due to this, often once a patient is diagnosed with ESRD, all medications will be reviewed and if needed, adjusted, to account for this decrease in medication metabolism and excretion. With the pharmacotherapeutic principles involved being complex, it is important to ensure medication reconciliations are done on a regular basis (suggested every six weeks). Hemodialysis patients are at a high risk for medication discrepancies, and if not ordered by a nephrologist, the potential for non-therapeutic or toxic dosages of medications prescribed (Patricia & Foote, 2016).

The Dialysis of Drugs booklet by Bailie & Mason, (2013) provides an extensive list of the medications that are dialyzed out during a treatment and those that are not. Most medications are dialyzed out during hemodialysis. However, if ever uncertain, consult with clinical pharmacist, or use clinical tools such as Up to Date, CPS, or reputable resources that can be found online such as the Dialysis of Drugs booklet.

The dialyzability of a medication is dependent upon:

- Molecular Weight.
- Protein Binding.
- Volume of Distribution.
- Water Solubility.
- Plasma Clearance.
- Dialysis Membrane.
- Blood and Dialysate Flow Rates.
- Permeability of Dialyzer.

Medications must be administered following the 6 rights of medication administration (6 R’s) which include: right dose, right time, right amount, right route, right patient, and right documentation.

Patient education surrounding medication administration should be provided by the nurse to ensure that the patient understands what their medications are, what the medications dose is, how to take the medication, and potential side effects that may occur from taking the medication (Lancaster, 2001).

<u>Dialysate:</u> The nephrologist will order what dialysate they want the patient on. The dialysate ordered will be dependent on a patient's serum potassium and calcium levels.

Maintaining stable potassium levels (3.5-5.0 mEq/L) is critical to reduce dyskalemia in hemodialysis patients. A patient that consistently has a high pre-dialysis serum potassium for example would not dialyze with a high potassium dialysate and therefore would probably be ordered a 1K+ or a 2K+ (Haras, 2015).

Maintaining stable calcium concertation attempts to manage serum calcium and phosphate balance to improve bone metabolism and to reduce arteriosclerosis and cardiovascular mortality. Low calcium dialysate (1.0) will aid in the use of Vitamin D and calcium-based phosphate binders with less risk of hypercalcemia and calcification. There is a risk of a low calcium dialysate predisposing to cardiac arrhythmias and interdialytic hypotension. Higher dialysate calcium (>1.25) are helpful in maintaining normal serum calcium levels when patients are not supplementing calcium. A calcium dialysate of 1.75mmol/L is helpful in the suppression of hyperparathyroidism. The risks of a higher calcium dialysate however are: hypercalcemia, metastatic calcification, and increased parathyroid hormone suppression (Alayoud, El Kabbaj, Benyahia, Asseraji, & Zemraoui, 2015).

Therefore, monitoring patient's bloodwork and signs and symptoms of hypo/hyper kalemia and calcemia is very important.

Note: The dialysate must be cosigned in the patient's Kardex by two nurses.

<u>Heparin: (Must be double signed on nursing Kardex)</u>

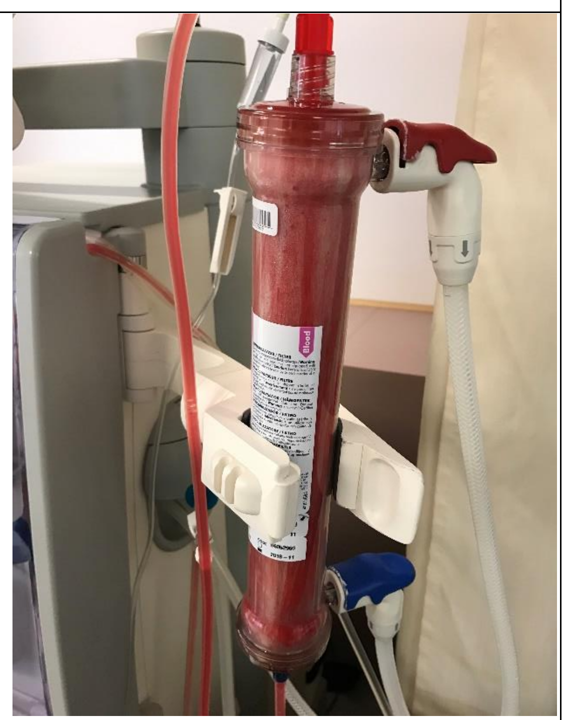
Figure 5.1: Heparin

1. An anti-coagulant, heparin binds to antithrombin preventing the formation of thrombus and blood clotting by blocking thrombin and activated factor X. Systematic anticoagulation with heparin aids in the prevention of extracorporeal clotting and ultimately extracorporeal system/ patient blood loss (Murea et al., 2017).

Heparinization of the patient will be ordered by the physician. It is the responsibility of the nurse to monitor heparization during the hemodialysis treatment and to report if there are any issues noted with the prescribed heparin ordered. This includes:

- Bleeding. Prior to the start of every treatment the patient will be asked if there were any issues with bleeding since last hemodialysis day. If patient is actively bleeding, heparin should be held, the physician should be notified, and patient should receive a heparin free dialysis treatment until the bleeding resolves. Note: Severity of bleeding will dictate the nurses' judgement in wheatear to contact the physician regarding the heparin bolus/infusion. If the patient has a nosebleed and does not lose a lot of blood for example, heparin may not need to be held.
- Loss of extracorporeal circuit. If issues noted with clotting during treatment or noticed in the dialyzer and or venous chamber after hemodialysis treatment, the heparin bolus and or infusion may need to be increased by the physician.

Example of a dialyzer post reinfusion where there is no clotting or streaking seen (suggests proper heparinization).



Example of a dialyzer post reinfusion where there is evidence of streaking seen (suggests the need for a heparin dosage adjustment).

Figure 5.2: Dialyzer post reinfusion.

Heparin Bolus: The heparin bolus is given immediately after the treatment is started.

Heparin Infusion: The heparin infusion is given intralytically hourly during the hemodialysis treatment to prevent systematic clotting.

Stop Time: The stop time for heparin is dependent upon the vascular access of the patient.

Note: The heparin bolus and heparin infusion must be cosigned in the patient's Kardex by two nurses.

Vascular Access	**Stop Time**
Arteriovenous (AV) Fistula	60 minutes [1 hour]
Arteriovenous (AV) Graft	60 minutes [1 hour]
Central Venous Catheter [Tunneled or Temporary]	0 minutes
• Special Considerations: Depending upon the amount of time it takes a patient to stop bleeding from their AV fistula or AV graft the stop time of the heparin may be individualized. If a patient bleeds and must hold longer than the typical 10 minutes' heparin stop time may be increased. • Note: If using 1-1 dialysis (one needle in AVF/AVG/BHAVF for one access and CVC for other) you always go with the stop time of the AVF/AVG/BHAVF therefore, 60 minutes [1 hour].	

Activated Coagulation Time (ACT):

The ability of the blood to clot is checked by the ACT. The ACT will dictate the patient's heparin bolus, infusion, and stop time. The ACT will be checked at 10 minutes into the treatment (to test adequacy of the heparin bolus) and at 90 minutes (to test adequacy of the heparin infusion).

<u>Supplies Needed:</u>

3mL syringe

ACT tester and machine vial

Gloves (non-sterile)

Chlorhexidine

20 gauge needle

Figure 5.3: ACT Machine

<u>Procedure:</u>

1] Ensure ACT machine on and ready.

2]Disinfect the arterial port with chlorohexidine

3] Insert needle (attached to syringe) into the arterial port.

4] Withdraw 0.6mLs of whole blood.

5] Inject 0.6mL of whole blood into the ACT tube and withdraw 0.6mL of air.

6] Place tube in ACT machine and press start.

Normal results are between the range of 150-250 seconds (the higher the seconds, the longer the blood takes to clot). If the range is below 150, the patient **does not have enough** heparin. If the range is above 250 seconds the patient **has too much** heparin (Contemporary Nephrology Nursing: Principles and Practice, 2006).

Calculation of Heparin:

Dialyzer: FX 800 Concentrate: 2K 1.5CA Prescription Bicarbonate: 34 Prescription Sodium: 138 Sodium Profile: Treatment Time: 4:00 Frequency: 3 times a week Dry Weight (Kg): 63.0 Heparin Bolus (units): 1500 Heparin Infusion (units per hour): 800 Heparin Pre Stop Time (minutes): 0 Dialysate Temperature (C): 36.0	• Ordered 800 unit infusion for 4 hours • Stop time 0 minutes (Central Venous Catheter) • 800 units x 4 hours= 3200 units 3200 unit for infusion +

Figure 5.3: View of a patient's heparin hemodialysis orders (as seen in the administration data)

	1500 units for bolus=4700 units • 4700 units + 1000 units (Heparin line prime) = 5700 • Heparin 1000 units in 1 mL Or 1000units/mL Therefore 5.7 mLs needed

<u>Citrasate® Bath</u>: Patients that are ordered heparin free dialysis can be dialyzed with <u>no</u> heparin and <u>no</u> flushes with a Citrasate® bath. The Citrasate® bath is composed with 2.4 mEq/L of calcium. This allows for the chelation of free localized calcium that is responsible for the anti-coagulation of the clotting cascade (BC Renal Agency, 2013).

Figure 5.4: Citrasate Bath

<u>Heparin-Free Dialysis:</u>

Indications for not using heparin may include:

- Allergy
- Active bleeding

Heparin-free dialysis includes using 100 mL of normal saline flushes every 30 minutes after the initiation of the hemodialysis treatment to prevent blood stagnation and clotting formation during the hemodialysis treatment. Once hemodialysis treatment is started, every 30 minutes of treatment time the patient will need to receive a bolus with 100mLs of normal saline. The amount of the normal saline that will be needed throughout the treatment for the initiation of heparin free dialysis will need to be included in the overall goal of the patient’s weight worked. Below are some examples:

	Treatment Time 4:00 hours	**Treatment Time 3:30 hours**
	Hemodialysis start time: 0700	Hemodialysis start time: 1600
	Flush 100mLs at 0730	Flush 100mLs at 1630
	Flush 100mLs at 0800	Flush 100mLs at 1700
	Flush 100mLs at 0830	Flush 100mLs at 1730
	Flush 100mLs at 0900	Flush 100mLs at 1800
	Flush 100mLs at 0930	Flush 100mLs at 1830
	Flush 100mLs at 1000	Flush 100mLs at 1900
	Flush 100mLs at 1030	________________________
	Total amount of flushes needed 700mLs	Total amount of flushes needed 600mLs

Calcium Supplements:

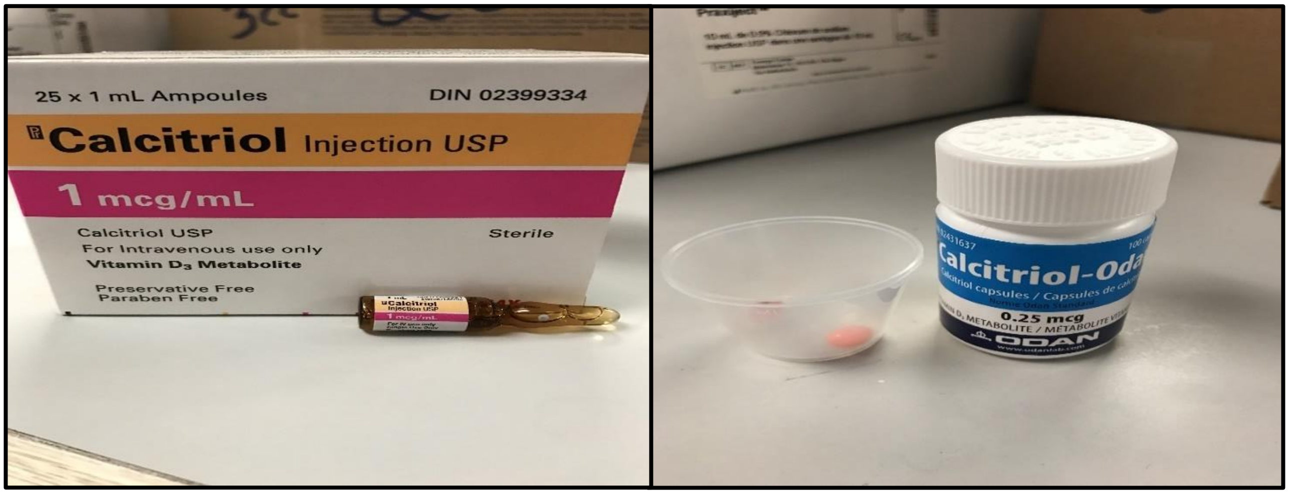


Figure 5.5. Forms of vitamin D supplementation

Maintaining calcium balance is important to improve bone metabolism and to reduce arteriosclerosis and cardiovascular mortality. ESRD patients have a decreased ability to absorb calcium due to a lack of activated Vitamin D. The presence of activated Vitamin D is necessary to absorb calcium (Alayoud, El Kabbaj, Benyahia, Asseraji, & Zemraoui, 2015; Parikh, Gutgarts, Eisenberg, & Melamed, 2015).

Patients are commonly ordered Rocaltrol® (oral supplement) and Calcitriol (Calcijex®) (intravenous injection). Rocaltrol® is typically taken orally at home. Calcitriol (Calcijex®) is administered by the nurse working in hemodialysis intravenously though the hemodialysis machine in the medication port.

Cinacalcet (Sensipar®), is a calcimimetic agent. It treats overactive parathyroid glands and reduces high serum blood calcium in patients with secondary hyperparathyroidism by targeting calcium receptors to lower parathyroid hormone, calcium, and phosphorous levels (Messa et al., 2008).

Phosphate Binders:

Without the ability of the kidney to excrete phosphate, ESRD patients experience hyperphosphatemia, or high serum phosphate. In patients with ESRD, phosphate input and intestinal absorption need to be addressed (Writers, 2013).

Note: Patient education surrounding phosphate binders is extremely important as patients *must take these medications with food.* When taken with food, the phosphate binder medication will bind with the phosphate of the food to aid in its excretion. There are a variety of phosphate binders available and include medications that are calcium-based binders, or non-calcium-based binders.

Calcium-based binders:	**Non-Calcium based binders:**
Calcium Carbonate (Os-Cal®, Tums®) Calcium Acetate (PhosLo®)	Sevelamer Hydrochloride (Renagel®) Lanthanum Carbonate Magnesium Carbonate Iron-Magnesium Hydroxycarbonate Aluminium Hydroxide

Figure 5.6: Tums®, a commonly used phosphate binder

Iron Derivatives & Erythropoietin (EPO or ESA (Erythropoietin Stimulating Agent):

Figure 5.7. From left to right: Ferrlecit®, Aranesp®, and Venofer®

The kidneys are responsible in the release of erythropoietin which contributes to red blood cell production. In patients with ESRD, this release is absent or lessened, therefore not as many red blood cells are produced, leading to anemia.

Serum iron is also pivotal in the production of hemoglobin (oxygen carrying capacity) on red blood cells.

Iron Derivatives: The need for iron supplementation is determined by the patients' hemoglobin, transferrin saturation, and ferritin levels (National Kidney Foundation, 2015).

Transferrin Saturation & Ferritin:

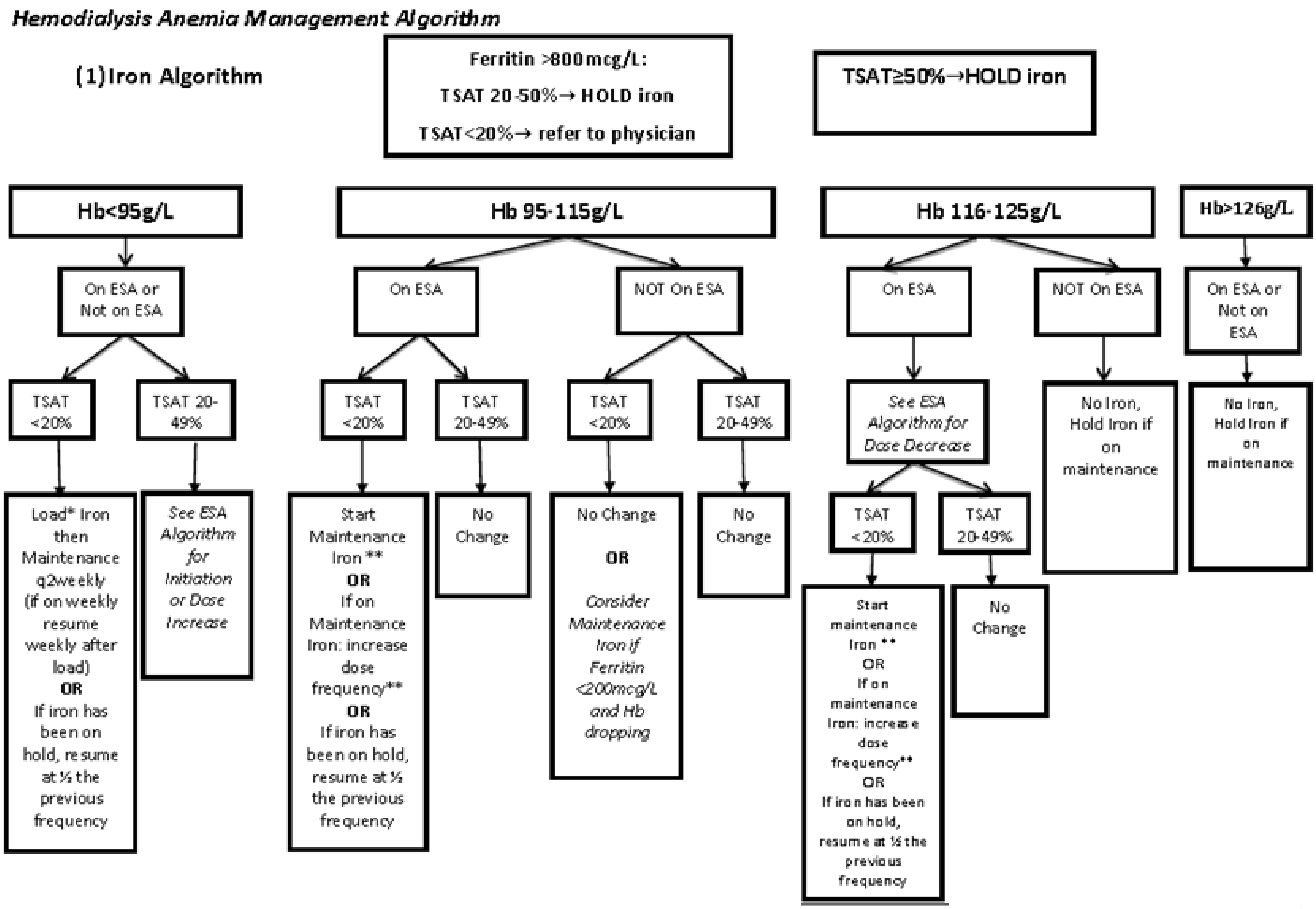
- Iron is needed to make red blood cells. Most ESRD patients are anemic and need help to maintain iron store levels.

-Transferrin Saturation (TSAT) measures how much stored iron can be used to make red blood cells. TSAT should be at 20%

-Ferritin measures how much iron is stored in the body. The ferritin level should be at 200ng/mL

Algorithm used to determine if a patient needs iron supplementation (See figure 5.8 below).

Figure 5.8: Iron Anemia Management Algorithm



There are two common forms of IV iron used:

1] Sodium Ferric Gluconate [Ferrlecit ®]

2] Iron Sucrose [Venofer®]

<u>Preparation:</u> When ordered as 125mg of Ferrlecit ® and 100mg of Venofer®, the medication is to be mixed in 100mL mini-bag of normal saline. 125 mg of Ferrlecit® is to be infused over 1 hour and 100mg of Venofer® is to be infused over 30 minutes. The medication should be infused **<u>after</u>** the patient has commenced hemodialysis.

<u>Frequency:</u> Depending upon patient's blood work (TSAT and ferritin) supplementation would typically be ordered first as a IV iron loading dose of:

125mg of Ferrlecit IV with each hemodialysis x 8 doses

Or

100mg of Venofer IV with each hemodialysis x 10 doses

Followed by a maintenance dose of iron weekly, biweekly, or monthly based on the above algorithm.

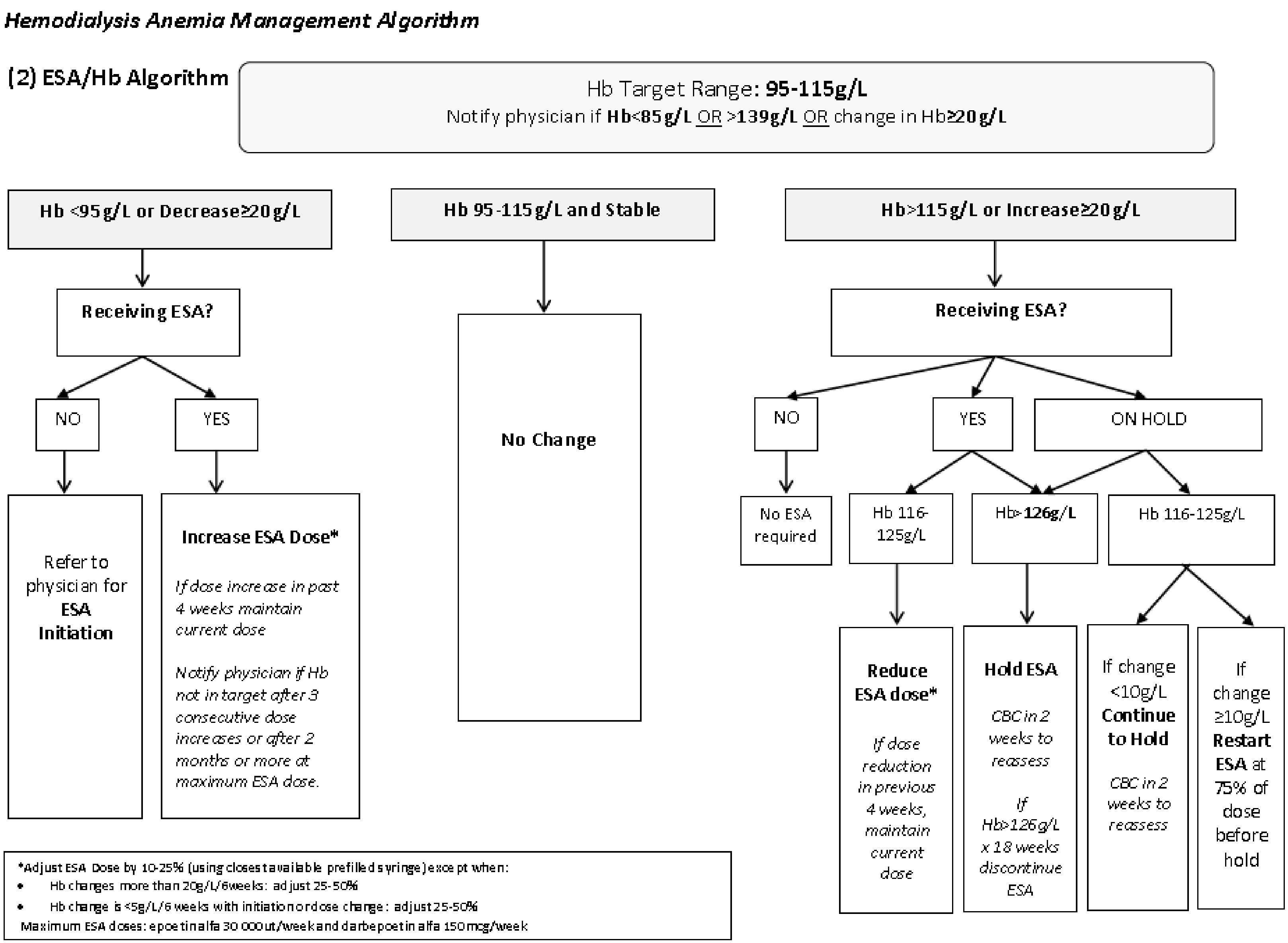
<u>Administration:</u> Iron supplementation is administered as a IV infusion.

<u>Side Effects:</u> The major potential side effect of iron supplementation is a hypersensitivity reaction (life-threatening and or fatal anaphylactic reaction). Therefore, it is important to administer iron supplementation after the first 30 minutes of hemodialysis so there is time to monitor patient status post administration (at least one hour of monitoring post infusion).

<u>Erythropoietin:</u> The need for erythropoietin supplementation is dependent upon a patient's hemoglobin level.

Algorithm used to determine if a patient needs erythropoietin supplementation (See figure 5.9).

Figure 5.9: ESA Anemia Management Algorithm



There are two forms of erythropoietin used in our hemodialysis facilities:

1] Aranesp® (darbepoetin alfa)

2] Eprex® (epoetin alfa)

Note: Aranesp® is the most used ESA in the hemodialysis setting. Eprex® is used when Aranesp® is contraindicated (i.e. allergy).

<u>Preparation:</u> Both Aranesp® and Eprex® come in pre-filled syringes in varying dosages. Therefore, there is no preparation of medication needed prior to administration.

<u>Frequency:</u> The frequency of the ESA is dependent on the patient's hemoglobin level and on the ESA algorithm (figure 5.9).

<u>Administration:</u> ESA is administered as a IV injection.

<u>Side Effects:</u> Hypertension, blood clots, increased rate of cancer growth (patients with active cancers are **never** prescribed ESA unless otherwise indicated) (Aranesp, 2015).

<u>Intravenous Antibiotics **[RN ONLY]**:</u>

Hemodialysis patients are at an increased risk of infection. Therefore, the need for the administration of IV antibiotics may arise. Most antibiotics are dialyzed out during hemodialysis and therefore must be administered post hemodialysis. IV infusions of antibiotics can be connected to the patient's vascular access and infused (AVF/AVG/BHAVF/ or CVC) once hemodialysis is completed. It is important to check the Dialysis of Drugs booklet by Bailie & Mason, (2013) to determine which antibiotics are dialyzed out and which are not. One commonly used antibiotic that is not dialyzed out and can be administered as an IV infusion during hemodialysis in the last 30-60 minutes is Vancomycin (Bailie & Mason, 2013).

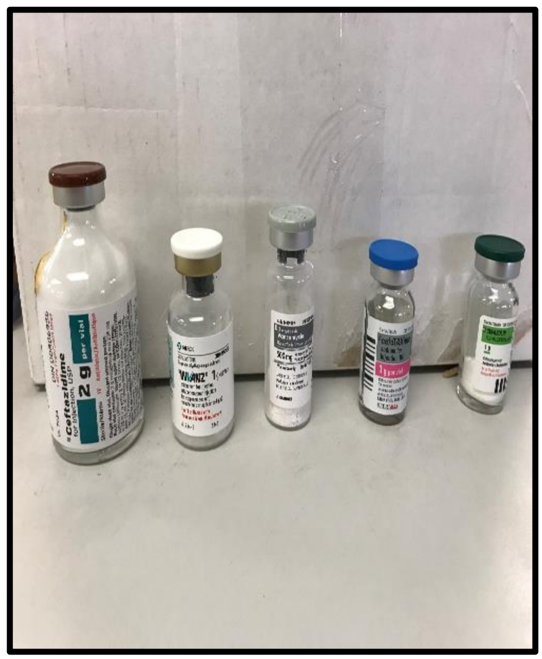


Figure 5.10: Types of antibiotics utilized in hemodialysis

Central Venous Catheter Locking Solutions:

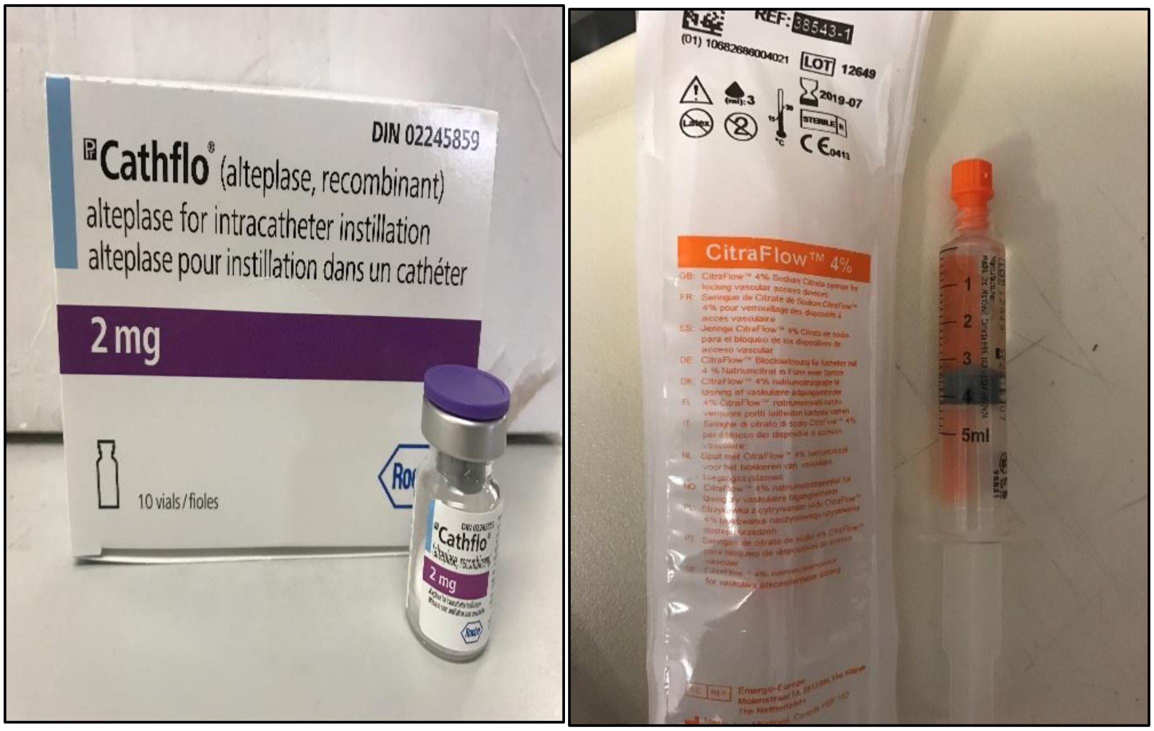


Figure 5.11: Types of locking solutions

Central venous catheters are prone to infection from biofilm, catheter hub contamination, or colonization of the catheter. This infection increases the risk of intraluminal thrombosis. Therefore, if a patient has a CVC, after hemodialysis is completed it is important to close (or lock) the line with an antithrombotic to prevent clotting and infection of the vascular access (Franklin, 2017). Two antithrombotic medications used in hemodialysis currently include CitraFlow 4% (4% sodium citrate) or Cathflo**®.**

Locking the central venous catheter post hemodialysis involves filling the catheter lumen to lumen length with a 0.2mL overfill. Therefore, if the lumen length is 1.6mLs then the locking solution should be 1.8mLs (1.6mLs + 0.2mLs overfill).

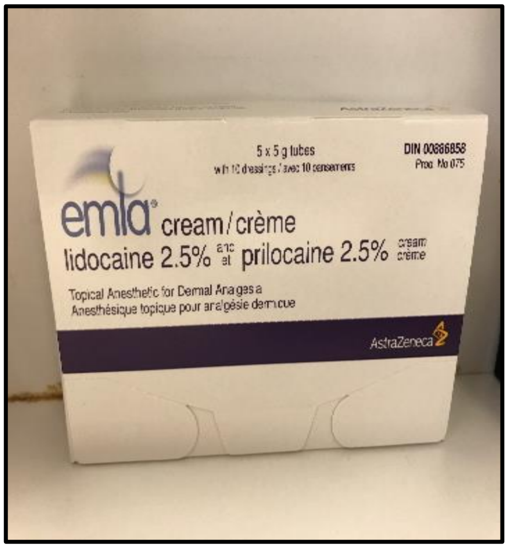


Figure 5.12: Elma® cream

<u>Elma Cream®:</u>

Elma cream is a 1:1 combination of 2.5% lidocaine and prilocaine. It has been found to have analgesic effects when applied topically 45 minutes prior to cannulation. Hemodialysis patients that are being cannulated often will use Elma Cream® for its analgesic properties (Miller, Balakrishnan, Eichbauer, & Betley, 2001).

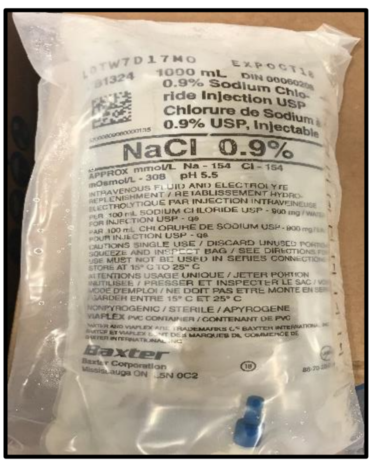


Figure 5.13: Normal Saline (used to prime machine and for patient complications)

<u>NaCl:</u>

Normal saline is used in the priming of the hemodialysis machine, and for treatment of hypotension and muscle cramping.

<u>Blood Pressure Support:</u> Hemodialysis patients will often experience hypotension when having hemodialysis treatment. Ideally, primary prevention of hypotension increases the chances of an effective treatment with minimal complications. Often, patients will be prescribed Midodrine Hydrochloride (Midodrine®) or Pseudoephedrine (Sudafed®) for blood pressure support to be taken orally pre-hemodialysis.

Midodrine®: An oral alpha-1 adrenergic agonist, Midodrine®, can treat hypotension when taken 30 minutes prior to hemodialysis (Anstey et al., 2017).

Sudafed®: A common ingredient in over 135 medications, Sudafed® has been found to increase systolic blood pressure when taken. When ordered, patients are prescribed to take this medication 30 minutes prior to hemodialysis (Berbano, Jackson, & Salerno, 2005).

Figure 5.14: On top (Sudafed®)

On bottom (Midrodrine®)

Used for blood pressure support

Vitamin Replacement:

Figure 5.15: Replavites®, vitamin replacement

ESRD patient's due to dysgeusia, loss of appetite, and fluid and diet restrictions are at an elevated risk of nutrient deficiencies. Furthermore, once hemodialysis is initiated, water soluble vitamins are often dialyzed out. Due to this, it is important to replace the vitamin losses post hemodialysis. Patients are most often ordered *Replavites® 2 tablets po post q HD*. If a patient has a sensitivity or side effect from Replavites® an alternative vitamin replacement is Vitamin B-50 Complex® (BC Renal Agency, 2011).

Home Medications:

In addition to the medications that are administered in the hemodialysis unit, ESRD patients are typically prescribed an abundance of other medications to treat symptoms/ potentiating factors of ESRD at home (Lancaster, 2001).

1. Antihypertensive (for regulation of blood pressure).
   One of the biggest contributing factors predisposing ESRD is hypertension. Due to this, often patients are prescribed a variety of antihypertensive medications for blood pressure regulation. Some of the classifications of antihypertensive prescribed include:

Angiotensin-converting enzyme (ACE) inhibitors: (Denker & Cohen, 2015).
-Works by blocking angiotensin I to angiotensin II. Medications ending in "pril" Medications include:
Benazepril (Lotensin®)
Enalapril (Vasotec®)

Fosinopril (Monopril®)

Lisinopril (Prinivil®, Zestril®)

Quinapril (Accupril®)

Ramipril (Altace®)

Side Effects:
-Chronic Cough.
-May need dosage adjustment as medications can be dialyzed.
-Monitor for orthostatic hypotension.
-Liver damage reported (monitor liver function).
- Monitor for hyperkalemia.

Angiotensin II receptor blockers (ARBs): (Denker & Cohen, 2015).
-Prevents angiotensin II from being activated, causing relaxation and vasodilation. Medications ending in “sartan”.
Medications include:
Candesartan (Atacand®)

Irbesartan (Avapro®).

Losartan (Cozaar®).

Side Effects: ARBs have less side effects when compared with ACE inhibitors.

Sympatholytic (including Beta-Blockers and Central Alpha-Agonists) (Denker & Cohen, 2015).

Beta-Blockers. Medications ending in “lols”: Hemodialysis patients have increased SNS activity with cardiac arrest and arrhythmias accounting for ¼ of all deaths. Beta-blockers decrease the heart rate and blood pressure by blocking beta-receptor sites from norepinephrine and epinephrine activation.
Medications include:
Atenolol (Tenormin®)

Labetalol (Trandate®)

Metoprolol (Lopressor®)

Nadolol (Corgard®)

Propranolol (Inderal®)

Side Effects:
-Monitor glucose levels as beta-blockers can mask hypoglycemia.
-Monitor apical pulse as medications may decrease blood pressure and pulse.

Central Alpha-Agonists: Cause brain simulation decrease sympathetic nervous activity in peripheral blood vessels, lowering blood pressure by constriction of vascular arterioles.
Medications include:
Clonidine (Catapres®)

Side Effects:
-Monitor glucose levels as beta-blockers can mask hypoglycemia.
-Monitor apical pulse as medications may decrease blood pressure and pulse.

Vasodilators: Decrease blood pressure by relaxing smooth muscle in the arterioles.
Medications include:
Hydralazine (Apresoline®).
Minoxidil (Loniten®)

Side Effects:
-Reflex tachycardia and angina.
- Minoxidil (Loniten®) may cause pericardial effusion.

Calcium Channel Blockers: Decrease blood pressure by restricting the amount of calcium that can enter cells. Decreasing calcium, decreases the ability of the vasculature to contract.
Medications include:
Amlodipine (Norvasc®).

Role of the Clinical Pharmacist:

The clinical pharmacist has a diverse role in the hemodialysis unit. Eastern Health policy distinguishes the scope of practice of a pharmacist employed within the nephrology unit. Current policy states that a pharmacist can interpret blood work results and adjust the following medications:

- Independently increase or decrease ESA dosage/frequency.
- Independently increase or decrease IV iron dosage/frequency.
- Start a patient on ESA if patient has been prescribed ESA in the past.
- Start a patient on IV iron if the patient has been prescribed IV iron in the past.

The pharmacist cannot:

- Start a patient on iron or ESA for the first time.

Administration of Intravenous Medications:

IV medications administered through injection or through infusion can be administered via the hemodialysis machine through the venous medication port.

For IV injections:	For IV infusions:
Stop the blood pump.	Ensure clamp on the venous medication line is clamped (see figure 5.16).
Swab the venous medication port (see figure 5.16).	Connect primed IV infusion to the venous medication line. *[Note: Due to pressure on the machine the medication MUST be infused via a IV pump]*
Inject the medication into the venous medication port (blue port).	Once connected, unclamp the venous medication line (see figure 5.16).
Swab the venous medication port.	Infuse medication as per manufactures specifications.
Turn on the blood pump.	

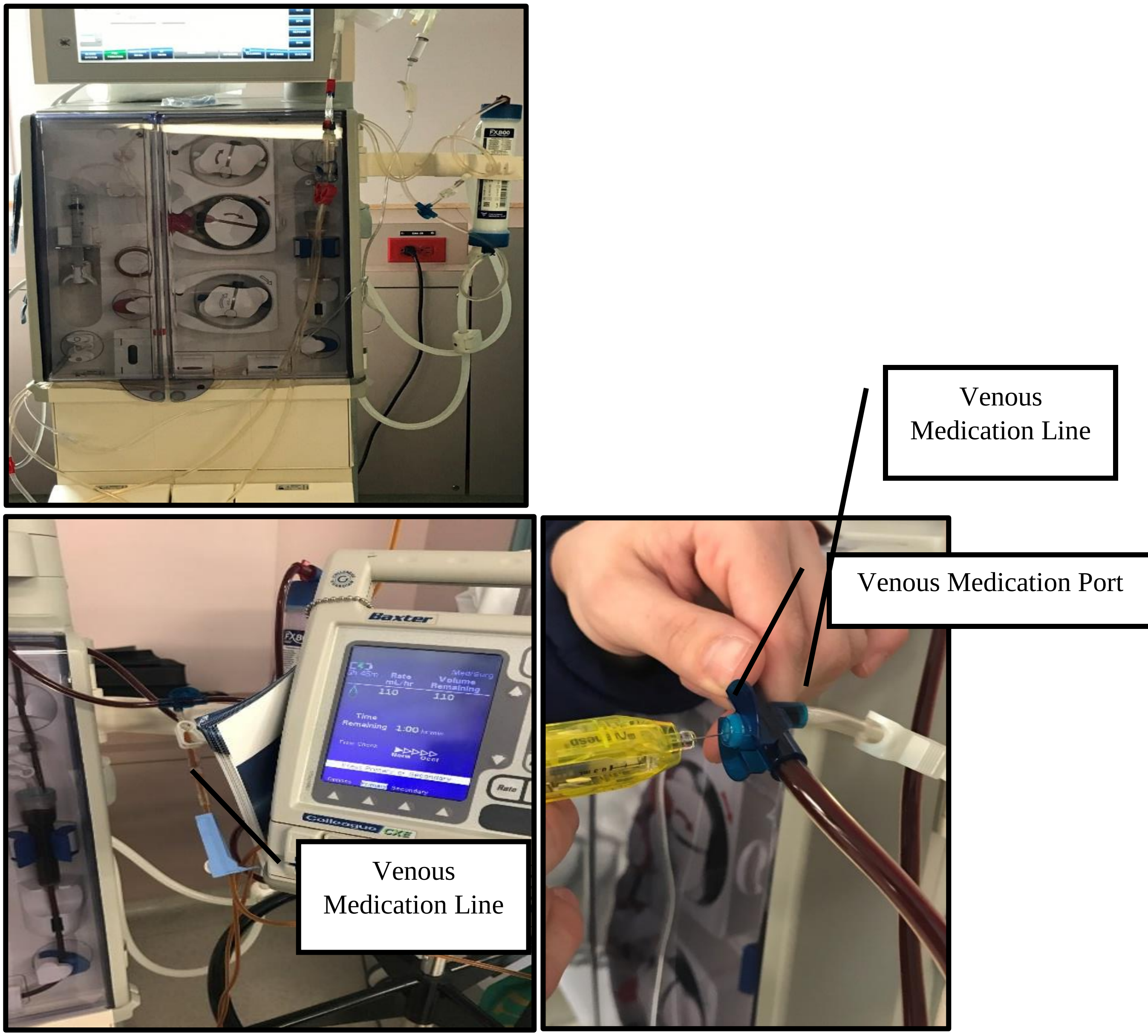


Figure 5.16: Depiction of where to inject and infuse hemodialysis medications

Module 5 Evaluation

Hemodialysis Medications

1. Calculate how much heparin you would draw up for the following patients:

	Total
Dialyzer: FX 1000 Concentrate: 2K 1.5 Ca Prescription Bicarbonate: 34 Prescription Sodium: 138 Sodium Profile: Treatment Time: 4HR-4.30HR Frequency: 3X WEEKLY Dry Weight (Kg): 89 kg Heparin Bolus (units): 1000 Heparin Infusion (units per hour): 1000 Heparin Pre Stop Time (minutes): 0 Dialysate Temperature (C): 35.5	
Dialyzer: Optiflux 250 Concentrate: 2 K 1.25 CA Prescription Bicarbonate: 34 Prescription Sodium: 138 Sodium Profile: Treatment Time: 4:15 Frequency: 3 TIMES A WEEK Dry Weight (Kg): 95.0 Heparin Bolus (units): 2600 Heparin Infusion (units per hour): 2000 Heparin Pre Stop Time (minutes): 60 Dialysate Temperature (C): 36.0	
Dialyzer: FX 1000 Concentrate: 3k 1.25 ca Prescription Bicarbonate: 34 Prescription Sodium: 136 Sodium Profile: Treatment Time: 3:30 Frequency: 3 TIMES A WEEK Dry Weight (Kg): Heparin Bolus (units): 1000 Heparin Infusion (units per hour): 1000 Heparin Pre Stop Time (minutes): 0 Dialysate Temperature (C): 36.5	

Dialyzer: FX 800
Concentrate: 2K 1.25Ca
Prescription Bicarbonate: 34
Prescription Sodium: 138
Sodium Profile: NOT ORDERED

Treatment Time: 3:30
Frequency: 2x week
Dry Weight (Kg): 57.0

Heparin Bolus (units): 1000
Heparin Infusion (units per hour): 1000
Heparin Pre Stop Time (minutes): 0
Dialysate Temperature (C): 36.5

Dialyzer: FX 1000
Concentrate: 2K 1.25Ca
Prescription Bicarbonate: 34.0
Prescription Sodium: 141
Sodium Profile: PROFILE #1 START AT 148

Treatment Time: 4:00
Frequency: 3 times a week
Dry Weight (Kg): 86.5kg

Heparin Bolus (units): 1000
Heparin Infusion (units per hour): 500
Heparin Pre Stop Time (minutes): 120
Dialysate Temperature (C): 36.0

Dialyzer: FX800
Concentrate: 4k 1.25ca
Prescription Bicarbonate: 34
Prescription Sodium: 138
Sodium Profile:

Treatment Time: 3:30
Frequency: 3 TIMES A WEEK
Dry Weight (Kg): 62.5

Heparin Bolus (units): 2000
Heparin Infusion (units per hour): 1500
Heparin Pre Stop Time (minutes): 60
Dialysate Temperature (C): 36

Dialyzer: Optiflux 250 Concentrate: 3K 1.25Ca
Prescription Bicarbonate: 34 Prescription Sodium: 138
Sodium Profile: No Profile

Treatment Time: 4:00 Frequency: 3 X WEEK
Dry Weight (Kg): 117.0 kg

Heparin Bolus (units): 1800
Heparin Infusion (units per hour): 1400
Heparin Pre Stop Time (minutes): 0.0 Dialysate Temperature (C): 36

Dialyzer: FX 1000 Concentrate: 3k 1.25 ca
Prescription Bicarbonate: 34 Prescription Sodium: 136
Sodium Profile:

Treatment Time: 3:30 Frequency: 3 TIMES A WEEK
Dry Weight (Kg):

Heparin Bolus (units): 1000
Heparin Infusion (units per hour): 1000
Heparin Pre Stop Time (minutes): 0 Dialysate Temperature (C): 36.5

Dialyzer: Opt 250 Concentrate: 3K 1.5Ca
Prescription Bicarbonate: 34 Prescription Sodium: 138
Sodium Profile:

Treatment Time: 3:30 Frequency: 3x/week
Dry Weight (Kg): 74.5 kg

Heparin Bolus (units): 1000
Heparin Infusion (units per hour): 1000
Heparin Pre Stop Time (minutes): 0 Dialysate Temperature (C): 36.5

Dialyzer: FX 1000	Concentrate: 2K 1.25ca bath
Prescription Bicarbonate: 34	Prescription Sodium: 140
Sodium Profile:	
Treatment Time: 4:00	Frequency: 3 X WEEK
Dry Weight (Kg): 81.8	
Heparin Bolus (units): 3000	
Heparin Infusion (units per hour): 1500	
Heparin Pre Stop Time (minutes): 60	Dialysate Temperature (C): 36

2. Which medication is used in hemodialysis to increase red blood cell production? (Select all that apply)

a) Eprex®

b) Aranesp®

c) Calcijex®

d) Replavites®

3. The clinical pharmacist of the hemodialysis unit under their scope of practice can: (select all that apply)

a) Start a patient on Eprex® or Aranesp® for the first time

b) Increase/decrease dosage of Eprex® or Aranesp®

c) Increase/ decrease frequency of Eprex® or Aranesp®

d) Discontinue Eprex® or Aranesp®

e) Start a patient on Ferrlecit® or Venofer® for the first time

f) Increase/ decrease dosage of Ferrlecit® or Venofer®

g) Increase/ decrease frequency of Ferrlecit® or Venofer®

h) Discontinue Ferrlecit® or Venofer®

i) Start a patient on Ferrlecit® or Venofer® whom received the medication 1 year ago

j) Start a patient on Eprex® or Aranesp® whom received the medication 1 year ago

4. When providing patient education surrounding phosphate binders' ______________ is the most important point

a) It is important to take the medication after meals

b) It is important to take the medication 1 hour prior to meal consumption

c) It is important to take the medication with meals

d) It is important to take the medication 1 hour post meal consumption

5. _________________ is the biggest risked side effect associated with iron supplementation in the hemodialysis population.

a) Hemolysis

b) Cardiac Arrest

c) Anaphylaxis

d) Cerebral Vascular Event

6. Which of the following actions are within the scope of the LPN practicing in the hemodialysis unit? (select all that apply).

a) IV iron infusions

b) IV antibiotic infusions

c) PO antibiotic administration

d) Cathflo® protocol

e) Cathflo® to close the central venous catheter post hemodialysis

f) Cannulation with 17 gauge needles

g) IV Aranesp® injections

7. If a patient is heparin free and receiving normal saline flushes how much normal saline would you need for a patient that dialyzes for 3:30 hours?

a) 500mLs

b) 600mLs

c) 700mLs

d) 400mLs

8. What machine value is an indicator that the extracorporeal system is clotting?

a) TMP

b) ART

c) VEN

d) Na

e) OCM

f) Kt/V

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Module 6

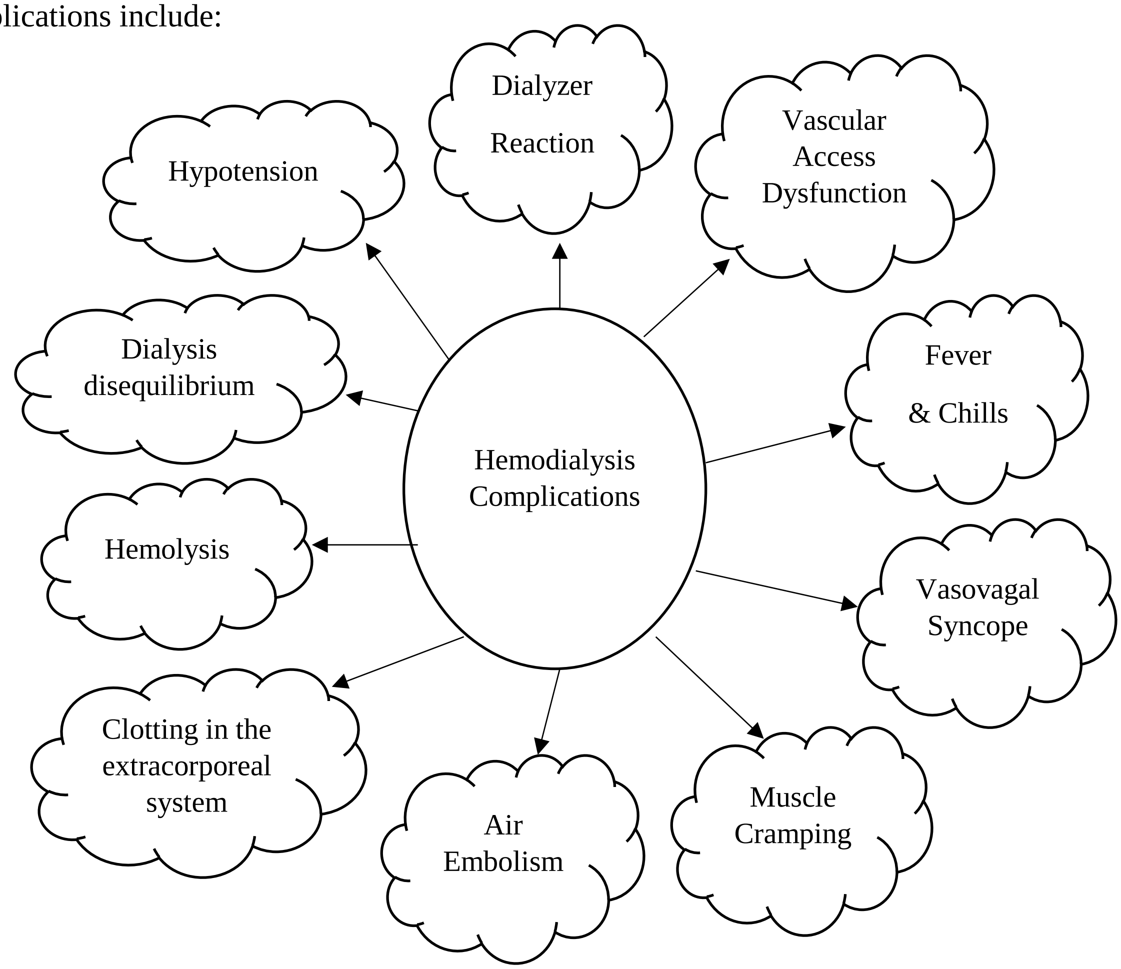
Hemodialysis Complications

<u>Purpose:</u> The goal of every hemodialysis treatment is to provide an effective and safe treatment to the patient. The ability to provide this treatment relies upon the nurses' skill of assessment. There are many complications that may arise during a hemodialysis treatment. It is the responsibility of the nurse to observe for, detect, and act accordingly on these complications to preserve patient safety.

<u>Learning Objectives:</u> After completing this module the learner will complete a post test that will measure the learner's ability to:

- List the most common compilations that may arise using hemodialysis treatment;
- Identify the cause(s) of the complications;
- Explain the ways in which a nurse can prevent these complications from occurring;
- Recognize various nursing interventions used to treat these complications once they occur.

Hemodialysis, as a treatment regime can potentiate treatment complications. These complications include:



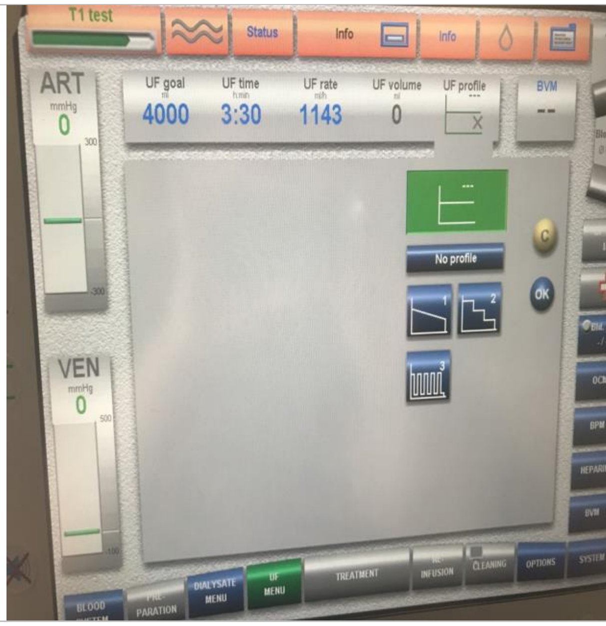
- Hypotension (Bradshaw, Bennett, & Hutchinson, 2017; Lancaster, 2001).
  A sudden drop in blood pressure during hemodialysis treatment. Hypotension is reported in 25%-50% of all hemodialysis treatments. Without immediate treatment, death may occur.

Causes

1] Rapid removal of fluid from the vascular blood compartment in the body. This occurs when the body does not have time for the blood compartment of the body to refill from the interstitial fluid compartment.

How can it be prevented?	Nursing Scope of Practice
➢ Patient education surrounding strict fluid monitoring intra hemodialysis treatments. The lower the total amount of fluid that needs to be taken off the lower the ultrafiltration (UF) goal. For example: A patient that does a 3-hour treatment that has 4L to remove will be	➢ Patient education surrounding fluid control. Recommended to limit fluid intake to

dialyzed at a UF rate of 1334mL/hr. If this patient monitored fluid intake and needed to only remove 2.5L the UF will be 834mL/hr. If too much fluid is gained intra hemodialysis treatments the patient may need to have an extra treatment to “catch up” on the excess fluid. This needs to be ordered by a nephrologist. ➢ The use of sodium (Na) profiling. Na profiling allows for the dialysate to regulate the amount of Na concentration delivered into the blood system. Water will shift from the lesser amount of Na initially to follow the higher Na in the blood, increasing the amount of fluid available for removal. ➢ The use of UF profiling or blood volume monitoring (BVM) [advanced nursing skill]. Blood volume monitoring uses information from the hemodialysis machine to monitor and detect the amount of fluid in the blood being dialyzed and adjusts the UF rate accordingly. The more fluid that is detected the higher the UF rate. There are 3 profiles available for UF control of fluid removal. UF profiles can start fluid removal at higher or varying rates allowing for the fluid to be removed more quickly at the beginning of the hemodialysis treatment when blood pressure is the highest and the patient is more saturated with fluid. It becomes more difficult to remove fluid as the treatment progresses and when the patient approaches their dry weight. UF Profile 1- Starts at high UF and progresses to lesser UF as the treatment time professes. UF Profile 2- Step progression. Three steps of UF starts at higher rate, then drops to middle rate, then drops to lower rate. UF Profile 3- Multiple breaks. UF starts at high rate, then goes low (to allow patient to refill), then it returns to high UF.	1L/day. Consider dietitian consultation. ➢ The use of BVM [advanced nursing practice] or UF profiles for UF control. ➢ If symptomatic hypotension place UF goal “on hold”. UF rate as close to 0 mL/hr. ➢ Monitor the use of Na profiling. ➢ Administer normal saline (NS) intravenously to increase blood volume. Typically you will do this in 100 – 200mL increments. There is a medical directive for this (See below). ➢ Have patient’s feet in an upright position and not hanging down. Feet that are not reclined shunts blood away from the body to the extremities, lowering blood pressure. ➢ Trendelenburg position. If a patient experiences symptomatic hypotension the steps to follow are: 1] Place patient on hold. 2] Recline chair [Trendelenburg Position] 3]Administer IV NS. 4]Check V/S. 5]Monitor patient status Note: When symptomatic hypotension occurs ask for help; generally, steps 1, 2, and 3 will occur simultaneously.



- Medical Directive for administration of normal saline:
  1] The nurse can administer by IV bolus up to 200mLs of normal saline during the treatment for treatment of hypotension. This can be repeated x 3 if required.
  2] Post hemodialysis if the patient's BP is low and they are symptomatic the nurse can administer by IV bolus up to 500mLs of normal saline for treatment of hypotension.
  If the patient needs more NS than what is indicated in the above medical directive contact the nephrologist. This medical directive can be found on the intranet. 210G-MDI-040

2] Aggressive ultrafiltration attempt for the hemodialysis treatment [and/or] improper calculation of target weight for hemodialysis treatment.

How can it be prevented?	Nursing Scope of Practice
➢ Astute patient fluid assessment. ➢ Consultation with other nursing staff regarding weight worked.	➢ Ensure to calculate weight worked in accordance with: -LPN 1.0% +/- the prescribed dry weight. -RN 1.5% +/- the prescribed dry weight. -With the net fluid removal calculation 12mL x weight worked (in kg) x treatment time (in hrs). -Rechecking of all mathematical workings. -If uncertain, have experienced staff member recheck the weight worked.

	➢ Maintain blood pressure using: UF breaks “on hold”, NS bolus, vital signs monitoring (more frequently if patient’s blood pressure low), and patient positioning (feet up and/or Trendelenburg position.

3] Food consumption whilst on the hemodialysis machine.

- When food is consumed whilst on the hemodialysis machine, circulating blood is shunted to the stomach to aid in the digestion process of the food just ate. Due to this loss of circulating blood, blood volume is lessened which can contribute to hypotension, GI upset, and nausea and vomiting.

How can it be prevented?	Nursing Scope of Practice
➢ Limitation of big meals while on hemodialysis should be encouraged. ➢ A light snack may be indicated in patients that can tolerate (for example diabetic patients). ➢ The ability to tolerate eating while on the machine is individualized. Some patients can tolerate eating whereas others cannot. ➢ Note: New hemodialysis patients (new starts) should not eat when just commencing treatment. Due to the nature of the hemodialysis treatment it is important to determine how the patient will tolerate the treatment. Eating while on the machine may co-contribute to complications.	➢ Patient education surrounding why eating is not recommended is pivotal to patient compliance. ➢ If patient does become hypotensive follow steps above for BP maintenance (maintain blood pressure using: UF breaks “on hold”, NS bolus, vital signs monitoring (more frequently if patient’s blood pressure low), and patient positioning (feet up and/or Trendelenburg position).

4] Medication use.

Due to the co-morbidities that contribute and precipitate kidney disease, patients are most often on antihypertensive medications as hypertension is one of the leading causes of ESRD. Generally, the nephrologist will often order patients to hold these medications prior to hemodialysis treatment as their effects:

1. Decrease blood pressure. Without a good blood pressure the ability to remove fluid is lessened. Often this will lead to not being able to achieve the UF goal or targeted dry weight which may lead to patient complications with fluid overload.
2. Decrease the irritability of the heart. This decrease prevents the heart rate from increasing during low blood pressure disabling the compensatory mechanism.
3. Inability for vasoconstriction. Vasoconstriction (contraction of vessels that causes a narrowing of blood vessels) causes an increase in blood pressure. Therefore, the inability for vasoconstriction limits the patient with an inability to compensate and increase blood pressure.

How can it be prevented?	**Nursing Scope of Practice**
➢ Have a nephrologist assess each patient for the need to hold these medications on hemodialysis days. **Most** patients hold these medications on hemodialysis days. This is on an individual basis and each patient needs to be assessed by a nephrologist.	➢ Patient education surrounding the need to hold (if applicable) medications that may contribute and/or potentiate hypotension.

➢ Muscle Cramping (Lancaster, 2001; Mastnardo et al., 2016).

Cramping of the muscles, particularly in the lower extremities can occur on hemodialysis related to the removal of fluid and waste products. Occurrence is seen in 25%-50% of patients and may occur while on dialysis in center, or following hemodialysis treatment.

Etiology of muscle cramping is not well known. It is thought that co-contributing factors are:

-Hypovolemia -Electrolyte imbalances -Dialysate composition

-Blood flow rate of machine -Ultrafiltration rate (mL/hr) -Hypotension

How can it be prevented?	**Nursing Scope of Practice**
➢ Encourage patients to control fluid gains intra hemodialysis treatments (less fluid to remove→ lower UF goal→ less potential for muscle cramping). ➢ Use of Na ramping.	➢ Administration of intravenous NS (volume expander) to counteract hypovolemia contributing to muscle cramping. This increases vasculature osmolarity drawing fluid from

➢ Use of BVM [advanced nursing skill] to monitor level of relative blood volume. ➢ Use of UF profiling to control the rate of fluid removal and patient refilling.	the interstitial compartment raising BP. ➢ Lower/lessen UF goal (to decrease UF rate). Allow the muscle cramping to subside and then recalculate when/if to place the patient back on from ultrafiltration on hold. ➢ Warm moisture compression. ➢ Cold (ice) compression. ➢ Stretching. ➢ Massage.

➢ Clotting in the extracorporeal system

Clotting in the extracorporeal system can happen for several reasons. Blood will begin to clot when it meets a foreign substance. This activates platelets to form fibrin which leads to thrombosis. In the hemodialysis setting where the patients are already susceptible to anemia the loss of an extracorporeal blood system that contains approximately 200mLs of blood is not ideal. There are several types of blood clotting that can occur in the hemodialysis treatment. Clotting that is mostly seen post hemodialysis post blood reinfusion is seen in the dialyzer or the venous chamber. Dialyzers can be clear, streaky, or clotted. If the dialyzer is not clear it should be brought to the nephrologist and the patient's heparin may need to be adjusted. This type of clotting generally does not hinder the dialysis treatment but the patient will have a loss of red blood cells as seen in the coagulated areas.

Another type of clotting is a complete extracorporeal system clotting. This clotting involves a major clotting of the dialyzer and/or blood lines that hinders the continuance of hemodialysis. If a patient's extracorporeal system clots completely the entire blood system (approximately 200mLs of blood) will be lost. An indicator of clotting in the extracorporeal system in the TMP (transmembrane pressure) alarm. The TMP measures the pressure exerted across the dialyzer. Typical TMP will run between 0-30 mm HG. If the TMP pressure begins to become negative this is an indicator of clotting. The closer the TMP is to 0 the more likely the system is clotting.

Some of the reasons why the extracorporeal system may clot include:

- Multiple machine alarms. When the machine alarms and a red light is indicated on top of the machine, the blood pump stops until the alarm is cleared. Each second this is prolonged increases the changes of blood coagulation. Therefore, it is pivotal to ensure to answer alarms promptly and to find the source of the alarm if it is consistently alarming.
- Low blood flow rates. The higher the blood flow rate the higher the turbulence of the blood that is flowing in the extracorporeal system. The turbulent blood has a

lessened change of coagulating and forming an occlusive thrombus in the hemodialysis circuit. (For example, a blood flow rate at 200mL/min would be much more likely to clot than a blood flow rate of 300mL/min).

- Inadequate anticoagulation (heparinization). The intravenous heparin bolus and infusion that are ordered for each patient will differ. Typically, patient's that are bigger (higher weight in kG) will need more heparin. This needs to be assessed each treatment and can be indicated depending on the dialyzer and venous chamber post reinfusion. If clotting or streaking is noted in either, notify the nephrologist to have heparin reassessed.

Dialyzer Type	Prime Volume (mL)
FX 800	500mL
FX 1000	500mL
Optiflux 250NR	500mL
AN69	1500mL

- Inadequate priming of the hemodialysis extracorporeal system. It is important that the extracorporeal system and dialyzer fibers are primed according to manufacturing recommendations. Without proper priming, blood from the patient may encounter a unprimed or "dry" part of the circuit causing it to clot. The prime amount (mL) will be determined by the dialyzer used. Currently in the hemodialysis unit there are four (4) dialyzer types: FX800, FX1000, Optiflux 250NR and AN69.
- Patients whom are contraindicated to use heparin. Heparin may be held during hemodialysis due to (a) patient bleeding or (b) heparin sensitivity. Prior to every hemodialysis treatment it is important to assess and ask the patient if there has been any bleeding since their last hemodialysis treatment. From this information, the nurse will make a decision whether or not to hold the heparin. For example, if a patient experienced +++ blood in their stool the heparin would be held. However, if the patient experienced a nose bleed that resolved quickly with minimal blood loss the heparin would not be held.
- For patients that are being dialyzed heparin free (without heparin) 100mLs of normal saline will be flushed through the extracorporeal system every 30 minutes to visualize the dialyzer and the venous chamber. Flushing serves two purposes (1) to visualize if clotting is occurring in the venous chamber and/or dialyzer and (2) to create turbulence in the extracorporeal system to prevent coagulation and thrombus formation of blood. If a lot of clotting or streaking is noted a decision needs to be made regarding the treatment. Since we do not want an extracorporeal blood system loss, if clotting or increased TMP is noted an option to save the blood within the system would be to reinfuse the patient and then reset up the machine (from the beginning) for treatment continuance.

➢ Dialysis Disequilibrium (Lancaster, 2001; Richey, 2015).

Dialysis disequilibrium is caused by a rapid removal of urea during hemodialysis. This rapid removal of urea shifts the osmotic gradients between the fluid compartments in the body. This leads to a shift of fluid from the plasma across the blood brain barrier, causing cerebral edema in the brain and cerebrospinal fluid which can cause neurological complications.

The blood brain barrier cannot remove urea as quickly from the brain and cerebrospinal fluid. When a patient starts hemodialysis, urea can be removed from the blood quickly and is directly influenced by how much blood is being processed, treatment time, the blood flow rate of the blood pump, and the dialyzer used.

Therefore, with dialysis the urea concentration of the blood will decrease dramatically quicker than the urea concentration in the brain and cerebrospinal fluid. This creates an unbalanced concretion gradient with higher urea in the brain and cerebrospinal fluid and less urea concertation in the body. The body attempts to compensate for this difference in concentration by shifting fluid into the brain which can contribute to cerebral edema.

When a patient is uremia (high urea) it is important that their urea concentrations be brought down slowly to prevent this from happening. Due to this, the nephrologist may often order for a decreased blood flow rate of 200mL/min -250mL/min, a shorter treatment time, and a smaller surface dialyzer. This allows the body to slowly remove toxins from the blood, allowing toxins in the brain adequate time to be removed as well. This prevents a major concertation gradient difference, reducing the potential for fluid shifting. Once the patient's urea starts to decrease, the blood flow rate, treatment time, and dialyzer used can be altered.

Signs and Symptoms of Dialysis Disequilibrium:

- Headache
- Nausea
- Vomiting
- Hypertension
- Seizure
- Decreased LOC
- Coma

How can it be prevented?	Nursing Scope of Practice
➢ Daily dialysis until urea is reduced (slow). ➢ Small surface area dialyzer. ➢ Decreased treatment times. ➢ Lower blood flow rates.	➢ Monitor newly started patients for signs and symptoms above. ➢ If symptoms are present it is important to administer an osmotic agent (for example

	normal saline) to equalize the concertation gradient between the blood and the brain/cerebrospinal fluid. ➢ It is important to note that dialysis disequilibrium is not only seen in new patients. It can be seen in patients that are: ➢ A] Under dialyzed. Patients that are under dialyzed are at a higher risk for uremia. If at a certain point these patients increase treatment time, frequency, dialyzer, or blood flow rates, it is possible for dialysis disequilibrium to occur. ➢ B] Patients that get a new vascular access. Patients that have poorly functioning vascular accesses are at risk for dialysis disequilibrium if they receive a new access that can effectively clean more blood thereby decreasing urea more efficiently.

- Dialyzer (membrane reaction) (Lancaster, 2001; Sayeed, Murdakes, Spec, & Gashti, 2015).

  Hypersensitivity dialyzer reactions in the hemodialysis population are rarely seen. However, when a reaction does occur, it can manifest severe complications. Hemodialysis patients can develop a dialyzer reaction to the dialyzer in addition to the components of the extracorporeal circuit (for example blood lines). There are two (2) types of reactions Type A and Type B.

	Type A	**Type B**
What is it?	Hypersensitivity reaction that occurs quickly following the initiation of the treatment. Onset of symptoms is severe.	Hypersensitivity reaction that occurs later in the treatment (up to 30 minutes). Onset of symptoms are mild.
Rate of Onset	Immediately.	Later in treatment.

Occurrence:	Rare.	Common.
Severity of symptoms	Severe.	Mild.
Caused by?	Allergy to the ethylene oxide sterilant used to sterilize dialyzers OR the use of ACE inhibitors with the AN69 dialyzer. The AN69 dialyzer is negatively charged allowing it to bind with many factors creating anaphylactoid reactions increasing levels of kinins.	Complement mediated. Occur when free hydroxyl groups are activated. This activation starts an alternative complement pathway that is responsible for increasing neutrophil activity whilst hindering leukocytes.
Symptoms Experienced	-Burning. -Urticaria. -Dyspnea. -Hypotension.	-Chest discomfort. -Back discomfort. -Nausea and vomiting.
How can it be prevented?	-Use alternative dialyzer types. -Do not use an AN69 dialyzer for a patient on ACE inhibitors. -Ensure priming of dialyzer and extracorporeal system as per manufacturers recommendations.	-Ensure priming of dialyzer and extracorporeal system as per manufacturers recommendations.
Nursing Scope of Practice	-Symptom management. -If reaction is progressing in severity stop the hemodialysis treatment. Clamp all the extracorporeal blood lines and discard the system **(the patient is not reinfused their blood).** -Notify the nephrologist.	-Symptom management. [Antiemetic for nausea and vomiting, normal saline for hypotension] -If symptoms progress, notify the nephrologist.

- Hemolysis (Lancaster, 2001)

  Hemolysis is the breakdown of red blood cells during hemodialysis. Since technological increases in hemodialysis machinery have progressed, the machine has multiple alarms to detect and alert of hemolysis. This can occur for a variety of reasons which include:

- High dialysate temperature (≥ 42▫C).
- Improper occlusion of bloodlines on the hemodialysis machine.
- Delivery of +++ hypo and or hypertonic dialysate or IV solutions.

Signs and Symptoms of Hemolysis:

- Chest pain.
- Shortness of breath.
- Burning in the return side of the access (venous).
- Decreased serum hematocrit.
- Hyperkalemia (K+ release during red blood cell breakdown).
- Translucence of blood in the venous bloodline (after the dialyzer).

How can it be prevented?	Nursing Scope of Practice
➢ Set up machine as per protocol and policy. ➢ Ensure to consult with biomedical technician when needed or if machine has alarms that are not clearable. ➢ Administer IV medications as per protocol and policy. ➢ Administer IV normal saline for hypotension or muscle cramping as per policy. ➢ Ensure to mix all dialysates according to protocol and ensure proper dosing.	➢ If hemolysis is noted **STOP** treatment. Clamp all blood lines and discontinue dialysis (the patient should NOT get the blood reinfused). ➢ Monitor patient (vital signs). ➢ Complete requisition and pull hemodialysis machine for biomedical technicians to perform maintenance. ➢ Notify Nephrologist (may want to order blood work to monitor hemoglobin and electrolytes. Hemoglobin→ May be lower due to red blood cell loss. Potassium (electrolytes)→ May be higher due to breakdown of red blood cells and release of potassium into the body. ➢ Depending on treatment time remaining, patient may need to

	continue treatment (new machine). ➢ May need to replace volume loss (when the blood lines are discarded approximately 200mL of fluid is loss).

- Air Embolism (Lancaster, 2011).

  The entry of air into a patient vein (venous air embolism) or into an artery (arterial air embolism). This air entry can occur from a break in the hemodialysis extracorporeal system, or when accessing a CVC.

  Hemodialysis Extracorporeal Air in Blood: If all connections of the extracorporeal blood lines, and dialyzer are not tightened air may enter the system. In the current hemodialysis machine, there is an air detector noted below the venous bubble catcher. Therefore, air will be detected here and the machine will alarm prior to any air being returned to the patient via venous blood flow return. Air in this form will present as foam or froth seen in the circuit particularly in the venous chamber. If air in blood is detected you will have to disconnect the patient and follow the protocol for air in blood [advanced nursing skill]. Since this occurs rarely, the opportunity to troubleshoot this may not be gained during preceptorship. Therefore, if encountered in practice, seek assistance from a senior nurse.

  Microbubbles: Different from air in blood, microbubbles can be detected in the machine due to a system break. Microbubbles will be bubbles or froth in the venous chamber of the machine.

  Preventative Care:
  -Follow proper procedure when setting up the hemodialysis machine.
  -Check and secure all connections on blood lines, dialyzer, and those connected to the vascular access.
  -Monitor machine for air detector alarms.
  Nursing Care: If air in blood or microbubbles do occur, follow the procedure below.

Check extracorporeal system and tighten all connections

Check extracorporeal blood lines for air [check full line of the machine continuing all the way to the patient]

If not air is not noted you can decrease the blood flow rate to 250mL/min and override the microbubbles.

If not air is noted in the extracorporeal system you cannot override the alarm as you do not want to infuse air to the patient

Keep checking your machine every 10 minutes and the problem should resolve. Once the microbubbles alarm disappears you can increase the pump back to its original flow rate

Follow air in blood procedure [advanced nursing skill]. Seek assistance from a senior nurse

If the alarm re-occurs you can repeat the process. You can override the machine 3 times. If the alarm occurs again after this you need to proceed to do the air in blood procedure [advanced nursing skill]

Air embolism related to CVC accessing: It is important that the Tego® connectors are always tightly secured pre, intra, and post hemodialysis. If the Tego® connector happens to fall off and if the CVC clamp is not clamped or faulty, the patient is exposed to risk of an air embolism. Anytime the Tego® needs to be changed (policy is once a week), it is important to have the CVC clamp clamped prior to removal of the Tego®. Anytime the Tego® is removed or if it falls off, the CVC clamp is the only line of protection from air entering the body.

Signs and Symptoms of an Air embolism:
-Chest pain.
-Coughing.
-Cyanosis.
-Visual disturbance.
-Confusion.
-Coma.
-Death.

Preventative Care:
-Always be diligent when assessing or changing the Tego® connector that the connector is tight and that the CVC clamps are intact and properly functioning.
-CVC clamps should **always be clamped** when changing the Tego® connector
-CVC clamps should always be clamped when the patient leaves the hemodialysis unit.
-Patient education surrounding the need to check their clamps to make sure they are clamped. Although patients should be educated on not touching their CVC, they should be taught on how to close the clamps in case one accidently becomes unclamped.

Nursing Care:
If a person is exposed to air or there is potential for an air embolism this is **an emergency.**
-Stop the machine and clamp all the lines.
-Position patient to left side lying Trendelenburg position. (This will capture and trap any air in the right ventricle apex of the heart from traveling to the lungs or to the brain).
-Administer oxygen.
-Notify the physician immediately.

- Vascular Access Dysfunction (CANNT, 2015)

The vascular access (AVF, AVG, or CVC) of the patient is the lifeline they need for life sustaining treatment therefore its continued preservation is important. Despite this, there are complications that may arise with the vascular access either pre, intra, or post hemodialysis treatment. Some of these complications include:

- Clotting.
- Bleeding (in between dialysis treatments it is not normal for a vascular access to bleed).
- No bruit.
- No thrill.
- Arterial and or venous needle infiltrations (blows).
- Infection (redness, swelling, bruising, warmth, tenderness, drainage, pain).
- Dysfunction (unable to maintain an adequate blood flow rate to complete hemodialysis treatment).

For more information surrounding vascular access dysfunction see the vascular access module.

- Vasovagal Syncope (Lancaster, 2011; Marchiondo, 2010).

Reactions that are vasovagal in nature are caused by increased vagal tone in combination with decrease sympathetic response to central venous nervous system stimulation. When a vasovagal even occurs, it follows with a hypotensive-bradycardic reflex whereby inadequate vasoconstriction leads to a systolic blood pressure drop and bradycardia. Vasovagal events can occur in the hemodialysis population for a variety of reasons including: cannulation, needle manipulation, and manipulation of CVC (reversing and/or flushing of CVC lines).

<u>Risk Factors:</u>

-Anxiety.

-Fear inducing events (for example the sight of blood or the sight of needles).

-Anticipation of what is to come.

-Observation of procedures (for example watching during cannulation).

<u>Nursing Care:</u>

Once a good working relationship is established with the patient those that are more prone to vasovagal events will be identified. However, if the patient is new or unknown, it is important to provide care, comfort and education upon the procedures being completed.

Preventative Measures

If a vasovagal episode occurs, it is important to treat the patient's hypotension following the above recommendations.

-Place patient on UF minimum (on hold; no fluid removal).
-Place patient in Trendelenburg position.
-Monitor Vital signs.
-Administer IV normal saline (if needed depending on the severity and patient's symptoms of the hypotension).

- Fever and chills

Fever occurs when a patient's temperature (independent on route taken from) is over 38.5 °C. Often if fever experienced, it is accompanied with chills or involuntarily shaking (rigors). Dependent upon the time experienced, fever/chills will generally be an indicator of what the contributing factors are.

Fever at beginning of the treatment:

If fever/chills occur at the beginning of the treatment it can be contributed to an allergic reaction to the dialysis circuit or patient infection. A patient can have an allergic reaction to the dialysis circuit which includes (dialyzer, extracorporeal circuit, anticoagulants used (heparin), or materials used for accessing/caring for the vascular access (for example: needles, choice of antiseptic, dressings used, and hence forth)).

Vascular access infection (CVC, AVF, and AVG) can occur at any time during the treatment but typically is it exhibited or enhanced after starting hemodialysis. This is due to the removal and return of infection ridden blood (as infection cannot be dialyzed out). This increases patient's signs and symptoms of infection once hemodialysis is initiated.

Fever at end of the treatment:

Fever and/or chills that occur post hemodialysis can be generally contributed to contamination during the washback (termination) of hemodialysis.

How can it be prevented?	Nursing Scope of Practice
➢ Follow appropriate set up of hemodialysis machine. ➢ Aseptic care of CVC during dressing and Tego® change. ➢ Patient assessment [Increased temperature, rigors, shaking, being +++ cold]. ➢ Vascular access assessment [noting S&S of infection].	➢ Follow policy protocol and procedure for proper care and maintenance of a hemodialysis patient (machine set-up included). ➢ Monitor V/S. ➢ Report S&S of infection to nephrologist whom may order prescribed medications for same. ➢ Administration of IV antibiotics **[RN scope of practice only]** . ➢ If ordered by Nephrologist collect swab on questioned source of infection for culture and sensitivity (C&S). ➢ If ordered by Nephrologist collect blood cultures. ➢ Close observation and monitoring of patient symptoms during hemodialysis treatment.

Although there are multiple complications that may arise during hemodialysis treatment it is important that nephrology nurses are aware of complication potential and how to react if the complication arises. It is important to note that during orientation nurses may not get to troubleshoot or see these complications. Despite this, knowing the complications and how to react is important. If ever in a situation whereby something encountered renders uncertainty do not hesitate to seek assistance from a senior nurse in the unit.

Module 6 Evaluation

Hemodialysis Complications

1. List 5 complications that may occur during a hemodialysis treatment

1.____

2.____

3.____

4.____

5.____

2. ________________ is the most common hemodialysis complication.

a) Dialysis Disequilibrium

b) Infection

c) Nausea and vomiting

d) Hypotension

3. What is the best nursing intervention to prevent dialysis disequilibrium?

a) Maintain low UF rate

b) Maintain low dialysate temperature

c) Maintain low blood flow rate

d) Maintain high blood flow rate

4. What extracorporeal system is most likely to clot?

a) A system with a TMP of 15

b) A system with no heparin infusion with normal saline flushes

c) A system with multiple alarms (starting/stopping of the treatment)

d) A well primed system

e) All of the above

5. If a patient exhibits a severe membrane reaction what should the nurse do?

a) Monitor patient closely for the remainder of the treatment

b) Reinfuse patient and discontinue treatment

c) Terminate dialysis without reinfusing blood

d) Notify nephrologist to change the dialyzer for next treatment

6. Which of the follow reactions is the biggest medical emergency?

a) Muscle cramping

b) Hypotension

c) Fever and chills

d) Dialysis Disequilibrium

e) Hemolysis

f) Air embolism

7. Which of the following would contribute to hypotension in a hemodialysis patient? Select all that apply.

a) High UF goal/rate

b) Consumption of food while on the machine

c) Medications taken prior to hemodialysis treatment

d) Higher than normal hemoglobin level

8. What interventions should be employed when a patient experiences hypotension? Select all that apply.

a) Reduce UF goal

b) Reduce blood flow rate

c) Administer normal saline

d) Turn patient in left side lying position

e) Recline patient in Trendelenburg position

9. Patients should be encouraged to keep intradialytic weight gains to ____ to ____ liters between treatments.

a) 3 to 4 liters

b) 2 to 3 liters

c) 0 to 1 liters

d) 1 to 2 liters

10. Monitoring of patients vital signs should be kept at a minimum to every ______________

a) 15 minutes

b) 30 minutes

c) 60 minutes

d) 10 minutes

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Module 7

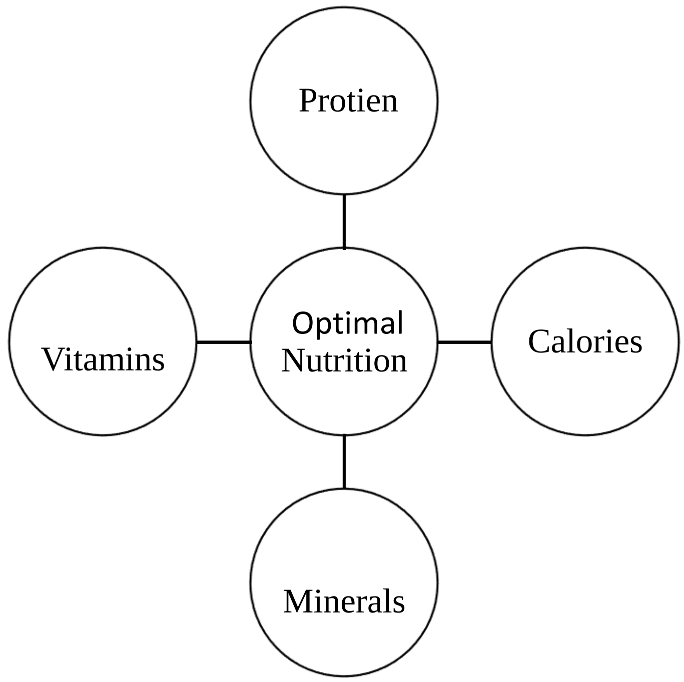
Nutrition

Purpose: Nutrition plays a key role in the health of any hemodialysis patient. It is important that the patient maintains adherence to a renal diet while ensuring they are consuming enough calories for body maintenance, growth, and healing. Nurses play an important role in the identification of patient knowledge deficits and in reiteration of important nutrition information.

Learning Objectives: After completing this module the learner will complete a post test that will measure the learner's ability to:

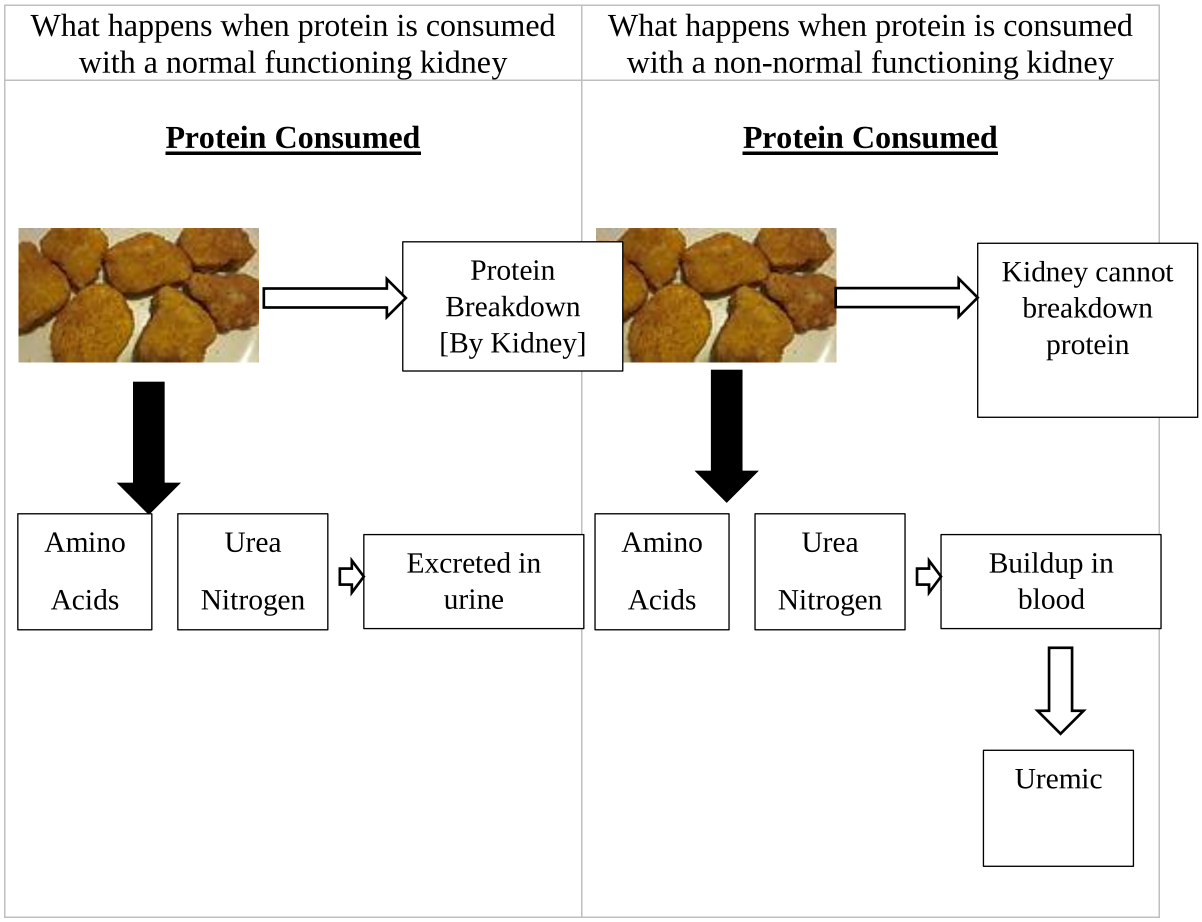
- Identity the main components of the renal diet that influence hemodialysis patient;
- Explain the importance and sources of: protein, minerals, and vitamins;
- Discuss potential barriers in the consumption of a renal friendly diet.

Nutrition in the hemodialysis patient is important as nutritional and dietary parameters need to be adhered to maintain optimized nutritional health. Nutrition in the hemodialysis population includes an interplay of a variety of components, each yielding an important role in the optimized nutritional health of the hemodialysis patient (Beto & Bansan, 2004).



- Protein (Beto & Bansan, 2004).

Protein is needed to maintain and repair body tissue and to fight infection. The building blocks of protein are amino acids. A functioning kidney handles the breakdown of protein into the individual amino acid components and excretes nitrogen and urea as waste products. In patients with ESRD this breakdown and the ability to excrete waste is decreased and lessened therefore the protein requirements of those with ESRD is less. Current recommendations identify a low protein diet of (0.6g/kg/day) of any patient with a EGFR of <25 mL/min.



Protein Consumption: A Balancing Act

Enough protein [To enhance tissue building and infection immunity]

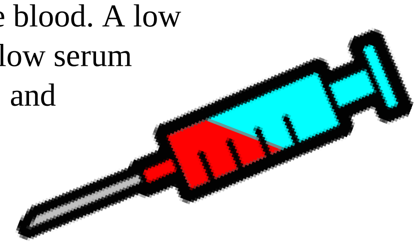
Ability to remove protein waste products to not become uremic.

Foods high in protein include:

- Fresh meat, poultry, and seafood
- Fish
- Eggs (egg whites)

Bloodwork:

Serum Albumin is an indicator of the amount of protein found in the blood. A low serum albumin is indicative of protein and /or calorie deficiency. A low serum albumin places a patient at risk for infection, risk for feeling unwell, and lack of energy (Sarwar & Sherman, 2017)



- Vitamins (Beto, & Bansal, 2004).

There is minimal research upon the vitamin need in the hemodialysis population to date. Current recommendations suggest however that:

- No supplements needed for fat soluble vitamins (A and E) as in abundance they accumulate and are not easily excreted.
- Excessive Vitamin K can adversely affect clotting times and/or vascular access patency.
- Water soluble vitamins are dialyzed out during hemodialysis but are supplemented post hemodialysis (Replavites®; vitamin B & C).

➢ Minerals (Beto & Bansan, 2004).

There are 5 major minerals in the body which include:

- Calcium *
- Phosphorus*
- Potassium*
- Sodium*
- Magnesium

*indicates the most important minerals to consider for patients afflicted with ESRD.

Calcium and Phosphorous:

Calcium and phosphorous interplay in the ESRD patient to maintain bone composition. ESRD patients cannot convert Vitamin D to active Calcitriol. Calcitriol is responsible for the absorption of phosphorous and calcium in the gastrointestinal tract. Without the ability to absorb calcium and to excrete phosphorous, secondary hyperparathyroidism occurs. Calcium leaches from the bone leading to serum hypocalcemia and phosphorous is unable to be excreted leading to serum hyperphosphatemia. Patients will present with bone pain that progresses, due to bone brittleness and breakdown (Saliba & El-Haddad, 2009).

Calcium Rich Foods	**Phosphorous Rich Foods**
• Milk. • Kale. • Yogurt. • Broccoli. • Cheese. • Bok Choy.	• Milk. • Chocolate. • Oatmeal. • Dark carbonated beverages (colas). • Whole grains/cereals. • Dried legumes/beans (chick peas, baked beans, split peas, soy beans, lentils).

Potassium: (National Kidney Foundation, 2015).

An intracellular electrolyte, potassium is responsible for bodily muscle contraction. Hyperkalemia is a dangerous condition and can lead to irregular heartbeat, arrhythmias, and death.

Foods high in potassium include:

- Fruit (banana, dates, oranges, kiwi, grapefruit).
- Vegetables (potatoes, tomatoes, beans, peas, mushrooms).
- Bread and cereal (whole grain).
- Milk.
- Chocolate.
- Gravy.
- Salt substitutes.

Sodium: (National Kidney Foundation, 2015).

Sodium is an extracellular electrolyte, that aids in fluid balance. In the hemodialysis patient sodium should be monitored as it regulates fluid balance. This is important because fluid in should equal fluid out. To decrease the amount of fluid retained, hemodialysis patients should consume a diet low in dietary/added sodium.

Sources of sodium:

- Table salt
- Processed foods (lunch meat, canned food, frozen TV dinners).

- Fluid Restriction:
  ESRD patients need to strictly monitor and adhere to a fluid intake regime because a big percentage of patients have no urine output. When a patient has no urine output the water that is taken in stays in place adding to the circulating blood volume. Patients are encouraged to restrict fluid to approximately 1L/day. Some ways in which patients can monitor fluid include:
  -Use small cups and glasses.
  -Consume candy/gum to keep mouth moist.
  -Monitor food intake (a lot of foods host a lot of hidden water. Education is important).
  - Avoid excessive consumption of salty foods (an increase in sodium increases thirst mechanism).
  -Rinse mouth with cold water when thirst encountered.
  -Diabetic control (if applicable).
  -Keep a daily log of fluid consumed.

Nutritional Complications Hemodialysis Patients Encounter:

The hemodialysis patient may encounter many nutritional complications related to diet. Some of these complications include:

Complications	Possible solutions
Constipation	- Increase fiber intake. - Consult nephrologist for prescription for stool softener/laxative. - Even with limited fluid intake the fluid drank should be water. Avoid colas, tea, coffee. (National Kidney Foundation, 2015).
Electrolyte imbalances - **Nutrition plays a role in imbalances in calcium, phosphorous, potassium, and sodium. As always, education is pivotal to ensure an adequate renal friendly diet is followed.**	- Hyperkalemia (High potassium): Monitor foods for K levels and monitor dialysate K level (higher the K in the dialysate the higher the K in the body). - Hyperphosphatemia (High phosphorous): Monitor foods for high phosphorus levels. (National Kidney Foundation, 2015).
Decreased appetite (malnourished).	- Eat small frequent meals.

	- Use meal replacements (as per nephrologist and dietitian recommendation). (Kovesdy, 2016).

Additional Complications:

Despite the nutritional complications patients may often face financial concerns in paying for a renal friendly diet. There are multiple resources available for patients for assistance. If this arises, please contact the program social worker or social work assistant to aid these patients.

Role of the Dietitian:

The dietitian is a very valuable and important member of the interdisciplinary team that is a great source of information for hemodialysis patients. With each new hemodialysis start a referral to the program dietitian should be ordered. As it is the dietitians' expertise, they will counsel and educate the patient on food choices and how to eat renal friendly meals and diets. The dietitian in consultation with the physician will order an individualized nutrition prescription for each patient to follow.

Module 7 Evaluation

Nutrition

1. ________________& ________________ play an important role in bone composition
   a) Potassium & Calcium
   b) Phosphorous & Calcium
   c) Phosphorous & Magnesium
   d) Sodium and Calcium

2. __________ are the building blocks of amino acids
   a) Protein
   b) Creatinine
   c) Calcium
   d) Phosphorus
   e) Potassium

3. Patients are advised to restrict fluid intake to ___ liters/day
   a) One
   b) Two
   c) Three
   d) Four

4. The role of protein in the body is to________________________
   a) Maintain and repair body tissue and to fight infection
   b) Maintain hemostasis of electrolytes
   c) Maintain hemostasis of fluid balance
   d) Maintain hemoglobin levels

5. Foods high in potassium include: ______________ (select all that apply)
   a) Banana
   b) Potatoes
   c) Tomatoes
   d) Dates
   e) Oranges

f) Milk

6. What are the most common nutritional complications hemodialysis patients experience?
   a) Malnourishment
   b) Constipation
   c) Electrolyte imbalance
   d) Obesity

7. List 4 ways a patient can monitor their fluid intake
   1) ____
   2) ____
   3) ____
   4) ____

8. What are the 5 most common minerals found in the body?
   a) Calcium
   b) Phosphorus
   c) Potassium
   d) Sodium
   e) Magnesium
   f) Protein
   g) Amino Acids
   h) Bicarbonate

9. Vitamin _________ can adversely affect clotting times and/or vascular access patency
   a) A
   b) B
   c) C
   d) D
   e) K

10. What is the role of Replavites® for hemodialysis patients?
    a) To correct malnutrition
    b) To replace water soluble vitamins that are dialyzed out

c) To replace water insoluble vitamins that are dialyzed out
d) For nutritional supplementation

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Appendix A: List of program policies for hemodialysis

Program Policies	Policy # & Name
Hemodialysis machine setup	• 210G-EQU-010 5008 Fresenius Hemodialysis System Preparation • 210G-TBS-031 Single Needle Dialysis Using the 5008 Fresenius Hemodialysis Machine • 210G-MED-100 Potassium Concentrate in Dialysate • 210G-MED-120 Calcium Concentrate in Dialysate • 210G-EQU-140 Disconnecting Patient from the 5008 Fresenius Hemodialysis Machine • 210G-EQU-030 Heparin Preparation Using the 5008 Fresenius Hemodialysis Machine • 210G-EQU-050 Programming-Profiling Sodium Using the 5008 Fresenius Hemodialysis Machine
Hemodialysis Monitoring	• 210G-EQU-130 Hemodialysis Treatment Monitoring • 210G-CLP-020 Fluid Assessment Pre-Dialysis • 210G-CLP-150 Activated Clotting Times for Hemodialysis Patients • 210G-EQU-140 Disconnecting Patient from the 5008 Fresenius Hemodialysis Machine • 210G-CLP-290 Administration of Blood-Blood Products During Hemodialysis • 210G-MED-010 Administration of Medications to Inpatients During Hemodialysis • PHA-122 Anemia Management in Outpatient Hemodialysis Units • 210G-DIA-020 Assessment of Hemodialysis Adequacy • 210G-CLP-230 Clotting in the Extracorporeal System • 440-PHA-CA-005 Blood Work Orders for Drug Therapy Monitoring by Clinical Pharmacists • 210G-DIA-051 Hemodialysis Bloodwork • 210G-TBS-020 Changing Dialyzer-Blooding During Hemodialysis Treatment • 210G-TBS-040 Circulation During Hemodialysis Treatment • DIA(NET)-DIA-100 Blood Culture Collection During Hemodialysis • 210G-MED-011 Intravenous Administration of Medications by Licensed Practical Nurses in Hemodialysis

	• 210G-DIA-140 Nasal Swab Testing for Staphylococcus Aureus • 210G-CLP-250 Hemolysis • 210G-CLP-280 Exsanguination • 210G-CLP-300 Cardiac Arrest • 210G-CLP-270 Chest Pain (Cardiovascular Disease) • 210G-CLP-260 Air Embolism • 210G-CLP-240 Membrane Reaction Colonization in Hemodialysis Patients • 210G-CLP-200 Muscle Cramping • Dialysis Medical Directive: Adjustment of the dry weight of the hemodialysis patient. • Dialysis Medical Directive: Administration of 0.9% sodium chloride for the treatment of hypotension in hemodialysis patients • Dialysis Medical Directive: Administration of Influenza vaccine to hemodialysis patients • Dialysis Medical Directive: Administration of Pneumococcal vaccine to hemodialysis patients
Care of AVF/AVG/BHAVF	• 210G-CLP-050 Cannulation of Arteriovenous Fistula-Graft • 210G-CLP-080 Cannulation of New Arteriovenous Fistula • 210G-CLP-070 Buttonhole-Constant Site • 210G-CLP-060 Fistula-Graft Care Post- Dialysis
Care of Central Venous Catheter	• 210G-CLP-110 Care of Hemodialysis Central Venous Catheter • 210G-CLP-121 Accessing Central Venous Catheters Using Tego Connectors • 210G-MED-130 Closing Central Venous catheter Alteplase (Cathflo) • 210G-CLP-140 Hemodialysis Central Venous Catheter Dressing • 210G-CLP-131 Closing Central Venous Catheter Using 4% Sodium Citrate • 210G-MED-140 Alteplase-Thrombolytic Therapy for Poorly Function Hemodialysis Catheters • Dialysis Medical Directive: Administration of Cathflo (Alteplase) for the maintenance of blood flow above 250 milliliters per minute in hemodialysis central venous catheters

Appendix B: Important Contact Numbers

Position	Name	Phone #	Fax #
Divisional Manager	Cheryl Harding	777-3615	777-3498
PCC Waterford Site	Linda MacPherson	77-3558	777-3498
Home Dialysis (Hemodialysis + Peritoneal Dialysis) [Waterford Site]	• Sister Eileen Penny • Sharon MacDonald	• 777-3570 • 777-3048	777-3498
Transplant Coordinator [Waterford Site]	Marion Coffey	777-3601	777-3498
Post-Transplant Clinic [Waterford Site]	• Michelle Mackey • Denise Sullivan	• 777-3985 • 777-3663	777-3449
PRI Clinic [Waterford Site]	Paula Wheeler	777-3577	777-3498
Vascular Access Nurse [Waterford Site]	Betty Ann Curran	777-3473	777-3498
Clinical Educator	Cathy Cake	777-3704	777-3498
Social Worker [Waterford Site]	Suzie Davis	777-3581	777-3498
Social Work Assistant [Waterford Site]	Susan Galway	777-3623	777-3498
Dietician [Waterford Site]	Cindy Murphy	777-3612	777-3498
Hemodialysis Unit [Waterford Site]		777-3571	777-3498
Clinical Pharmacist [Waterford Site]	Randy McFadyen & Jessica Biggin	777-3924	Pager: 570-2684
PCC St. Clare's	Patricia Gillespie	777-5307 or 777-5308	777-5856
Hemodialysis Unit [St. Clare's Site]		777-5307 or 777-5308	777-5856
PCC Health Sciences Site	Roxanne Jackson	777-7085	777-8410

Waterford Site

SCMH

HSC

Clarenville

Burin

Carbonear

Bonavista

Hemodialysis Unit [Health Sciences Site]	________	777-7212	777-8410
Clinical Pharmacist [Health Sciences Site]	Allen Brake & Mike Murcell	777-7217	________
Biomedical Staff [For Waterford, St. Clare's, and Health Sciences Site]	Adam Walsh, Stefanie Roberts Dan Bobbett	730-0848 Tech Room: 777-3492	________
PCC Clarenville	Sandra Elliott	466-5757	466-6403
Clarenville Hemodialysis Unit	________	1-866-466-5755	466-6403
BioMed Clarenville	Gavin Lungdrian	466-6877	________
Clinical Pharmacist Clarenville	Sarah Fennell		
Carbonear Hemodialysis Unit	________	945-5390	945-5113
Clinical Pharmacist Carbonear	Renee Hawe & Nancy Parsons Drover		
BioMed Carbonear	Cory Mulvinan & Jillian Molloy	945-5220	________
PCC Burin	Patricia Legge	891-3319	891-3292
Burin Hemodialysis Unit	________	891-3266	891-3292
Clinical Pharmacist Burin	________		
BioMed Burin	Adam Slade	891-1040	________
PCC Bonavista	Sandra Elliott	466-5757	468-5309
Bonavista Hemodialysis Unit	________	468-5315	468-5309
BioMed Bonavista	Gavin Lungdrian	466-6877	________

Note: Not all hemodialysis units have interdisciplinary support from every discipline.

Physician Name	Pager Number	Office Number
Dr. Sean Murphy **Chief of Nephrology**	733-6028	777-8030
Dr. Brendan Barrett	733-6045	777-8073
Dr. Michael Paul	733-6056	777-6548
Dr. Maureen Hannaford	533-2089	579-4191
Dr. Patrick Parfrey	733-6053	777-7261
Dr. Brian Curtis	733-6038	777-8759
Dr. John Shik	733-6037	777-2300
Dr. Pamela Pike	570-9857	____________________
Dr. Sean Martin	778-6168	____________________

Appendix C: Answer Key to Post Module Quizzes [Module 1-7]

Module 1 Evaluation

Chronic Kidney Disease & Hemodialysis Principles

Answer Key

1.Calcium and phosphorous are absorbed at which three sites in the body?

a) Blood, bone, and kidney
b) Blood, bone, and intestine
c) Bone, kidney, and intestine
d) Bone, intestine, and liver

2. What are the three principles of hemodialysis?

a) Sodium ramping, fluid removal, and vascular access
b) Diffusion, reverse osmosis, and total fluid removal
c) Diffusion, osmosis, and ultrafiltration
d) Diffusion, osmosis, and hemostasis

3.Which of the following is the biggest potential complication of immunosuppressant usage post renal transplant?

a) Acute renal rejection
b) Weight gain
c) Increased risk of developing cancer
d) Increased risk of infection

4.What is the most commonly experienced complication that patients on peritoneal dialysis experience?

a) Peritoneal membrane failure
b) Hyperglycemia from the dialysate
c) Weight gain
d) Peritonitis

5.List how many ways you can mix a dialysate bath to get a 4K+1.25 Ca++ dialysate.

1.Use a 2K+1.25 Ca++ and use 4 packs of K+

2.Use a 3K+1.25 Ca++ and use 2 packs of K+

3.Use a 1K+1.25 Ca++ and use 6 packs of K+________________________________

6.____________ is the functional unit of the kidney

a) Nephron
b) Proximal Tubule
c) Bowman's Capsule
d) Cortex

7.There are ___ stages of chronic kidney disease?

a) 3
b) 4
c) 5
d) 6

8.At a eGFR between 15-29 is what stage of kidney disease

a) 1
b) 2
c) 4
d) 3

9.Fill in the blanks. At _______less than 15____ eGFR a patient will start a renal replacement therapy. This eGFR is classified as stage ______5________ kidney disease?

10.A majority of end stage renal disease also are afflicted with what other comorbidity?

a) Hypertension
b) Diabetes
c) Obesity
d) Congestive heart failure

True or False

1. Renal transplant is a cure for end stage renal disease.	☐True ☐False
2. In the dialyzer the blood and dialysate mix to remove toxins.	☐True ☐False
3. The arterial line takes blood away from the patient	☐True ☐False
4. Acute renal failure is reversible	☐True ☐False
5. Chronic renal failure is reversible	☐True ☐False

Module 2 Evaluation

Hemodialysis Machine and Prescription

Answer Key

1. Putting a hemodialysis machine in T1 test involves ________________________.
   a) Connecting the dialyzer couplings
   b) Putting the machine in a rinse
   c) Putting the machine in dialysate bath and bicarbonate
   d) Turning on the machine

2. A rinse should be performed on the hemodialysis machine when___________ (select all that apply).
   a) In between patient treatments
   b) After a blood leak
   c) After the machine tests positive for residual disinfectant
   d) At the beginning of the shift
   e) At the end of the shift

3. Which of the following cannot be done when a machine is in rinse mode?
   a) Placing the lines in the hemodialysis machine
   b) Priming the lines with normal saline
   c) Putting the machine in dialysate bath and bicarbonate
   d) Connecting the dialyzer couplings
   e) Connecting a patient to the hemodialysis machine

4. A heat disinfect is good for ____ hours if the machine has not been used on patients
   a) 48
   b) 24
   c) 36
   d) 72

5. The machine is put in a cold disinfect or degreasing ____ times a week
   a) One
   b) Two
   c) Three
   d) Four

6. Which of the following hemodialysis parameters will the nephrologist order on patient that has been on hemodialysis for 1 year? Select all that apply
   a) Dialysate bath
   b) Treatment Time
   c) Blood flow rate
   d) Net fluid removal
   e) Dry weight
   f) Heparin bolus
   g) Cannulation sites
   h) UF Profiles
   i) BVM monitoring
   j) Dialyzer
   k) Na Profiles

7. Which of the following hemodialysis parameters will the nephrologist order on patient that is having their first hemodialysis treatment? Select all that apply
   a) Dialysate bath
   b) Treatment Time
   c) Blood flow rate
   d) Net fluid removal
   e) Dry weight
   f) Heparin bolus
   g) Cannulation sites
   h) UF Profiles
   i) BVM monitoring
   j) Dialyzer
   k) Na Profiles

8. Which of the following hemodialysis parameters will the nurse decide regarding a patient that has been on hemodialysis for one year? Select all that apply
   a) Dialysate bath
   b) Treatment Time
   c) Blood flow rate
   d) Net fluid removal
   e) Dry weight
   f) Holding heparin bolus
   g) Holding heparin infusion
   h) Cannulation sites
   i) UF Profiles
   j) BVM monitoring

k) Dialyzer
l) Na Profiles

9. When ‘putting on’ a patient how many clamps need to be clamped prior to putting a patient on hemodialysis?
   a) 6
   b) 4
   c) 5
   d) 3
   e) 2
   f) 7

Module 3 Evaluation

Patient Assessment

Answer Key

1. 1 Kg is equal to ____ lbs.
   a) 2
   b) 1.1
   c) 2.2
   d) 1

2. The LPN and the RN can adjust the dry weight of a hemodialysis patient by ____ and ____ percent.
   a) 2% & 5%
   b) 1 % & 2%
   c) 1 % & 1.5%
   d) 0.5% & 2%

3. By using the percentages that a LPN can adjust a patient's dry weight by, what weight can a LPN work a patient with a dry weight of 58.0kg for?
   a) 56.54 to 57.44
   b) 57.42 to 58.58
   c) 57.13 to 58.87
   d) 57.55 to 58.32

4. By using the percentages that a RN can adjust a patient's dry weight by, what weight can a RN work a patient with a dry weight of 58.0kg for?
   a) 56.54 to 57.44
   b) 57.42 to 58.58
   c) 57.13 to 58.87
   d) 57.55 to 58.32

5. Deviations in dry weight can be contributed to? Select all that apply

a) Weight gain
b) Weight loss
c) Decrease in appetite
d) Increase in appetite
e) Constipation
f) Diarrhea
g) Increase in urinary output

h) Decrease in urinary output
i) Increase in the weight of clothing worn whilst weighing
j) Decrease in the weight of clothing worn whilst weighting
k) Weight scale malfunction
l) Improper use of the scale

6. If a patient is under their dry weight what are common signs and symptoms a patient may exhibit? Select all that apply

a) Hypotension
b) Hypertension
c) SOBOE
d) Tachycardia
e) Poor skin turgor
f) Blurred vision
g) Orthopnea
h) Headache
i) No edema noted
j) Dizziness
k) Dyspnea
l) Edema
m) Weakness
n) Fatigue
o) Weight loss (loose clothing)
p) Cough
q) Weight Gain (tight clothing)

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l) Edema
m) Weakness
n) Fatigue
o) Weight loss (loose clothing)
p) Cough
q) Weight Gain (tight clothing)

8. The Kt/V measures ____________________________
   a) The adequacy of hemodialysis
   b) The adequacy of fluid removal
   c) The adequacy of the vascular access
   d) The adequacy of the heparin to prevent clotting

9. The targeted Kt/V is ___________________________
   a) 1.1
   b) 1.2
   c) 1.3
   d) 1.4
   e) 1.5
   f) 1.6

10. The Kt/V can be increased by _________________ (select all that apply)
    a) Increasing treatment time
    b) Increasing surface area of the dialyzer
    c) Increasing blood flow rate
    d) Increasing the ultrafiltration rate

Module 4 Evaluation

Vascular Access

Answer Key

1. _______________ is the best vascular access (least amount of complications)

a) Arteriovenous fistula

b) Arteriovenous graft

c) Arteriovenous button hole fistula

d) Tunneled central venous catheter

e) Temporary central venous catheter

2. The dressing and Tego® of a central venous catheter should be changed _______ .

a) Every treatment

b) When integrity is compromised

c) Once a week

d) Once a month

3. The entrance and exit suture of a central venous catheter should be removed after _____ and _______ days

a) 4 and 7

b) 7 and 14

c) 14 and 7

d) 1 and 5

e) 7 and 4

f) 5 and 1

4. When changing a central venous catheter if using bridine you need to allow it to dry for ___________ minutes, if using chlorohexidine you need to allow it to dry for _____________ minutes.

a) 5 minutes and 2 minutes

b) 2 minutes and 2 minutes

c) 3 minutes and 5 minutes

d) 2 minutes and 5 minutes

5. If creating buttonholes it is important that they be created with: (select all that apply)

a) Same cannulator

b) Same cannulation areas

c) Same angle of depth

d) Same needle gauge

6. Prior to having an arteriovenous fistula created, vein perseveration will begin. This involves saving the veins by avoiding ______________ in the arm that is to have the fistula created (select all that apply)

a) Blood Pressure

b) Pulse

c) Bloodwork

d) PICC lines inserted

e) IV insertion

f) Pulse oximetry readings

7. It normally takes approximately ____ minutes of compression for the fistula to achieve hemostasis post hemodialysis

a) 2 minutes

b) 5 minutes

c) 10 minutes

e) 15 minutes

8. What is the maximum arterial and venous pressures that are acceptable to dialyze with for any developed vascular access?

a) -200/+200

b)-195/+195

c)-230/+230

d)-250/+250

9. If no thrill was felt during prior to cannulation, it is important to:

a) Initiate hemodialysis as a life sustaining treatment

b) Use a smaller gauge needle for cannulation

c) Attempt cannulation and contact vascular access nurse

d) Notify nephrologist/vascular access nurse

10. If no bruit was heard during prior to cannulation, it is important to:

a) Initiate hemodialysis as a life sustaining treatment

b) Use a smaller gauge needle for cannulation

c) Understand that sometimes a bruit will not be present

d) Notify nephrologist/vascular access nurse

11. If a patient is unable to maintain at least a _____ blood flow rate _________is the appropriate nursing intervention?

a) 200mL/min: flushing and reversing of central venous catheter lines

b) 220mL/min: decreasing blood flow rate (decreasing pump speed)

c) 250mL/min: Cathflo® protocol

d) 200mL/min: patient readjustment/ repositioning

12. A new arteriovenous fistula will start the new fistula protocol using ____________ gauge needles

a) 14

b) 15

c) 16

d) 17

Module 5 Evaluation

Hemodialysis Medications

Answer Key

1. Calculate how much heparin need to be prepared for the following patients:

	Total
Dialyzer: FX 1000 Concentrate: 2K 1.5 Ca Prescription Bicarbonate: 34 Prescription Sodium: 138 Sodium Profile: Treatment Time: 4HR-4.30HR Frequency: 3X WEEKLY Dry Weight (Kg): 89 kg Heparin Bolus (units): 1000 Heparin Infusion (units per hour): 1000 Heparin Pre Stop Time (minutes): 0 Dialysate Temperature (C): 35.5	6000-6500
Dialyzer: Optiflux 250 Concentrate: 2 K 1.25 CA Prescription Bicarbonate: 34 Prescription Sodium: 138 Sodium Profile: Treatment Time: 4:15 Frequency: 3 TIMES A WEEK Dry Weight (Kg): 95.0 Heparin Bolus (units): 2600 Heparin Infusion (units per hour): 2000 Heparin Pre Stop Time (minutes): 60 Dialysate Temperature (C): 36.0	10,100

Dialyzer: FX 1000 Concentrate: 3k 1.25 ca Prescription Bicarbonate: 34 Prescription Sodium: 136 Sodium Profile: Treatment Time: 3:30 Frequency: 3 TIMES A WEEK Dry Weight (Kg): Heparin Bolus (units): 1000 Heparin Infusion (units per hour): 1000 Heparin Pre Stop Time (minutes): 0 Dialysate Temperature (C): 36.5	5500
Dialyzer: FX 800 Concentrate: 2K 1.25Ca Prescription Bicarbonate: 34 Prescription Sodium: 138 Sodium Profile: NOT ORDERED Treatment Time: 3:30 Frequency: 2x week Dry Weight (Kg): 57.0 Heparin Bolus (units): 1000 Heparin Infusion (units per hour): 1000 Heparin Pre Stop Time (minutes): 0 Dialysate Temperature (C): 36.5	5500
Dialyzer: FX 1000 Concentrate: 2K 1.25Ca Prescription Bicarbonate: 34.0 Prescription Sodium: 141 Sodium Profile: PROFILE #1 START AT 148 Treatment Time: 4:00 Frequency: 3 times a week Dry Weight (Kg): 86.5kg Heparin Bolus (units): 1000 Heparin Infusion (units per hour): 500 Heparin Pre Stop Time (minutes): 120 Dialysate Temperature (C): 36.0	3000

Dialyzer: FX800 Concentrate: 4k 1.25ca Prescription Bicarbonate: 34 Prescription Sodium: 138 Sodium Profile: Treatment Time: 3:30 Frequency: 3 TIMES A WEEK Dry Weight (Kg): 62.5 Heparin Bolus (units): 2000 Heparin Infusion (units per hour): 1500 Heparin Pre Stop Time (minutes): 60 Dialysate Temperature (C): 36	6750
Dialyzer: Optiflux 250 Concentrate: 3K 1.25Ca Prescription Bicarbonate: 34 Prescription Sodium: 138 Sodium Profile: No Profile Treatment Time: 4:00 Frequency: 3 X WEEK Dry Weight (Kg): 117.0 kg Heparin Bolus (units): 1800 Heparin Infusion (units per hour): 1400 Heparin Pre Stop Time (minutes): 0.0 Dialysate Temperature (C): 36	8400
Dialyzer: FX 1000 Concentrate: 3k 1.25 ca Prescription Bicarbonate: 34 Prescription Sodium: 136 Sodium Profile: Treatment Time: 3:30 Frequency: 3 TIMES A WEEK Dry Weight (Kg): Heparin Bolus (units): 1000 Heparin Infusion (units per hour): 1000 Heparin Pre Stop Time (minutes): 0 Dialysate Temperature (C): 36.5	5500

Dialyzer: Opt 250 Concentrate: 3K 1.5Ca Prescription Bicarbonate: 34 Prescription Sodium: 138 Sodium Profile: Treatment Time: 3:30 Frequency: 3x/week Dry Weight (Kg): 74.5 kg Heparin Bolus (units): 1000 Heparin Infusion (units per hour): 1000 Heparin Pre Stop Time (minutes): 0 Dialysate Temperature (C): 36.5	5500
Dialyzer: FX 1000 Concentrate: 2K 1.25ca bath Prescription Bicarbonate: 34 Prescription Sodium: 140 Sodium Profile: Treatment Time: 4:00 Frequency: 3 X WEEK Dry Weight (Kg): 81.8 Heparin Bolus (units): 3000 Heparin Infusion (units per hour): 1500 Heparin Pre Stop Time (minutes): 60 Dialysate Temperature (C): 36	8500

2. Which medication is used in hemodialysis to increase red blood cell production? (Select all that apply)

a) Eprex®

b) Aranesp®

c) Calcijex®

d) Replavites®

3. The clinical pharmacist of the hemodialysis unit under their scope of practice can: (select all that apply)

a) Start a patient on Eprex® or Aranesp® for the first time

b) Increase/decrease dosage of Eprex® or Aranesp®

c) Increase/ decrease frequency of Eprex® or Aranesp®

d) Discontinue Eprex® or Aranesp®

e) Start a patient on Ferrlecit® or Venofer® for the first time

f) Increase/ decrease dosage of Ferrlecit® or Venofer®

g) Increase/ decrease frequency of Ferrlecit® or Venofer®

h) Discontinue Ferrlecit® or Venofer®

i) Start a patient on Ferrlecit® or Venofer® whom received the medication 1 year ago

j) Start a patient on Eprex® or Aranesp® whom received the medication 1 year ago

4. When providing patient education surrounding phosphate binders' _____________ is the most important point

a) It is important to take the medication after meals

b) It is important to take the medication 1 hour prior to meal consumption

c) It is important to take the medication with meals

d) It is important to take the medication 1 hour post meal consumption

5. ________________ is the biggest risked side effect associated with iron supplementation in the hemodialysis population.

a) Hemolysis

b) Cardiac Arrest

c) Anaphylaxis

d) Cerebral Vascular Event

6. Which of the following actions are within the scope of the LPN practicing in the hemodialysis unit? (select all that apply).

a) IV iron infusions

b) IV antibiotic infusions

c) PO antibiotic administration

d) Cathflo® protocol

e) Cathflo® to close the central venous catheter post hemodialysis

f) Cannulation with 17 gauge needles

g) IV Aranesp® injections

7. If a patient is heparin free and receiving normal saline flushes how much normal saline would you need for a patient that dialyzes for 3:30 hours?

a) 500mLs

b) 600mLs

c) 700mLs

d) 400mLs

8. What machine value is an indicator that the extracorporeal system is clotting?

a) TMP

b) ART

c) VEN

d) Na

e) OCM

f) Kt/V

Module 6 Evaluation

Hemodialysis Complications

Answer Key

1. List 5 complications that may occur during a hemodialysis treatment

1. Hypotension

2. Hemolysis

3. Muscle Cramping

4. Dialysis Disequilibrium

5. Air Embolism

(There are a variety of answers that could be correct for this question).

2. _______________ is the most common hemodialysis complication.

a) Dialysis Disequilibrium

b) Infection

c) Nausea and vomiting

d) Hypotension

3. What is the best nursing intervention to prevent dialysis disequilibrium?

a) Maintain low UF rate

b) Maintain low dialysate temperature

c) Maintain low blood flow rate

d) Maintain high blood flow rate

4. What extracorporeal system is most likely to clot?

a) A system with a TMP of 15

b) A system with no heparin infusion with normal saline flushes

c) A system with multiple alarms (starting/stopping of the treatment)

d) A well primed system

e) All of the above

5. If a patient exhibits a severe membrane reaction what should the nurse do?

a) Monitor patient closely for the remainder of the treatment

b) Reinfuse patient and discontinue treatment

c) Terminate dialysis without reinfusing blood

d) Notify nephrologist to change the dialyzer for next treatment

6. Which of the follow reactions is the biggest medical emergency?

a) Muscle cramping

b) Hypotension

c) Fever and chills

d) Dialysis Disequilibrium

e) Hemolysis

f) Air embolism

7. Which of the following would contribute to hypotension in a hemodialysis patient? Select all that apply.

a) High UF goal/rate

b) Consumption of food while on the machine

c) Medications taken prior to hemodialysis treatment

d) Higher than normal hemoglobin level

8. What interventions should be employed when a patient experiences hypotension? Select all that apply.

a) Reduce UF goal

b) Reduce blood flow rate

c) Administer normal saline

d) Turn patient in left side lying position

e) Recline patient in Trendelenburg position

9. Patients should be encouraged to keep intradialytic weight gains to ____ to ____ liters between treatments.

a) 3 to 4 liters

b) 2 to 3 liters

c) 0 to 1 liters

d) 1 to 2 liters

10. Monitoring of patient's vital signs should be kept at a minimum to every _______________

a) 15 minutes

b) 30 minutes

c) 60 minutes

d) 10 minutes

Module 7 Evaluation

Nutrition

Answer Key

1. ________________& ________________ play an important role in bone composition
   a) Potassium & Calcium
   b) Phosphorous & Calcium
   c) Phosphorous & Magnesium
   d) Sodium and Calcium

2. __________ are the building blocks of amino acids
   a) Protein
   b) Creatinine
   c) Calcium
   d) Phosphorus
   e) Potassium

3. Patients are advised to restrict fluid intake to ___ liters/day
   a) One
   b) Two
   c) Three
   d) Four

4. The role of protein in the body is to________________________
   a) Maintain and repair body tissue and to fight infection
   b) Maintain hemostasis of electrolytes
   c) Maintain hemostasis of fluid balance
   d) Maintain hemoglobin levels

5. Foods high in potassium include: ______________ (select all that apply)
   a) Banana
   b) Potatoes
   c) Tomatoes
   d) Dates
   e) Oranges

f) Milk

6. What are the most common nutritional complications hemodialysis patients experience? (Select all that apply)
   a) Malnourishment
   b) Constipation
   c) Electrolyte imbalance
   d) Obesity

7. List 4 ways a patient can monitor their fluid intake
   1) ______________________________
   2) ______________________________
   3) ______________________________
   4) ______________________________

Use small cups and glasses, consume candy/gum to keep mouth moist, monitor food intake, avoid excessive consumption of salty foods, rinse mouth with cold water when thirst encountered, diabetic control, keep a daily log of fluid consumed.

8. What are the 5 most common minerals found in the body?
   a) Calcium
   b) Phosphorus
   c) Potassium
   d) Sodium
   e) Magnesium
   f) Protein
   g) Amino Acids
   h) Bicarbonate

9. Vitamin ________ can adversely affect clotting times and/or vascular access patency
   a) A
   b) B
   c) C
   d) D
   e) K

10. What is the role of Replavites® for hemodialysis patients?
    a) To correct malnutrition
    b) To replace water soluble vitamins that are dialyzed out
    c) To replace water insoluble vitamins that are dialyzed out
    d) For nutritional supplementation

Appendix D: Differences in scope of practice of the registered nurse and the licensed practical nurse in a hemodialysis setting.

	Scope of practice of the registered nurse	**Scope of practice of the licensed practical nurse**
Cannulation	• Novice nephrology nurses are to cannulate only well-established AVF/AVG/BHAVF (as per the Vascular Access nurse). • Experienced nephrology nurses are to cannulate any AVF/AVG/BHAVF.	• Not to cannulate new AVF/AVG/BHAVF. • No BHAVF creation. • Cannulate only well-established AVF/AVG/BHAVF (as per the Vascular Access nurse).
Locking Solutions	• Can lock with 4% citrate and Cathflo®.	• Not to lock with Cathflo®.
Troubleshooting CVC problems	• Can implement Cathflo® protocol.	• Cannot implement Cathflo® protocol.
Dry weight calculation	• Can work the dry weight + or – 1.5 % of the dry weight.	• Can work the dry weight + or – 1.0% of the dry weight.
Medications	• Can administer any medications.	• Cannot administer post IV antibiotics. • Cannot lock CVC post dialysis with Cathflo®. • Cannot administer vaccines.
Patient Condition	• Can care for all patients.	• Can care for all <u>stable</u> patients. • Cannot draw blood cultures.

Appendix E: Evaluation of the developed learning resource manual [To be completed after orientation]

1. I found the learning resource useful

☐	☐	☐	☐	☐
Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

2. I found the information in the learning resource easy to understand

☐	☐	☐	☐	☐
Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

3. I feel the information contained in the learning resource manual prepared me for when I start working in the hemodialysis unit

☐	☐	☐	☐	☐
Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

4. I found the use of pictures, figures, tables, and flowsheets helpful in the learning resource manual.

☐	☐	☐	☐	☐
Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

5. If I were to change the learning resource manual I would

____
____
____
____

6. What I liked/found helpful about the earning resource manual was

7. What I did not like or did not find helpful about the learning resource manual was

Appendix F: Evaluation of the developed learning resource manual [To be completed 6 months post orientation]

1. I found the learning resource useful.

☐	☐	☐	☐	☐
Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

2. I still use the learning resource manual in practice

☐	☐	☐	☐	☐
Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

3. The information presented in the learning resource manual helped me when working in the hemodialysis unit?

☐	☐	☐	☐	☐
Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

4. If I were to change the learning resource manual I would

____
____
____
____

5. What I liked/found helpful about the earning resource manual was

____
____
____
____

6. What I did not like or did not find helpful about the learning resource manual was

____

____

____

7. The learning resource manual was relevant in my practice in the hemodialysis unit

☐	☐	☐	☐	☐
Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

8. I still use the learning resource manual as a reference when needed.

☐	☐	☐	☐	☐
Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree