DEVELOPMENT OF A VIRTUAL PERITONEAL DIALYSIS RESOURCE FOR REGISTERED NURSES

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Abstract

Background: Peritoneal dialysis (PD) is a common renal replacement therapy for patients with end-stage renal disease (ESRD) and chronic kidney disease (CKD). Poor care of patients who use PD could lead to severe complications, including peritonitis, exit-site infection, technique failure and death. To ensure safe and effective peritoneal dialysis, nurses must receive comprehensive education and training on the proper techniques and procedures involved in the process. This will help them develop the skills and expertise to perform PD tasks proficiently and provide the best care to patients undergoing dialysis treatment. **Purpose:** To assess current evidence on virtual education methods to develop an educational resource for registered nurses providing care to patients who use peritoneal dialysis. **Methods:** Three methods were used to collect information for this project. First, an integrative literature review was conducted using a literature search in CINAHL, PubMed, and Scopus. Eleven relevant articles were identified, and research studies were critically appraised using standardized appraisal tools. Second, consultations with stakeholders (i.e., registered nurses, physicians, managers, patient care facilitators, and vendor representatives) were conducted to determine the learning needs of registered nurses in Newfoundland and Labrador (NL) and gather recommendations and feedback from all stakeholders regarding the development of a virtual peritoneal dialysis resource. Finally, an environmental scan was conducted to determine current resources and the best options for registered nurses. **Findings:** Registered nurses were effectively educated on peritoneal dialysis through virtual education methods, which included computer-assisted programs, e-modules, and Microsoft Teams. These findings aligned with the outcomes of the consultations and environmental scan. **Conclusion:** Limited literature exists on virtual methods to educate nurses about peritoneal dialysis. However, available research confirms the

effectiveness of online methods for this purpose. An evidence-based virtual peritoneal dialysis resource has been developed to aid nurses in caring for patients who use peritoneal dialysis. This virtual resource will be shared with Newfoundland and Labrador Health Services (NLHS) members so they can plan to implement it.

Keywords: Peritoneal dialysis, virtual education, nurse education, chronic kidney disease

Acknowledgements

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Introduction

In Canada, more than 48,000 people are living with end-stage renal disease (ESRD), and of those, approximately 30,000 people are receiving dialysis (Canadian Institute for Health Information, 2023). Renal replacement therapy (RRT) options to treat those with ESRD typically include hemodialysis, home hemodialysis, peritoneal dialysis, transplantation, and conservative treatment (Counts, 2020).

Of those, hemodialysis and peritoneal dialysis are the two most used renal replacement therapies (RRT). Hemodialysis has challenges, including inflexible schedules, limited patient space in centers, excessive healthcare system costs, travel to dialysis appointments, and caregiver burden (Chen et al., 2017; Counts, 2020; Kidney Foundation, 2024). Peritoneal dialysis is associated with benefits, including the ability to complete treatment at home, which allows people to avoid frequent travel to dialysis centers (Francois & Bargman, 2014). Peritoneal dialysis offers several benefits to patients, such as increased flexibility, cost savings, and the ability to manage their treatment in the comfort of their homes (Francois & Bargman, 2014).

In Newfoundland and Labrador (NL), the shortage of experienced peritoneal dialysis nurses can make it challenging for patients to access clinics regularly. To ensure patients have access to care, nurses must be skilled in performing and managing peritoneal dialysis, including catheter care and the steps to complete a peritoneal dialysis exchange. Therefore, providing resources to enhance nurses' proficiency in peritoneal dialysis would be highly beneficial. As a registered nurse who worked on a peritoneal dialysis unit, I saw firsthand the struggles of patients and nurses related to peritoneal dialysis. Many nurses reach out to our department, the peritoneal dialysis unit in St. John's, NL, looking for assistance in caring for patients who use peritoneal dialysis. Our unit is responsible for educating and maintaining peritoneal dialysis for

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patients living in the Eastern and Labrador zones. Resources for peritoneal dialysis in St. John's are limited and unavailable outside business hours and on weekends. Online resources related to peritoneal dialysis are available but not easily accessible, especially for nurses who need information immediately. Therefore, this project aimed to determine the best education delivery method and develop a peritoneal dialysis resource accessible to nurses in NL and beyond.

Objectives

This practicum project aimed to create a virtual resource on peritoneal dialysis. The resource covers the basics of peritoneal dialysis, associated complications, and patient care. Although this virtual resource was developed because of the identified barrier for rural patients, the information can be used by all registered nurses caring for people who use peritoneal dialysis. The project had the following specific objectives:

- To identify virtual educational interventions for enhancing nurses' knowledge and skills concerning peritoneal dialysis care.

- To develop a resource that addresses the learning needs of registered nurses and enhances the peritoneal dialysis care provided to people living in Newfoundland and Labrador.

- To demonstrate advanced nursing practice competencies in research, education, and leadership.

Overview of Methods

Three main methods were used to inform the development of this practicum project: an integrative literature review, consultations with stakeholders, and an environmental scan. The final drafts of the integrative review, consultation report, and environmental scan are in the appendix of this report.

Summary of the Literature Review

Literature Review

The literature review aimed at synthesizing scholarly literature on the effectiveness of virtual education delivery methods for nurses in peritoneal dialysis education. The Cumulative Index of Nursing and Allied Health Literature (CINAHL), PubMed, and Science Direct were searched for this literature review. Databases were searched using keywords and MESH terms to narrow the literature. These were: "peritoneal dialysis", "hemodialysis", "dialysis", "virtual education", "education", "nursing", "nursing education", "chronic kidney disease", "internet-based intervention", "distance", "virtual", "professional education", "nurse" and "clinical education." Initially, limited literature on peritoneal dialysis education for registered nurses was identified. As a result, the search was expanded to include all dialysis modalities and nursing students.

Literature Review Results

For this literature review, 11 studies were reviewed, most of which used quantitative approaches. Several quantitative studies (Bennett et al., 2014; Blackman et al., 2014; Olszewski et al., 2018; Poinen et al., 2021; Ghahfarokhi et al., 2022) provided evidence in support of the use of virtual learning methods for peritoneal dialysis nurses and other members of the interdisciplinary team. These studies highlighted the effectiveness of e-learning modules, simulators, demonstrations, video displays, and virtual social spaces in enhancing the learning experience. In qualitative studies, virtual education modalities were also supported for PD education (Bergjan & Schaepe, 2016; Jeffs et al., 2019; Poinen et al., 2021). Three qualitative studies (Bergjan & Schaepe, 2016; Jeffs et al., 2019; Poinen et al., 2021) addressed the theme of nurses' experiences and dialysis education. These studies aimed to investigate renal nurses'

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experiences, challenges, and strategies when educating patients on peritoneal dialysis. The studies also sought to understand the factors that influence the adoption of virtual care solutions, provide recommendations for enhancing outcomes and expectations for patients with chronic kidney disease (CKD) through virtual care, and evaluate the perceptions of the renal team regarding home-based therapies. The educational evaluation by Barnes and Wilkie (2023) provided valuable insights for this project. In their qualitative evaluation, Barnes and Wilkie (2023) found that nurses were satisfied with the virtual training program and reported increased knowledge following the virtual training sessions. Barnes and Wilkie (2023) supported their findings with evidence of visual engagement throughout the day, positive comments, and questionnaire responses indicating that the nurses believed patients would benefit from the program. After the program, the nurses reported that there was an excellent presentation of strategies to utilize with patients and staff, and that they experienced improved job satisfaction and had more time to spend with patients (Barnes & Wilkie, 2023).

The studies utilized various dialysis education techniques, including web-based educational packages, computer-based training systems, virtual peritoneal dialysis simulators, and asynchronous web-based e-learning modules to improve the understanding of peritoneal dialysis, chronic kidney disease (CKD) and home-based dialysis options among general practice nurses. Other learning methods included theoretical education, demonstration, video display, and virtual social spaces to improve nursing students' clinical skills in dialysis. One of the studies was particularly interesting as it used Microsoft Teams to deliver a virtual training program in a dialysis unit (Barnes & Wilkie, 2023). Microsoft Teams is frequently used in Canada and could be useful in disseminating regional information.

Each study used various data collection methods to assess the effectiveness of the e-learning program. Prior to any intervention, many nurses underwent a pre-intervention screening to determine their knowledge related to dialysis (Bennett et al., 2014; Blackman et al., 2014; Pun et al., 2016; Olszewski et al., 2018; Sinclair et al., 2019; Barnes & Wilkie, 2023). Some studies employed pre- and post-electronic surveys or online Likert-style survey tools, while others embedded surveys throughout the course. The surveys mainly focused on knowledge and skills related to dialysis and satisfaction. Several studies used the HD Knowledge Test or the HD Skills and Competence Checklist to evaluate the knowledge and effectiveness of the virtual learning modalities. Other instruments included the CKD knowledge evaluation instrument, the Learner's Satisfaction with the Asynchronous e-learning Instrument, the Peritoneal Dialysis Application Skill Assessment Checklist (PDASAC), and the General Self-Efficacy Scale (GSES). In contrast to these instruments, Ghahfarokhi et al. (2022) had experienced dialysis nurses using checklists like HD Skills for assessment.

These studies have demonstrated the positive outcomes of e-learning for nurses. For example, Sinclair et al. (2019) reported that nurses' knowledge scores increased from 3.77 to 5.48 out of 10 (95% CI [1.58, 2.16]) (p<0.01) and found that nurses' knowledge of chronic kidney disease improved significantly after completing an e-learning module. Nurses reported 85.8% satisfaction with the asynchronous e-learning instrument (Mean = 128, SD = 16.34).

 Bennett et al. (2014) reported that user feedback collected two months after the course dissemination revealed that users were satisfied with the e-learning program. The satisfaction score revealed that 99% of the participants were satisfied and had increased knowledge following the e-learning module (Bennett et al., 2014). Completing the e-learning module was found to improve procedural expertise in dialysis skills and increase the program's overall

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effectiveness. Participants also indicated that they better understood how well they learned skills and believed their renal assessment skills had improved. Before the e-module, only 20% of participants responded that hemodialysis could be performed at home, but afterwards, their response increased to 99% (z=7.3; p<0.001).

Pun et al. (2016) demonstrated that nurses who received both conventional training and computer-based training had higher scores in their skills test (Mean = 149.3, SD=19.4) compared to those who only received the conventional training alone (Mean = 113.7, SD=21.2) (p<0.001). Those who received the computer-based training also had higher scores in their knowledge test (Mean = 24, SD=1.0) compared to those who did not (Mean = 17.5, SD = 2.7) (p<0.001). Unfortunately, no confidence intervals were provided.

Although e-learning has positively affected nursing knowledge, limitations still exist. Ghahfarohki et al. (2022) studied different education methods for practical skills. Of the participants who received video displays, 80% were rated as having 'good' skills, and 20% had "very good" skills (p=0.045). Of those who only received demonstrations, none scored 'very good' on the skill level, but 90% were rated as 'good' (p=0.03). Those who received training in the virtual space had the best scores, with 50% being 'very good' and 50% being ranked as 'good' (p=0.02) (Ghahfarohki et al., 2022). Confidence intervals were not provided by Ghahfarohki et al. This demonstrates that there is success in teaching practical skills virtually, but more research could be done.

Qualitative Results

Bergjan and Schaepe (2016), Jeffs et al. (2019) and Poinen et al. (2021) provide insights into nurses' experiences with home-based dialysis modalities. They emphasize that practical skills, such as catheter care and bag exchange, are as essential as theoretical knowledge (Bergjan

& Schaepe, 2016). PD nurses suggest that teaching activities should prioritize the development of practical skills through instructional materials such as demonstrations, practice catheters, and aprons (Bergjan & Schaepe, 2016). According to Bergjan and Schaepe (2016), visual instructions such as pictures and film clips are commonly used, and learning environments should be conducive to learning. Learning environments that foster comfort and minimize the risk of mistakes or bad habits, like at home, were recommended for learners.

Nurses and allied health professionals preferred receiving more education related to home therapies, preferably through online continuing education or obtaining more practical experience (Poinen et al., 2021). Recommendations were made to improve the scalability of virtual care solutions and enhance outcomes and expectations for CKD patients (Jeffs et al., 2019). These included involving local stakeholders in the design process, integrating it into daily routines and workflows, implementing it gradually over time, sharing the benefits, and highlighting the solution's critical features, such as real-time monitoring, surveillance, and communication (Jeffs et al., 2019). These studies offer valuable insights into the learning requirements of peritoneal dialysis nurses. They suggest that online learning resources positively impact nurses' experiences and knowledge of peritoneal dialysis modalities. They also suggest that virtual learning techniques are appropriate and effective. These findings can help enhance the training and education of future nurses related to PD. The integrative literature review can be found in Appendix A.

Summary of Consultations

The consultations aimed to identify the learning needs of registered nurses related to peritoneal dialysis in NL, identify preexisting peritoneal dialysis education programs and identify

strengths and limitations associated with such programs. A summary of the consultations is provided below. The full consultation report is available in Appendix B.

Consultations

During the consultation phase of this project, semi-structured interviews and a focus group were conducted. Various stakeholders involved in peritoneal dialysis were consulted, including a nephrologist, management, a patient care facilitator (PCF), peritoneal dialysis nurses, nurses without dialysis experience, and a vendor (Baxter). Questions were developed to lead these focus groups and semi-structured interviews. The interview questions aimed to identify the most effective resources for providing peritoneal dialysis education to registered nurses in Newfoundland and Labrador. The aim of the questions was to assess nurses' knowledge, attitudes, barriers, and facilitators in identifying and managing peritoneal dialysis complications. They also aimed to determine the barriers and facilitators to providing peritoneal dialysis education to nurses. Additionally, the questions sought to gain insight into the experiences of registered nurses, particularly in terms of orientation programs and previously established resources. The insights gained from these consultations were an essential component of the research and informed the development of this project.

Consultation Results

Once the data were analyzed, common themes were identified, including resources for peritoneal dialysis education, outreach to professionals, orientation, barriers and facilitators, impact on patients, delivery methods, and access to supplies.

Existing Peritoneal Dialysis Education Resources. Several educational resources related to peritoneal dialysis are available. Companies such as Baxter (Kidney et al.), Fresenius Medical Care (Advance Renal Education Program), Mosby's Nursing Skills, British Columbia

(BC) Renal, and UpToDate have provided resources for peritoneal dialysis. However, all stakeholders agreed that these resources were unsuitable for nurses who lacked fundamental knowledge of peritoneal dialysis. Moreover, many of these resources are only available at a cost and, therefore, not practical for routine education.

Outreach of Professionals for Peritoneal Dialysis Information. There is a high demand for peritoneal dialysis information among nurses and healthcare professionals. Clinical educators often struggle to educate nurses caring for peritoneal dialysis patients. A professional practice group frequently contacts peritoneal dialysis professionals for further insight. Nurses from different settings and locations commonly contact the peritoneal dialysis unit for information on microbiology specimens, catheter issues, peritonitis, and inflow and outflow problems.

Peritoneal dialysis nurses provide in-person or video education to clinical educators and nurses. The patient care facilitator (PCF) delivers education through a PowerPoint presentation based on unofficial policies she created. The PCF stated that there is high staff turnover in places outside the city, making it challenging to maintain proficiency in peritoneal dialysis skills.

Orientation. Orientation was also a struggle for peritoneal dialysis nurses and non-peritoneal dialysis nurses. The hemodialysis unit has a clinical educator who provides an orientation to dialysis nurses. However, this educator has no experience in peritoneal dialysis and is not responsible for training nurses in this area. Instead, peritoneal dialysis nurses are responsible for upskilling and training new nurses. In the past, nurses have gained their peritoneal dialysis education through mentorship and hands-on experience. It was noted that Baxter Medical Care had previously trained nurses on peritoneal dialysis.

Barriers. Several barriers were identified throughout the semi-structured interviews and focus groups. The barriers noted were *logistical issues*, the *lack of a structured orientation program for new staff*, *the lack of designated educators*, and *workload and time constraints*.

Throughout the sessions, stakeholders mentioned that logistical issues, such as travel, time, and cost, were barriers to obtaining peritoneal dialysis education. It can be challenging for nurses to travel for education or training regarding peritoneal dialysis. It can also be expensive and time-consuming, taking away from their family and work-life balance.

Other barriers to peritoneal dialysis education include a structured orientation program, a program for new staff and the lack of designated educators. There is no structured orientation program for new peritoneal dialysis nurses in NL, making it challenging for them to acquire knowledge and proficiency with peritoneal dialysis skills. While hemodialysis nurses have a designated educator and orientation manual, those working with peritoneal dialysis lack these resources. Some stakeholders reported learning on the job without a sequential type of learning or a way to evaluate their knowledge.

The stakeholders have identified workload and time constraints as significant challenges in their respective units. Nurses typically work with limited staff and have limited time for education. Due to staffing shortages, it may be impossible for a nurse to attend peritoneal dialysis education in other areas, even if there is an opportunity to travel for education. Finding educational resources can also be challenging and, if time-consuming, may not be feasible to pursue while at work. Time constraints were identified as a significant obstacle to peritoneal dialysis education. Nurses noted that the available resources are not quick to complete, adding another layer of complexity to their learning requirements.

Facilitators. The facilitators associated with peritoneal dialysis education included *mentorship*, *policy development*, and *a checklist of peritoneal dialysis skills*. Previously developed modules, which were the organization's primary education source, are no longer used as the information provided did not align with best practice guidelines.

Stakeholders identified mentorship as a significant facilitator for peritoneal dialysis education in this area. Experienced nurses take new nurses under their wing and work with them to create a personalized learning plan based on their experience. The mentor can also inform the nurses about available resources and support them as they navigate the learning process. This allows nurses to feel comfortable asking questions about peritoneal dialysis.

Another identified facilitator for peritoneal dialysis education is policy development. Although the policies developed by the PCF are not yet finalized and posted for staff, they have been created based on best practice guidelines and have helped nurses learn about peritoneal dialysis. Finally, some nurses have created checklists for peritoneal dialysis tasks to learn and track progress. They reported that this had facilitated their learning and knowledge related to peritoneal dialysis and helped them to develop and adhere to learning plans.

Impact on Patients. Patients receiving peritoneal dialysis are facing challenges due to the lack of adequate education for nurses. When urgent care is required, patients often face inconvenience and high costs for travel as there may not be any nurse proficient in the procedure. This is especially difficult for patients living in remote areas like fly-in communities or coastal Labrador, where they must travel long distances for a 5-minute procedure. Other challenges that patients may face, in addition to cost and travel, include being separated from their families, taking time off work, and fear of not receiving appropriate care when needed. It is essential to

train nurses adequately in microbiology specimen testing, catheter care, and the addition of IV medications such as antibiotics to dialysate to address these issues for the well-being of patients.

Methods for Education Delivery. The group discussed the most effective resources for providing education on peritoneal dialysis during the sessions. They identified webinars, videos, modules, and guidebooks as the most suitable methods for delivering education. Webinars were considered easy to access and effective for educating people within the organization. Videos were preferred over written information because all nurses can access them and be broken down into specific skills. The group also mentioned that videos are less labour-intensive and can be watched by anyone after they are recorded, making the information readily accessible even after a turnover in staff. The group suggested a guidebook or pocket handbook with peritoneal dialysis information as another effective method for educating nurses. Finally, the group identified Microsoft Teams as the most popular software for reaching out to people.

Access to Peritoneal Dialysis Supplies. It was emphasized that access to the necessary supplies is crucial in delivering effective, high-quality patient care. However, this would add another layer of complexity to the existing problem of a lack of peritoneal dialysis education. It was also determined that stocking routine dialysis supplies in areas with no peritoneal dialysis patients would be uneconomic.

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Summary of Environmental Scan

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The environmental scan involved consultations with the vendor (Baxter) and an extensive internet search to identify preexisting virtual education resources for peritoneal dialysis nurses. The results are summarized below, and a detailed report can be found in Appendix C.

Environmental Scan Results

To conduct an effective environmental scan, a plan was developed that involved

discussions with a vendor of peritoneal dialysis equipment, followed by searches of websites with virtual peritoneal dialysis resources. Through this process, a range of relevant online resources were identified.

Vendor-Specific Results. Baxter Medical Care provides in-personal and virtual education to help customers (i.e., nurses) learn how to do the basic skills of peritoneal dialysis, including twin-bag exchange, catheter care, and automated peritoneal dialysis (APD). This education is provided to nurses in urban, rural, and remote locations. In addition to providing education online and virtually through webinars, they also have an online platform called Kidney Care Campus that contains videos related to peritoneal dialysis. This platform is exclusively accessible to Baxter Medical customers, who must sign in using their unique username and password. Not all nurses in Newfoundland and Labrador have access to this platform.

Online Resources. Six online resources that could benefit nurses were identified. These resources include the Advanced Renal Program by Fresenius Medical Care, UHN, BC Renal, Kidney Care Campus by Baxter Medical Care, UpToDate, and Mosby's Nursing Skill.

Advanced Renal Education Program. Fresenius Medical Care has an online resource related to peritoneal dialysis. It is called the Advanced Renal Education Program and is available online. It allows users to create an account with a username and password that is free of charge. Once registered, you can register for webinars and receive emails about the education sessions that are offered. There is also the opportunity to navigate their platform and complete modules. Some modules are video-based, others are slides from a PowerPoint presentation, and others are posters. Some modules have case studies and multiple-choice testing at the end of the module for evaluation. The Advanced Renal Education Program provides information about renal anatomy and physiology and basic details on peritoneal dialysis, is available internationally and in

multiple languages, and provides users with a self-directed, anonymous learning environment. The most significant limitation is that the procedure videos are irrelevant to nurses in NL because their products are not used here and differ from those purchased from Baxter Medical Care.

University Hospital Network. The University Hospital Network (UHN) in Toronto, Canada, offers online resources for nurses and patients about peritoneal dialysis. Although there was limited information for nurses, the online resources designed for patients included information relevant to nurses, such as anatomy and physiology, the principles of peritoneal dialysis, aseptic technique, and peritonitis. It was suggested during stakeholder consultations that essential information would be helpful for nurses, as resources can be content-heavy and include irrelevant information. There were strengths associated with this resource, such as including resources for training and policies and procedures that were evidence-based and aligned with best practice guidelines. UHN uses the same vendor for dialysis supplies as NL. Therefore, the information is pertinent. The limitations of the resources available at UHN are that they focus primarily on improving patient education rather than nursing education, which is not the intended audience for this project. Additionally, no videos or interactive materials were provided, nor was there any way to assess knowledge.

BC Renal. BC Renal is a resource for nurses that provides written policies and procedures but lacks interactive tools. It is important to note that policies and procedures may be specific to certain locations. For nurses in NL to adopt these policies, they would need to go through the appropriate channels. Policies were readily available regarding peritoneal dialysis, including instructions on performing an exchange, adding medications to a peritoneal dialysis bag, managing patients with peritonitis, and more. This resource focuses on nursing education

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and offers training materials and additional information to supplement learning. However, its website does not have interactive activities or videos available online or any evaluation components. Furthermore, there were no case studies or examples to enhance understanding of peritoneal dialysis.

Kidney Care Campus. Kidney Care Campus is an educational online platform powered by Baxter Medical Care. Strategies of resources include posters, videos, case studies, and PowerPoint presentations. The strengths of this resource are that it provides information related to anatomy and physiology, as well as other information about peritoneal dialysis. The platform is available internationally and in multiple languages. The barriers and limitations associated with this platform are that it is only available to Baxter customers, and customers must sign in using a username and password.

UpToDate. UpToDate is an online learning resource that stakeholders and vendors recommend. It provides information and videos on peritoneal dialysis and is highly recommended. Like other resources, its strengths are that it allows for autonomous and self-directed learning and is always available if the user is subscribed. However, it is essential to note that this resource is not readily accessible, non-affordable, and not specific to the NL context.

Mosby's Nursing Skills. Mosby's Nursing Skills, an online resource for nurses, presents challenges. While it offers information on various nursing skills, including peritonitis resource videos and aseptic techniques, its accessibility is limited to subscribers. Navigating the site can be difficult, as the dialysis information is not adequately categorized. These challenges highlight the need for more accessible and user-friendly resources for nurses.

Theoretical Framework

Knowles's Theory of Adult Education guided the practicum project because this theory acknowledges that adult learners possess a high degree of autonomy and self-direction (Mitchell & Courtney, 2005). This aligns with the characteristics of most practicing registered nurses, who are typically self-motivated and take responsibility for their own learning and professional development.

Malcolm Knowles expanded on Carl Rogers's concept of the learner's needs and focused on self-directed learning, which involves teaching adults to control their learning (Mitchell & Courtney, 2005). Knowles' theory of adult learning is based on six essential elements for learning to occur, forming the andragogical model, which is the art and science of helping adults learn (Mitchell & Courtney, 2005). It is essential to recognize these fundamental elements: the need to know, taking responsibility for your learning, utilizing your experiences as a valuable resource, making sure the information is relevant to your life, having the motivation to learn, and engaging in problem-centred learning with real-life situations (Michell & Courtney, 2005).

The occurrence of these elements together may vary as adults progress toward self-directedness at different rates, depending on life events (Mitchell & Courtney, 2005). They require information that is meaningful to their life situation. Educational interventions incorporating these features will likely positively impact learning outcomes (Mitchell & Courtney, 2005). This is particularly true for many registered nurses in Newfoundland and Labrador (NL) due to the limited orientation related to peritoneal dialysis and the changing need for this knowledge based on the patient population and needs in the region. Therefore, Knowles' Adult Learning Theory was selected as the appropriate theoretical framework for this practicum project and incorporated into various resource development steps. For example, we collaborated

with the nursing staff during consultations to discover their learning needs and preferences. We wanted to know what they already knew and what they wanted to learn, as adults are motivated to direct their own learning. We valued their experiences, which could enhance the learning process and provide us with valuable feedback to improve the learning resource. We aimed to incorporate content that was relevant to their work and personal lives, as adults learn best when the material applies to their daily experiences. Therefore, we developed a handbook with photos and videos demonstrating nurses performing tasks, aligning with Knowles' Adult Learning Theory, which emphasizes hands-on learning experiences for adults. This approach aimed to provide the nurses with practical, hands-on learning experiences.

Summary of the Resource

A virtual resource was developed to help nurses learn about peritoneal dialysis in a comprehensive and manageable way. The resource includes seven videos and a handbook with seven modules covering the basics of peritoneal dialysis, catheter care, how to conduct a peritoneal dialysis exchange, administering medications, addressing complications, and managing peritonitis. The videos provide visual and audio guidance, helping nurses care for patients undergoing peritoneal dialysis. Key features of the handbook include clear organization into modules, background information on kidney disease and the peritoneal dialysis process, and guidance on understanding the principles of peritoneal dialysis, such as ultrafiltration and the transport process. Additionally, it provides information on caring for the catheter, completing a peritoneal dialysis exchange, and managing any complications or issues that nurses might encounter. The handbook also guides monitoring vital signs and edema and selecting the appropriate peritoneal dialysis solution. Each procedure is clearly labelled and included in a table of contents, along with the rationale for the procedure, the required supplies, and step-by-step

instructions for completion.

To accompany the handbook, seven videos are associated with each module that covers the basics of peritoneal dialysis. The topics include dialysis solutions, catheter care, peritoneal dialysis exchange, administering medications, complications associated with peritoneal dialysis, and peritonitis. The videos are intentionally short, making them more engaging and allowing nurses to watch them quickly if they have urgent patient care needs related to peritoneal dialysis. The videos were recorded with the help of the peritoneal dialysis unit, which supplied supplies and a clinic room. After completing the next steps, the recorded and edited videos are ready for use. The only issue with the videos is that they were created on a limited budget without access to multimedia resources or equipment. It is recommended that appropriate audio-visual resources be acquired for producing future educational videos. To align with Knowles' Adult Learning Theory, which provided valuable insights into the practical strategies for adult learning, this resource contains specific clinical and teaching strategies to help nurses care for patients undergoing peritoneal dialysis.

Discussion of Advanced Nursing Practice (ANP) Competencies

The Canadian Nursing Association (CNA) has defined nursing competencies for advanced nursing practice, which enable nurses to enhance their skills and knowledge in various settings (CNA, 2019). During my practicum experience, I have had the opportunity to develop my advanced nursing competencies. The four most relevant ANP competencies to my practicum project are education, research, leadership, consultation, and collaboration.

Education

Advanced practice nurses (APNs) must be dedicated to the professional advancement and education of healthcare providers, students, clients, and their families (CNA, 2019). The CNA

framework emphasizes that nurses should have the educational skills to share new knowledge, develop educational programs, identify healthcare providers' learning needs, and create learning opportunities. This competency was demonstrated by creating a virtual peritoneal dialysis resource, which includes a handbook and video designed to enhance registered nurses' knowledge of peritoneal dialysis.

Research

APNs must be able to create, combine, and evaluate current literature (CNA, 2019). This competency is demonstrated by completing an integrative review involving analyzing and synthesizing review findings. Conducting a literature review allowed me to learn how to appraise literature, synthesize evidence, and extract pertinent information for policymaking and practice. I can now assess the reliability and credibility of evidence and determine whether it should be used to influence practice or policy. I can also determine if further research is needed to decide if a change in practice is necessary and, if so, how it should be implemented. The findings aided the development of a virtual resource on peritoneal dialysis. This resource will help share knowledge and enhance the peritoneal dialysis expertise of registered nurses to support evidence-based practice (CNA, 2019).

Leadership

The CNA (2019) emphasizes that APNs are organizational leaders. These nurses should aim to bring about positive change and explore ways to enhance healthcare practices (CNA, 2019). I demonstrated this competency by developing a peritoneal dialysis resource. I also demonstrated that nurses in clinical settings can take on leadership roles by exploring opportunities for and designing resources for the professional development of novice nurses, advocating for patients' needs, and prompting higher management to invest in nurses'

professional development. In this instance, I demonstrated effective leadership skills by clearly communicating with stakeholders, critically evaluating which resources would be most beneficial, offering support and guidance to the nurses, and adjusting the project to meet their needs. For instance, I actively listened to the nurses' feedback, developed a resource that they specifically requested, and included a handbook to complement the videos based on their suggestion that it would be helpful.

Consultations and Collaboration

Collaboration and communication with healthcare providers, clients, and key stakeholders are essential to ANP competency (CNA, 2019). Collaboration was fundamental to developing, delivering, and evaluating this virtual resource. During the practicum, I communicated with clinical stakeholders and nurses during consultations. These individuals were experts in peritoneal dialysis and offered valuable insights that could be leveraged to support the development of this resource. Furthermore, I communicated and collaborated with key Newfoundland and Labrador Health Services (NLHS) organization stakeholders, including nephrologists, patient care facilitators, managers, dialysis educators, and registered nurses. This collaboration was essential in developing a virtual resource to assist nurses in caring for patients using peritoneal dialysis. Although this resource has not been implemented yet, further discussion and collaboration with clinical stakeholders and nurses will be necessary during the implementation and evaluation phases of this project.

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Next Steps

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The practicum project did not include implementing this virtual resource because of the course's time constraints. However, appropriate next steps must be followed to implement this resource within NL. These would involve obtaining approval from the manager responsible for

the peritoneal dialysis unit, coordinating with professional practice, and collaborating with the clinical educator. Any educational materials must be approved through the appropriate channels before distribution. Ideally, the clinical educator could present the information to nurses without peritoneal dialysis knowledge and be available to answer questions or provide support.

It is crucial to evaluate the project to gauge what nurses have learned from the resource and their opinions on potential changes, updates, or modifications. To achieve this, multiple-choice questions could be created to assess the knowledge gained from the resource. A survey could also be used for nurses to evaluate this resource. The survey could focus on the resource's value, what nurses found helpful or unhelpful, and areas needing improvement or enhancement.

To further evaluate the effectiveness of this resource, we could conduct a randomized control study by selecting nurses across NL and randomly assigning them to either an intervention group or a control group. The intervention group would receive the resources, including a video and a handbook, and then care for a patient using peritoneal dialysis. On the other hand, the control group would not receive the resources and would also care for patients using peritoneal dialysis. To ensure the safety of the patients, the control group would still have access to all the necessary peritoneal dialysis resources for appropriate patient care.

Conclusion

Developing a virtual peritoneal dialysis resource can ensure that nurses in NL have access to high-quality, up-to-date, and comprehensive information. This resource is easily accessible and user-friendly and aims to encourage self-directed learning. Using videos supplemented by a handbook is an approach that can deliver both theoretical and practical content. Although there is a need for further research to establish the effectiveness of virtual

education programs for nurses, specifically related to peritoneal dialysis, adequate evidence is provided through consultations and the environmental scan to continue developing this resource.

The development of the virtual resource for peritoneal dialysis marks a significant step in advancing nursing practice by providing comprehensive and accessible education for nurses. The project demonstrates a commitment to fostering education, research, leadership, and collaboration in line with the Advanced Nursing Practice competencies outlined by the Canadian Nursing Association. Moving forward, it is essential to follow the appropriate steps for implementing the virtual resource and to conduct thorough evaluations to gauge its impact and effectiveness. Collaborative efforts with key stakeholders and continuous feedback from nurses will be valuable in refining and enhancing the resources for improving patient care in peritoneal dialysis.

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Appendix A

Type and Characteristics of Virtual Educational Modalities for Delivering Evidence-

Based Education of Dialysis Care

An Integrative Review

Abstract

Background: Peritoneal dialysis (PD) is a common renal replacement therapy for patients with end-stage renal disease (ESRD) and chronic kidney disease (CKD). Poor care of patients who use PD could lead to severe complications, including peritonitis, exit-site infection, technique failure and death. To ensure safe and effective peritoneal dialysis, nurses must receive comprehensive education and training on the proper techniques and procedures involved in the process. This will help them develop the skills and expertise to perform PD tasks proficiently and provide the best care to patients undergoing dialysis treatment. *Purpose:* To assess current evidence on virtual education methods to develop an educational resource for registered nurses related to peritoneal dialysis. *Methods:* A systematic search was conducted using CINAHL, PubMed, and Scopus. Eleven relevant articles were identified, and research studies were critically appraised. *Findings:* Registered nurses were effectively educated on peritoneal dialysis through virtual education methods, which included computer-assisted programs, e-modules, and Microsoft Teams. *Conclusion:* Although there is limited literature on virtual methods to educate nurses about peritoneal dialysis, the available research confirms the effectiveness of online methods for this purpose. Nurses have reported satisfaction and improved knowledge using online resources, supporting the development of a comprehensive educational resource for peritoneal dialysis nurses.

Keywords: Peritoneal dialysis, virtual education, nurse, nurse education, chronic kidney disease

Chronic kidney disease (CKD) is a chronic deterioration in renal function, resulting in fluid and waste accumulation in the blood (Counts, 2020; Lee et al., 2008). To adapt to these changes in health status, patients must decide on a course of renal replacement therapy (RRT), including peritoneal dialysis (PD), hemodialysis (HD), or transplant (Counts, 2020; Lee et al., 2008). Conservative therapy or palliative care are also treatment options for CKD patients (Counts, 2020; Triamchaisri et al., 2013). Peritoneal dialysis (PD) is a cost-effective treatment modality worldwide for end-stage kidney disease patients (Nopsopon et al., 2022). Nopsopon et al. (2002) suggested that PD is associated with long-term survival, superior treatment satisfaction, and longer preservation of residual kidney function. Nephrology nurses are crucial in providing specialized education, particularly for patients using PD (Nopsopon et al., 2022). Providing additional education and contact time to nurses caring for PD patients could help prevent complications, such as peritonitis, exit-site infections, technique failure, mortality, and quality of life. Therefore, it is essential to develop more comprehensive educational resources to support registered nurses (Nopsopon et al., 2022). Given the demographic diversity of Newfoundland and Labrador, the identification of virtual education approaches to enhance the evidence-based knowledge of nurses is appropriate.

Purpose

This literature review provides an overview of chronic kidney disease, focusing on peritoneal dialysis. The aim is to identify methods for learning based on collected evidence and literature to develop an educational resource.

Background

CKD is a highly prevalent health condition that, nationally and internationally, burdens public health (Bello et al., 2019). An estimated 4 million Canadians have CKD, and the global

mean prevalence of CKD is 13.4% (Bello et al., 2019). In Canada, approximately 30,000 people are receiving dialysis (CIHI, 2023). Significant burdens related to CKD include healthcare costs that exceed 40 million dollars annually and premature mortality (Bello et al., 2019). CKD patients receiving RRT often suffer psychological and socioeconomic burdens, leading to poor health and low quality of life (Cheng et al., 2022). Symptoms of CKD are often vague and can go unnoticed by those suffering from the disease, leading to unknown health issues during the early stages, leaving patients unknowledgeable about their prognosis, disease progression, and treatment options (Cheng et al., 2022). This lack of knowledge and healthcare provider support can leave patients unprepared and uncertain, reducing adherence and coping ability throughout the progression of the disease (Cheng et al., 2022).

The two most used RRT methods are hemodialysis and peritoneal dialysis (Counts, 2020). Hemodialysis is a process that requires patients to be connected to a dialysis machine at a center for 3-4 hours, typically for 3-4 days per week (Counts, 2020). In contrast, peritoneal dialysis uses the peritoneal membrane to filter waste products and excess fluids from the blood (Counts, 2020). Patients can perform this procedure in the comfort of their own homes (Chen et al., 2017; Counts, 2020).

Hemodialysis has challenges, including inflexible schedules, limited patient space in centers, high healthcare system costs, travel to dialysis appointments, and caregiver burden (Chen et al., 2017; Counts, 2020; Kidney Foundation, 2024). Many provinces have limited outpatient hemodialysis centers, resulting in long waitlists to meet the population's needs.

Peritoneal dialysis is associated with benefits, including the ability to complete treatment at home, which allows patients to avoid frequent travel to dialysis centers (Francois & Bargman, 2014). This can lead to significant cost savings for patients and the healthcare system since

peritoneal dialysis is less expensive than in-center treatments (Francois & Bargman, 2014).

Many peritoneal dialysis vendors offer free delivery to the patients' preferred address, which can improve patient travel. Compared to hemodialysis, peritoneal dialysis is usually more accessible and easier for patients to learn (Francois & Bargman, 2014). It involves the insertion of a catheter into the peritoneal cavity and requires only water and soap for maintenance, without the need for vascular access (Counts, 2020). On the other hand, individuals undergoing hemodialysis treatment with central venous catheters (CVC) may face limitations in performing certain physical activities as they need to avoid the risk of infection to their CVC (e.g., swimming) (Counts, 2020). Overall, peritoneal dialysis offers many benefits to patients, including more flexibility, cost savings, and the ability to manage their treatment at home (Francios & Bargman, 2014).

Insufficient knowledge about PD among nurses can result in negative impacts on patients, including issues like peritonitis, higher costs for both patients and the healthcare system, and a reduction in the quality of life for patients and their families, with increases in fatigue and burnout (Chen et al., 2018). Nurses must be knowledgeable about CKD and treatment options, including PD, to ensure patients receive high-quality, evidence-based care.

Context of Chronic Kidney Disease within NL

In Canada, 19,189 patients use hemodialysis, while 4,683 use peritoneal dialysis. In Newfoundland and Labrador (NL), 550 people use hemodialysis, and 101 use peritoneal dialysis (CIHI, 2023). Of the 101 patients in NL who use peritoneal dialysis, only 17 reside in the province's metropolitan area (CIHI, 2023). Several factors contribute to decreased peritoneal dialysis education for nurses in Newfoundland and Labrador. These include limited access to peritoneal dialysis resources outside of urban areas and insufficient availability of healthcare

provider education and information. To ensure the proposed resource is appropriate for nurses, a literature review was completed to determine what types and characteristics of virtual education suit this learning program.

Methods

Integrative literature reviews are an effective way to comprehensively understand research in the healthcare system (Dhollande et al., 2021). An integrative literature review was conducted to identify an effective virtual education method for nurses learning about PD. This method was chosen due to its wide-ranging use in healthcare (Younas et al., 2022) and allowing researchers to compile a wide range of empirical (qualitative, quantitative, and mixed methods) and non-empirical literature (Whittmore & Knafl, 2005). The guiding methodology and framework for this integrative review are Whittmore and Knafl's five-step process, which includes problem identification, literature search, data evaluation and analysis, and presentation (Whittmore & Knafl, 2005).

Problem Identification and Purpose

Despite the abundance of PD educational resources available, there is a need for more in the Newfoundland and Labrador (NL) region. As a result, nurses in NL have limited access to PD-related materials, which could negatively impact the quality of care provided to patients requiring PD treatment. This paper aims to critically review and appraise existing studies, identify gaps, and explore virtual education delivery modes for registered nurses. Review questions guiding this literature search include:

- How do learning resources affect registered nurses' knowledge of dialysis modalities?

- What virtual learning modalities are appropriate for RNs, and have they been successfully utilized?

Literature Search

The Cumulative Index of Nursing and Allied Health Literature (CINAHL), PubMed, and Science Direct were searched for this literature review. Databases were searched using keywords and MESH terms, including: "peritoneal dialysis", "hemodialysis", "dialysis", "virtual education", "education", "nursing", "nursing education", "chronic kidney disease", "internet-based intervention", "distance", "virtual", "professional education", and "clinical education." A total of 228 records were initially retrieved from the databases. Newsletter articles, dissertations, book chapters, conference proceedings, reports, and magazine articles were excluded. Irrelevant articles that focused primarily on peritoneal dialysis education for patients, caregivers, and nephrologists were removed. After assessing 22 articles by reading titles and abstracts, ten articles related to virtual education for patients and nephrologists were removed during the abstract screening. The remaining 12 articles underwent complete screening, and 11 were ultimately selected for review.

Inclusion and Exclusion Criteria

The studies that met the following criteria were included: a) original research (qualitative, quantitative, and mixed methods) that was published in peer-reviewed journals in the English language between 2014 and 2024, b) research articles that focused on registered nurses, nursing students, or multidisciplinary teams that mainly included nurses and their experiences with virtual learning techniques related to peritoneal dialysis, c) research articles that tested and evaluated virtual teaching and learning strategies, modules, and programs related to PD for nurses. Non-research articles and discussion papers about virtual education

methods for nurses and nursing students were excluded. The PRISMA flow diagram

showcasing the literature search and screening can be found in Appendix B.

Data Evaluation

To assess the quality of the studies that were included in this literature review, the

Mixed Methods Appraisal Tool (MMAT) developed by Hong et al. in 2018 and the Public

Health Agency of Canada (PHAC) Critical Appraisal Toolkit (2014) were used. The MMAT

(2018) was used to assess the qualitative literature and the education evaluation. While the

PHAC toolkit (2014) was used to assess the quantitative designs. Based on the

recommendations by Hong et al. (2018), the qualitative studies and the educational evaluation

were given ratings such as weak, moderate, and strong in quality. Overall scores were not

assigned (Hong et al., 2018). In contrast, two ratings were assigned to the quantitative

research evaluated using the PHAC toolkit (2014). A rating was given for quality (e.g., low-

quality, medium-quality, or high-quality), and another rating was for strength of study design

(e.g., weak, moderate, or strong). More information about the quality, limitations and

strengths of the studies can be found in the appendix of this paper.

Data Analysis

For this literature review, the data was extracted independently using literature summary

tables (Shahzad et al., 2021). These tables overview the various studies, including the authors,

publication dates, purpose, and quality rating (Shahzad et al., 2021). The summary tables contain

information about the design, setting, sample size, sampling, data collection, data analysis,

interventions, key findings, and critical appraisal and are in the appendix of this paper (Shahzad

et al., 2021). Thematic analysis was selected to analyze the data because the main purpose was to

understand nurses' knowledge and experiences with PD virtual education based on research

studies (Polit & Beck, 2020). Thematic analysis is a research method that uses an inductive approach to analyze data (Polit & Beck, 2020). This approach involves drawing conclusions based on the themes identified in the data. Inductive reasoning moves from specific observations to general rules (Polit & Beck, 2020). The articles were reviewed in-depth and analyzed thematically to synthesize the data. The process involved becoming familiar with the data and coding it using various codes such as knowledge, satisfaction, awareness, learning, effectiveness, perceptions, and understanding. These codes were then converted into themes, including "peritoneal dialysis training modalities affect knowledge" and "the experiences of registered nurses and dialysis education." Once the themes were generated, they were reviewed for accuracy and appropriateness and then summarized for the results section of this paper.

Findings

Overview of Studies

Out of the 11 studies, a range of countries were represented. Three studies were conducted in Australia, two in Canada, one in Germany, one in Hong Kong, one in Iran, one in Turkey, one in the United States, and one in the United Kingdom. Most of the studies were quantitative (n =8), followed by qualitative (n =2) and one educational evaluation (n=1). A range of study designs were included: three randomized control trials (Pun et al., 2016; Sinclair et al., 2019; Topbas et al., 2019), one uncontrolled before-after (Bennett et al., 2014), one quantitative descriptive study (Blackman et al., 2014), one exploratory qualitative study (Bergjan & Schaepe, 2016), one prospective cohort study (Olszewski et al., 2018), one cross-sectional survey design (Poinen et al., 2021), one qualitative descriptive (Jeffs et al., 2019), one semi-experimental research design (Ghahfarokhi et al., 2022) and one educational evaluation (Barnes & Wilkie, 2023).

Critical Appraisal

Eight of the 11 selected quantitative articles were given quality and design strength ratings as per the recommendation of the PHAC tool kit (2014), although only quality ratings are presented in the literature summary tables. The three randomized control trials (Pun et al., 2016; Sinclair et al., 2019; Topbas et al., 2019) were strong study designs, and all three were given a medium-quality rating. The uncontrolled before-after by Bennett et al. (2014) is a weak study design and was given a low-quality rating. The quantitative descriptive study (Blackman et al., 2014), the cross-sectional survey design (Poinen et al., 2021), and the semi-experimental research design (Ghahfarokhi et al., 2022) are weak study designs. Blackman et al. (2014) is a medium-quality study while Poinen et al. (2021) and Ghahfarokhi et al. (2022) are low-quality studies. Two of the selected qualitative research articles (Bergjan & Schaepe, 2016; Jeffs et al., 2019) and the educational evaluation (Barnes & Wilkie, 2023) were appraised using the MMAT. Jeffs et al. (2019) and Barnes & Wilkie (2023) received a weak quality rating, but Bergjan and Schaepe (2016) were moderate.

The studies discussed had limitations that affected their quality and resulted in a weak to moderate/medium quality rating. These limitations included inadequate sample sizes and samples being limited to one specific area, which made it difficult to generalize the results to peritoneal dialysis nurses in other areas. Moreover, the use of self-rating data collection methods, convenience sampling, the risk of expectation bias, and inadequate data analysis techniques all contributed to the limitations of the studies. Other factors, such as attrition bias, non-response bias, snowball, and voluntary response sampling, were also identified as potential limitations. Despite this, some studies had strengths, including robust and

appropriate data analysis, valid and reliable data collection tools, adequate sample size and response rates, and randomization.

<div align="center">

Results

</div>

Theme 1: Peritoneal Dialysis Training Modalities Affect Knowledge

Eight studies (Bennett et al., 2014; Blackman et al., 2014; Pun et al., 2016; Olszewski et al., 2018; Sinclair et al., 2019; Topbas et al., 2019; Ghahfarokhi et al., 2022; Barnes & Wilkie, 2023) addressed the theme, peritoneal dialysis training modalities affect knowledge.

These eight studies aimed to enhance the knowledge of registered nurses, nursing students, and interdisciplinary team members about dialysis and peritoneal dialysis training through training techniques and programs. Although some studies included allied health professionals, most participants were nurses or nursing students. The studies utilized various dialysis education techniques, including web-based educational packages, computer-based training systems, virtual peritoneal dialysis simulators, and asynchronous web-based e-learning modules to improve the understanding of chronic kidney disease (CKD) and home-based dialysis options among general practice nurses. Other learning methods included theoretical education, demonstration, video display, and virtual social spaces to improve nursing students' clinical skills in dialysis. One of the studies was particularly interesting as it used Microsoft Teams to deliver a virtual training program in a dialysis unit (Barnes & Wilkie, 2023). Microsoft Teams is frequently used in Canada and could be useful for disseminating information in the region.

Prior to any intervention, many nurses underwent a pre-intervention screening to determine their knowledge related to dialysis (Bennett et al., 2014; Blackman et al., 2014; Pun et al., 2016; Olszewski et al., 2018; Sinclair et al., 2019; Barnes & Wilkie, 2023). Each study used various data collection methods to assess the effectiveness of the e-learning program. Some

studies employed pre- and post-electronic surveys or online Likert-style survey tools, while

Others embedded surveys throughout the course. The surveys mainly focused on knowledge and

skills related to dialysis and satisfaction. Several studies used the HD Knowledge Test or the HD

Skills and Competence Checklist to evaluate the knowledge and effectiveness of the virtual

learning modalities. Other instruments included the CKD knowledge evaluation instrument, the

Learner's Satisfaction with the Asynchronous e-learning Instrument, the Peritoneal Dialysis

Application Skill Assessment Checklist (PDASAC), and the General Self-Efficacy Scale

(GSES). In contrast to these instruments, Ghahfarokhi et al. (2022) had experienced dialysis

nurses using checklists like HD Skills for assessment. One study utilized a redesigned

Kirkpatrick Model to evaluate trainees while incorporating collaborative discussions (Barnes &

Wilkie, 2023).

      These studies have demonstrated the positive outcomes of e-learning for nurses. Sinclair

et al. (2019) reported that nurses' knowledge scores increased from 3.77 to 5.48 out of 10 (95%

CI [1.58, 2.16]) (p<0.01) and found that nurses' knowledge of chronic kidney disease improved

significantly after completing an e-learning module. Nurses also reported 85.8% satisfaction with

the asynchronous e-learning instrument (Mean = 128, SD = 16.34).

      Bennett et al. (2014) reported that user feedback collected two months after the course

dissemination revealed that users were satisfied with the e-learning program. The satisfaction

score revealed that 99% of the participants were satisfied and had increased knowledge

following the e-learning module (Bennett et al., 2014). Completing the e-learning module was

found to improve procedural expertise in dialysis skills and increase the program's overall

effectiveness. Participants also indicated that they better understood how well they learned skills

and believed their renal assessment skills had improved. Prior to the e-module, only 20% of

participants responded that hemodialysis could be performed at home, but afterwards, their response increased to 99% ($z=7.3$; $p<0.001$).

Pun et al. (2016) demonstrated that nurses who received both conventional training and computer-based training had higher scores in their skills test (Mean = 149.3, SD=19.4) compared to those who only received the conventional training alone (Mean = 113.7, SD=21.2) ($p<0.001$). Those who received the computer-based training also had higher scores in their knowledge test (Mean = 24, SD=1.0) compared to those who did not (Mean = 17.5, SD = 2.7) ($p<0.001$).

Although e-learning has positively affected nursing knowledge, limitations still exist. Ghahfarohki et al. (2022) studied different education methods for practical skills. Of the participants who received video displays, 80% were rated as having 'good' skills, and 20% had "very good" skills. Of those who only received demonstrations, none scored 'very good' on the skill level, but 90% were rated as 'good'. Those who received training in the virtual space had the best scores, with 50% being 'very good' and 50% being ranked as 'good'. (Ghahfarohki et al., 2022). The practical skill levels in the virtual social network group were significantly better than those in the video display ($p=0.045$) and demonstration ($p=0.03$) (Ghahfarohki et al., 2022). This demonstrates that there is success in teaching practical skills virtually, but more research could be done.

Topbas et al. (2019) also studied different education methods for peritoneal dialysis practice skills. They compared using a PD simulator versus just using demonstration videos on nurses' practical skills. Like Ghahfarokhi et al. (2022), Topbas et al. (2019) also revealed that demonstrations alone were inadequate. Students who used the simulator scored better (Mean = 54.6, SD = 5.3) than those who had received only demonstrations (Mean = 41.1, SD = 7.8) ($p<0.0001$) (Topbas et al., 2019).

Overall, education, including e-learning, is an effective tool for increasing nurses' knowledge and skills. Throughout the studies that were identified, nurses felt that the education they received was relevant to their practice and would recommend it to other nurses.

Theme 2: The Experiences of Registered Nurses and Dialysis Education

Three studies (Bergjan & Schaepe, 2016; Jeffs et al., 2019; Poinen et al., 2021) addressed the theme of experiences of nurses and dialysis education. These studies aimed to investigate renal nurses' experiences, challenges, and strategies when educating patients on peritoneal dialysis. The studies also sought to understand the factors that influence the adoption of virtual care solutions, provide recommendations for enhancing outcomes and expectations for patients with chronic kidney disease (CKD) through virtual care, and evaluate the perceptions of the renal team regarding home-based therapies.

Bergjan and Schaepe (2016), Jeffs et al. (2019), and Poinen et al. (2021) provide insights into the experiences of nurses with home-based dialysis modalities. They emphasize that practical skills are as important as theoretical knowledge (Bergjan & Schaepe, 2016). PD nurses suggest that teaching activities should prioritize the development of practical skills through instructional materials such as demonstrations, practice catheters, and aprons (Bergjan & Schaepe, 2016). According to Poinen et al. (2021), visual instructions such as pictures and film clips are commonly used, and learning environments should be conducive to learning.

Dialysis nurses and other renal professionals have identified several factors influencing home therapy perceptions (Poinen et al., 2021). These factors include patient and system-level factors, perceived impact on a patient's modality system, perceived understanding of dialysis modalities, and the need for education (Poinen et al., 2021). Patient and system-level factors indicate that home therapies were more suitable for individuals with lower economic status,

comorbidities, lower educational attainment, older age, language barrier, and a lack of support (Poinen et al., 2021). It was observed that nephrologists had the most significant influence on the patients' modality choice in terms of the influence on the patients' modality system. Pre-dialysis nurses, home dialysis nurses, allied health professionals, and dialysis nurses followed (Poinen et al., 2021). Participants in these studies suggested that patients and nurses would benefit from additional education. Nurses and allied health professionals preferred receiving more education related to home therapies, preferably through online continuing education or obtaining more practical experience (Poinen et al., 2021). According to the literature, hands-on training and ongoing support are key factors in adopting peritoneal dialysis (Bergjan & Schaepe, 2016). Recommendations were made to improve the scalability of virtual care solutions and enhance outcomes and expectations for CKD patients (Jeffs et al., 2019). These included involving local stakeholders in the design process, integrating it into daily routines and workflows, implementing it gradually over time, sharing the benefits, and highlighting the solution's critical features, such as real-time monitoring, surveillance, and communication. (Jeffs et al., 2019). These studies offer valuable insights into the learning requirements of peritoneal dialysis nurses. They suggest that online learning resources positively impact nurses' experiences and knowledge of peritoneal dialysis modalities. They also suggest that virtual learning techniques are appropriate and effective. These findings can help enhance the training and education of future nurses related to PD.

Discussion

There is limited research on the effectiveness of virtual education for nurses about PD. However, some studies suggest that virtual learning programs can help registered nurses improve their PD skills. For this literature review, 11 studies were reviewed, most of which used

quantitative approaches. Three studies were RCTs, which tested the effectiveness of various computer-based training systems for healthcare workers. A system developed by Pun et al. (2016) for teaching nurses how to access catheters for dialysis was tested. The impact of an asynchronous web-based e-learning module on general nurses' knowledge about chronic kidney disease (Sinclair et al., 2019). The impact of theoretical training and the use of a PD simulator on the psychomotor skills of nursing students (Topbas et al., 2019). All the trials showed statistically significant outcomes in support of using virtual learning methods for registered nurses to learn about PD. Several quantitative studies (Bennett et al., 2014; Blackman et al., 2014; Olszewski et al., 2018; Poinen et al., 2021; Ghahfarokhi et al., 2022) have provided evidence in support of the use of virtual learning methods for peritoneal dialysis nurses and other members of the interdisciplinary team. These studies highlighted the effectiveness of e-learning modules, simulators, demonstrations, video displays, and virtual social spaces in enhancing the learning experience. Virtual modalities were supported for PD education in the qualitative studies. Nurses prioritize practical skills and require a conducive learning environment. (Bergjan & Schaepe, 2016). The educational evaluation conducted by Barnes and Wilkie in 2023 was a valuable addition to this literature review. It demonstrated nurses' satisfaction with virtual training and increased knowledge following virtual sessions, providing further evidence to support virtual education modalities.

Implications for Nursing Education, Research and Practice

The findings of this literature review have implications for nursing education, research, and practice. Virtual education programs could provide nurses with opportunities to enhance their skills and knowledge in a more flexible, and cost-effective manner (Blackman et al., 2014). Virtual education can also help prepare students for the demands of clinical practice, especially

in areas where hands-on training, such as PD education is not always possible (Topbas et al., 2019). Virtual education programs can provide a platform for continuing education and professional development, allowing nurses to stay updated with the latest research and practices in their field (Poinen et al., 2021). However, there is a gap in the literature which means more research is needed to establish the effectiveness of virtual education programs for nurses, specifically related to PD. There were limitations in some of the studies reviewed, such as small sample sizes, lack of long-term follow-up, and potential biases. Therefore, future research should address these issues and explore the potential benefits and challenges of virtual education programs for PD nurses. Overall, this paper contributes to the literature on nursing education and PD, highlighting how virtual education programs can improve nursing education, research, and practice.

Conclusion

End-stage renal disease has no cure, and many people rely on peritoneal dialysis to survive (Counts, 2020). This literature review briefly introduces CKD and its incidence and prevalence in Canada and worldwide. A shortage of literature and e-learning programs related to peritoneal dialysis for nurses exists. While the literature on this subject is limited, there is enough evidence to support the use of online learning for the proposed practicum project. Suitable virtual educational approaches that enhance nurses' evidence-based knowledge were identified to achieve this. The literature emphasizes the requirement for additional educational materials for nurses to facilitate peritoneal dialysis care. Registered nurses could provide enhanced care by having access to comprehensive educational resources to support their learning needs. This literature review establishes a foundation for developing a virtual educational resource on peritoneal dialysis care based on the collected evidence and literature.

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Appendix II Literature Summary Table

Key Question: Can nurses and nursing students learn about home dialysis using online learning methods?

Authors/Country	Purpose	Methods	Key Findings	Critical Appraisal
Bennett et al. (2014). Australia	To develop a web-based education package for health professionals to increase knowledge and positive perceptions of home-based dialysis options (i.e., peritoneal dialysis and home hemodialysis)	**Design:** Uncontrolled before-after **Setting:** University **Sample size:** 88 undergraduate students (86 were nursing students) **Sampling:** Convenience **Intervention:** A three-module e-learning package about home dialysis **Data collection:** Custom Electronic pre- and post-electronic surveys without names. **Data analysis:** Wilcoxon signed rank tests and Pearson correlational coefficient.	• Pre-survey results indicated a lack of awareness related to home dialysis. • Post-survey results improved statistically significantly after completing the e-learning. • 99% of participants agreed after e-learning that their knowledge had increased. • Informal user feedback was collated two months following dissemination and revealed user satisfaction with the e-learning program.	**Strengths:** Adequate data analysis. Adequate sample size. **Limitations:** Short testing period, so it is unsure if the e-learning resulted in long-term benefits. The sample is almost exclusively nurses, so it is not generalizable to other disciplines. There is no mention of the reliability of data collection instruments. Lack of randomization. **Quality rating:** Low

Authors/Country	Purpose	Methods	Key Findings	Critical Appraisal
Blackman et al. (2014). Australia	This study aims to identify and measure the strength of factors that simultaneously influence registered nurses' (RNs) beliefs about their learning about buttonhole (BH) cannulation using e-learning.	**Design:** Quantitative descriptive survey **Setting:** 10 Hemodialysis Units in Australia and New Zealand **Sample size:** 213 registered nurses' **Sampling:** Convenience **Data collection:** An online Likert-style survey tool was administered before and after the e-learning program. **Data analysis:** Partial Least Squares Path Analysis (PLS-PATH 3.01)	• Success arose from participants' procedural expertise in BH cannulation due to the completion of the e-learning module. • The overall effectiveness of the e-learning participants, who rated the e-learning program as more accessible and endorsed it as being more effective overall. • Participants indicated an understanding of cannulation and endorsed how well they learned these skills via e-learning. • Participants believed their renal assessment skills had improved explicitly after completing the e-learning module.	**Strengths:** Adequate data analysis. Reliability rating for data collection instruments was acceptable. Adequate sample size. **Limitations:** This study used the self-rating of staff as a data collection method. No control groups. **Quality rating:** Medium

Authors/Country	Purpose	Methods	Key Findings	Critical Appraisal
Bergjan & Schaepe (2016) Germany	To explore renal nurses' experiences, strategies, and challenges regarding the patient education process in peritoneal dialysis.	**Design:** Exploratory qualitative **Setting:** Nephrology wards in a university hospital **Sample size:** 20 peritoneal dialysis nurses' **Sampling:** Convenience **Data collection:** Semi-structured group interviews (5) using an interview guide with open-ended questions. **Data analysis:** Thematic qualitative text analysis using deductive category and inductive subcategory application.	**<u>Non-professional actors</u>** *Patients/Peers/Relatives* • Emphasized the importance of tailoring training for the individual. • Thorough assessment to identify learning barriers. **<u>Learning Content & Objectives</u>** • PD nurses emphasized that practical skills should take priority over theory. **<u>Teaching Activities & Instructional Materials</u>** • Demonstration and instruction are mostly used. • Artificial resources, like practice catheters & aprons, are used. • Visual instructions like pictures & film clips. **<u>Learning Environment</u>** • environment conducive to learning.	**Strengths:** Adequate qualitative analysis, such as ensuring inter-coder reliability. The interview guide was pilot tested. Experienced interviewer. **Limitations:** Convenience sample and lack of subject validation. Group interviews could have influenced findings (i.e., expectation bias). **Quality rating:** Moderate

Authors/Country	Purpose	Methods	Key Findings	Critical Appraisal

Pun et al. (2016) Hong Kong	To evaluate the effectiveness of a computer-based training system developed to teach healthcare workers catheter-access hemodialysis management. The system used interactive multimedia and computer-based simulation for the online learning of catheter-access HD management.	**Design:** Randomized control trial
		
		Setting: Sub-acute care private hospital
		
		Sample size: 40 nurses
		
		Sampling: Not given
		
		Intervention: Computer-based HD training system
		
		Data collection: (1) the HD knowledge test, (2) the HD skills competence checklist, (3) a questionnaire designed based on the Technology-Acceptance Model (TAM), and (4) the IBM Computer System Usability Questionnaire (CSUQ)
		
		Data analysis: Descriptive statistics
			Hemodialysis Knowledge Test
			Pre-test scores
			Control Group:
			• Mean = 4.70, SD = 1.59
			Intervention Group:
			• Mean = 4.0, SD = 1.49
			   ○ p=0.169
			Post-test scores
			Control Group
			• Mean = 17.4, SD = 2.74
			Intervention Group:
			• Mean = 24.0, SD = 1.03
			   ○ p<0.001
			Skills Competence Test
			Pre-test scores
			Control Group:
			• Mean = 39.0, SD = 0.00
			Intervention Group:
			• Mean = 39.0, SD = 0.00
			   ○ p=1.000
			Post-test scores
			Control Group:
			• Mean = 113.6, SD = 21.2
			Intervention Group:
			• Mean = 149.3, SD = 19.4
			   ○ p<0.001
			
			Technology Assistance & IBM Questionnaire
				Strengths: Randomization, valid and reliable data collection instruments, content validity
				
				Limitations: Small sample size, a study conducted in one nursing unit, sampling techniques not discussed, data analysis tables given but techniques not discussed in detail.
				
				Quality rating: Medium

Authors/Country	Purpose	Methods	Key Findings	Critical Appraisal
Olszewski et al. (2018) United States	To describe the development of a virtual PD simulator and report the first 22 months of online usage.	**Design:** Prospective cohort study **Setting:** 2500 hospitals in 70 countries **Sample size:** 1066 healthcare professionals (i.e., nurses, nursing students, physicians) **Sampling:** Not given **Data collection:** Embedded site analytics collected individual user actions within the simulator. Individual question responses and overall test percentage scores were collected. Satisfaction data was collected by survey via Survey Monkey in the first year of release. **Data analysis:** Descriptive statistics, linear regression, and paired t-tests compared user pre-and post-test scores.	• Generally satisfied with the computer-based HD training system. Nine hundred and thirty-three users had registered accounts, and 133 were anonymous. 57% were nurses (n=531), and 45% were nursing students (n=422). There was a statistically significant mean increase between pre-and post-test scores for 300 users who completed the structured curriculum. • Mean = 36.4%, SD = 19.9 • 95% CI [31.1-38.6] ○ $p<0.001$ 87% (20 of 23) survey respondents felt the simulator was relevant to their clinical practice, and 78% (18 of 23) would recommend it to others. Only 5% of users (n=23) completed the satisfaction survey.	**Strengths:** Adequate statistical analysis and data collection. Content validated by subject matter experts. Adequate sample size. **Limitations:** Low completion rate for the simulator (7%, 63 of 909 users). Sampling not discussed. **Quality rating:** Medium

Authors/Country	Purpose	Methods	Key Findings	Critical Appraisal
Jeffs et al. (2019). Canada	This study aims to assess and understand the factors influencing the uptake of virtual care solutions and to provide recommendations for the scalability of a virtual care solution to enhance CKD patients' outcomes and expectations.	**Design:** Qualitative descriptive **Setting:** Urban teaching hospital and community hospital **Sample size:** 25 participants (i.e., six patients, three caregivers, six healthcare providers, two vendors, and eight health system decision-makers) **Sampling:** Not given **Data collection:** Semi-structured interviews **Data analysis:** Experienced qualitative research assistants conducted and recorded interviews, which they then transcribed into Microsoft Word and analyzed using thematic analysis, specifically the coding schema. The principal researcher reviewed original manuscripts using the emerging coding schema.	**Themes** Factors associated with the uptake of the eQ Connect by patients receiving PD at home were: • Receiving hands-on training and ongoing communications from a supportive team • Adapting to meet user needs and embedding into the workflow. • Being influenced by patient and caregiver characters **Recommendations for scalability:** • Codesign locally, embed into daily routine and workflow and deploy over time. • Share the benefits and build the case. ○ Communicate key functionalities of the virtual care solution, such as real-time monitoring, surveillance, and communication.	**Strengths:** Adequate qualitative analysis. Text was categorized using a coding schema. Principal investigators review transcripts to ensure rigor. **Limitations**: Since the study was conducted at two hospitals, the transferability of the qualitative data is limited. Sampling was not discussed, and the sample size was small. Interviews were conducted after an initial training session; therefore, there were varying familiarities with the app at the time of the interview. **Quality rating:** Weak

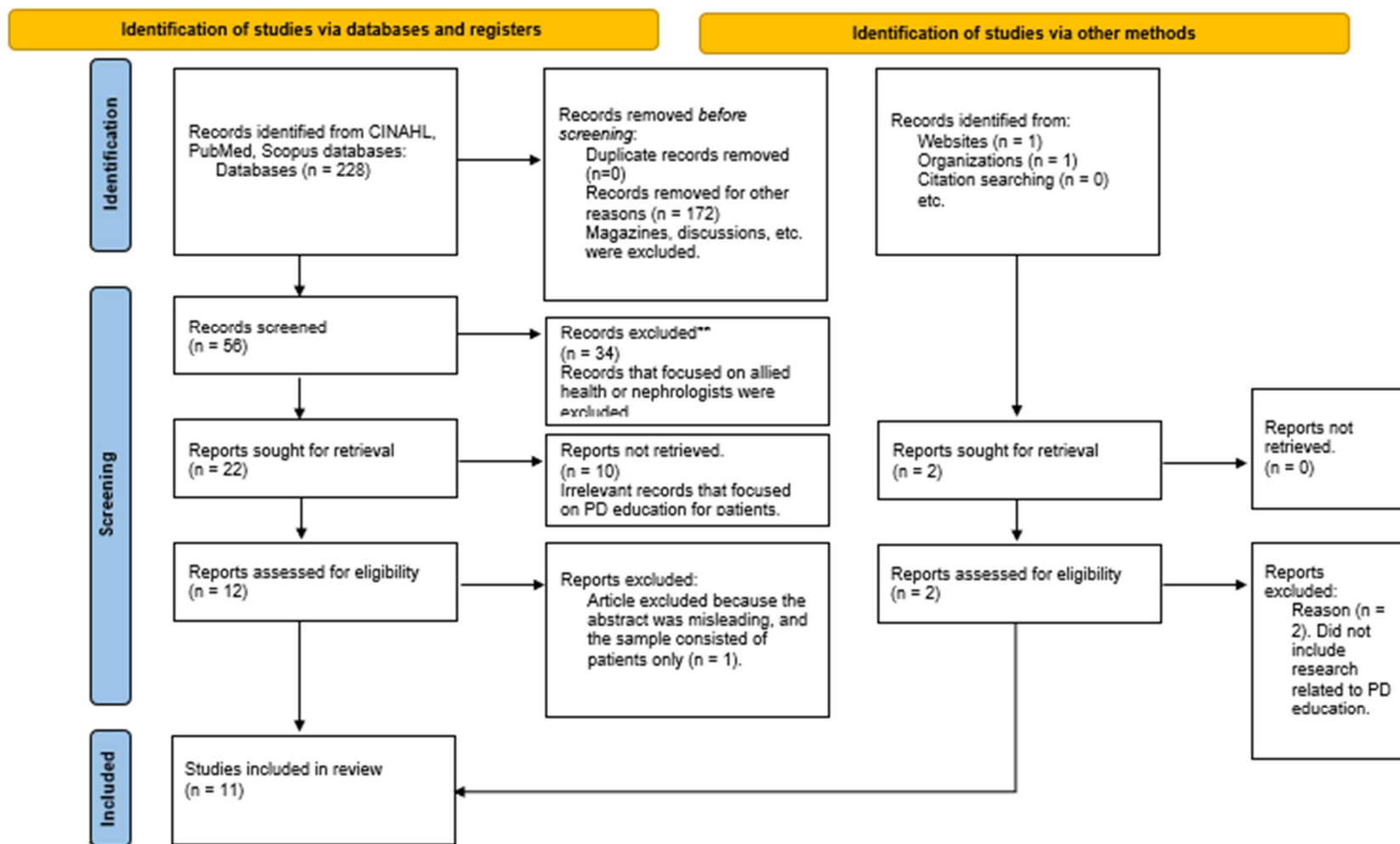| Authors/Country	Purpose	Methods	Key Findings	Critical Appraisal
Sinclair et al. (2019). Australia	This study evaluated the effect of an asynchronous web-based e-learning module on general practice nurses' knowledge about chronic kidney disease risk factors and screening practices and their perceived satisfaction with the e-learning module.	**Design:** Randomized control trial **Setting:** Hospital **Sample size:** 220 general practice nurses. **Sampling:** Snowball sampling. Voluntary response sampling. **Intervention:** Knowledge-based active control e-learning module (Module 1) and a tailored behavioral e-learning module (Module 2) **Data collection:** The CKD knowledge evaluation instrument. The Learner's satisfaction with the Asynchronous e-Learning instrument. **Data analysis:** Descriptive statistics. Paired samples t-tests. Cohen's d to measure effect size. Cronbach's *a*.	Changes in CKD knowledge was assessed using a pre-test and post-test evaluation design, and satisfaction scores were measured after the module was completed. from 3.77 to 5.48 out of 10 • 95% CI [1.58, 2.16] • $p<0.01$ Nurses' baseline scores were poor, but post-test scores were significantly improved. Baseline: • Mean = 3.85, SD = 1.77 Post-test: • Mean = 5.61, SD = 2.16 ○ $p<0.01$ Nurses also reported 85.8% satisfaction with the asynchronous e-learning instrument. • Mean = 128, SD = 16.34	**Strengths:** Content validity of knowledge instrument. Randomization into control or intervention group. Adequate sample size. **Limitations:** Non-response bias, so results may not be generalizable. Use of self-reported satisfaction survey. Snowball and voluntary response sampling. **Quality rating:** Medium

Authors/Country	Purpose	Methods	Key Findings	Critical Appraisal
Topbas et al. (2019). Turkey	To investigate the effects of different education methods in PD application training on psychomotor skills and self-efficacy of nursing students.	**Design:** Randomized control trial **Setting:** Nursing department of the health college of a university **Sample size:** 28 nursing students. **Sampling:** Simple random sample **Intervention:** Theoretical training and PD simulator **Data collection:** Peritoneal Dialysis Application Skill Assessment Checklist (PDASAC), General Self-Efficacy Scale (GSES), PD simulator **Data analysis:** Data were uploaded to IBM SPSS Statistics and analyzed using the independent t-test.	The nursing students' Psychomotor skill scores were significantly higher in the experimental group. Control: • Mean = 41.1, SD = 7.78 Experimental: • Mean = 54.5, SD = 5.32 　○ $p<0.0001$ There was no statistically significant difference in total self-efficacy score before the PD application. Control: • Mean = 30.4, SD = 4.57 Experimental: • Mean = 30.21, SD = 6.34 　○ $p=0.919$ No statistically significant difference was detected between the experimental group's self-efficacy scores regarding pre-test and post-test results. Control: • Mean = 32.5, SD = 6.94 Experimental: • Mean = 31.7, SD = 5.39 　○ $p=0.741$	**Strengths:** Appropriate data analysis. Valid and reliable data collection tools. **Limitations:** The inability to simultaneously conduct the application on the control and experimental groups is due to the inadequate number of instructors and PD simulators. Theoretical training was provided to both groups in preparation for this study, but books, articles, and internet resources were not provided. Small sample. **Quality rating:** Medium

Authors/Country	Purpose	Methods	Key Findings	Critical Appraisal
Poinen et al. (2021) Canada	To evaluate the perceptions of renal team members toward home dialysis therapies.	**Design:** Cross-sectional survey **Setting:** Five renal programs in British Columbia **Sample size:** 334 healthcare professionals (22 nephrologists, 172 hemodialysis nurses, 49 home dialysis nurses, 20 pre-dialysis nurses, 71 allied health staff) **Sampling:** Convenience **Data collection:** Baseline demographics. A survey was categorized into four domains: perceived patient- and system-level factors that influence modality choice, perceived current versus desired proportions of patients receiving either in-center HD or a home therapy (PD), perceived level of influence the respondent has on a patient's modality selection, opportunities for further education and training regarding dialysis modalities. **Data analysis:** Chi-squared. Logistic regression.	**Patient- and system-level factors:** Home therapies are preferred in the setting of lower socioeconomic status, comorbidities, lower educational attainment, older age, language barrier, and lack of support. **Perceived influence on a patient's modality system:** Nephrologists had the most influence on patients' modality choice, followed by pre-dialysis nurses, home dialysis nurses, allied health nurses, and finally, dialysis nurses. **Perceived understanding of dialysis modalities and the need for education:** 67 % of respondents felt patients would benefit from additional education and that nurses and allied health favored receiving more education in home therapies, preferably online continuing education or obtaining more practical experience.	**Strengths:** High response rate. Adequate representation from urban and rural sites. Adequate data analysis. Adequate sample size. **Limitations:** Possibility of responder bias. The survey did not capture specific timeframes in each domain. **Quality rating:** Low

Authors/Country	Purpose	Methods	Key Findings	Critical Appraisal

Ghahfarokhi et al. (2022) Iran	The purpose of this study is to compare the effectiveness of training through demonstration, video display, and virtual social space in learning hemodialysis clinical skills among nursing students.	**Design:** Semi-experimental research with post-test **Setting:** hemodialysis ward of the university hospital **Sample size:** 30 nursing students randomly assigned to three groups. **Sampling:** Convenience **Intervention:** *Group 1:* received a demonstration method. *Group 2:* watched videos. *Group 3:* Joined a two-way social channel on WhatsApp. **Data collection:** Evaluations were done by experienced HD nurses as research assistants under the supervision of a trainer using six separate checklists (i.e., demographics, HD skills, etc.) **Data analysis:** Descriptive statistics. Kolmogorov-Smirnov test. Mann-Whitney test. Kruskal-Wallis test. Chi-squared test.	**Practical Skills Levels in the Three Groups:**
			 • **Virtual Space** (n=10)
			 Very bad – 0
			 Bad – 0
			 Medium – 0
			 Good -5 (50%)
			 Very Good – 5 (50%)
			   ○ p=0.02
			
			 • **Video Display** (n=10)
			 Very bad – 0
			 Bad – 0
			 Medium – 0
			 Good – 8 (80%)
			 Very good – 2 (20%)
			   ○ p=0.045
			
			 • **Demonstration** (n=10)
			 Very bad- 0
			 Bad – 0
			 Medium –1 (10%)
			 Good – 9 (90%)
			 Very good – 0
			   ○ p=0.03
				Strengths: Adequate data analysis. Randomization to groups.
				
				 Limitations: The study had a small sample size. It was performed in one training setting, which was limited to nursing skills. There was no pre-test to evaluate previous knowledge. There was no control group.
				
				 Quality rating: Medium

Authors/Country	Purpose	Methods	Key Findings	Critical Appraisal
Barnes & Wilkie (2023). United Kingdom	This paper aims to explore the learning that informed the virtual training program 2022 and provide a qualitative evaluation to demonstrate evidence of understanding, behaviour change, and organizational benefit.	**Design:** Educational Evaluation **Setting:** Dialysis units **Sample size:** Not given. **Sampling:** Not given. **Intervention:** Virtual course delivered by Microsoft Teams **Data collection:** The Kirkpatrick Model was used with the redesign to provide an evaluation method— collaborative discussions. **Data analysis:** Thematic analysis	**Level 1 - Reaction (i.e., satisfaction)** Visual engagement throughout the day, increased energy levels, and positive comments on evaluation related to motivation and interest. **Level 2 - Learning (i.e., increase in knowledge skills or experience)** Documentation of learning and value for their units in evaluation comments between pre-and-post. **Level 3 - Behavior change (utilizing learning)** Staff thinking has changed based on their new understanding. **Level 4 - Measurable impact at the organizational level** Changes from baseline pre-assessment to date. Now, we have Shared Care Champions in each clinic and have incorporated standard documentation and electronic patient records.	**Strengths:** A detailed description of the virtual course, including design, team expectations, course content, and course evaluation. **Limitations:** Limited information about sample, sample size, data collection and analysis. **Quality rating:** Weak

APPENDIX III Search Strategy Prisma Diagram

Identification of studies via databases and registers

Identification of studies via other methods

Identification

Records identified from CINAHL, PubMed, Scopus databases:
Databases (n = 228)

→

Records removed *before screening*:
Duplicate records removed (n=0)
Records removed for other reasons (n = 172)
Magazines, discussions, etc. were excluded.

Records identified from:
Websites (n = 1)
Organizations (n = 1)
Citation searching (n = 0)
etc.

Screening

Records screened
(n = 56)

→

Records excluded**
(n = 34)
Records that focused on allied health or nephrologists were excluded

Reports sought for retrieval
(n = 22)

→

Reports not retrieved.
(n = 10)
Irrelevant records that focused on PD education for patients.

Reports sought for retrieval
(n = 2)

→

Reports not retrieved.
(n = 0)

Reports assessed for eligibility
(n = 12)

→

Reports excluded:
Article excluded because the abstract was misleading, and the sample consisted of patients only (n = 1).

Reports assessed for eligibility
(n = 2)

→

Reports excluded:
Reason (n = 2). Did not include research related to PD education.

Included

Studies included in review
(n = 11)

62

Appendix B

Development of a Virtual Peritoneal Dialysis Workshop for Registered Nurses

Consultation Report

Effective communication and collaboration with clients, other healthcare team members, and stakeholders whose services impact the determinants of health are essential aspects of all nursing practice (CNA, 2019). To create a comprehensive and helpful resource for peritoneal dialysis nurses, it was essential to involve various stakeholders. A deeper understanding of the experiences of other peritoneal dialysis professionals in the region and across Canada was gained through consultations with subject matter experts. These consultations were useful in gathering sufficient information about peritoneal dialysis resources and identifying the needs of this group. The consultations involved appropriate organizational, provincial, national, and international stakeholders (CNA, 2019). Various subject matter experts, including physicians, management, nurses, and vendors, were consulted during the consultations. Their contributions provided the information and insights necessary to develop the proposed educational resource.

Background

In Canada, more than 48,000 people are living with end-stage renal disease (ESRD), and of those, approximately 30,000 people are receiving dialysis (CIHI, 2023). As patients progress through their disease, they must decide on renal replacement therapy (RRT). Options for RRT typically include hemodialysis, home hemodialysis, which includes home hemodialysis and peritoneal dialysis, transplantation, and conservative treatment (Counts, 2020).

The two most used renal replacement therapy (RRT) methods are hemodialysis and peritoneal dialysis. Hemodialysis requires patients to be connected to a dialysis machine at a center for 3-4 hours, 3-4 days per week. In contrast, peritoneal dialysis uses the peritoneal membrane to filter waste products and excess fluids from the blood. Patients can perform this procedure in the comfort of their own homes (Chen et al., 2017; Counts, 2020).

Hemodialysis has challenges, including inflexible schedules, limited patient space in centers, excessive healthcare system costs, travel to dialysis appointments, and caregiver burden (Chen et al., 2017; Counts, 2020; Kidney Foundation, 2024). This province has a shortage of outpatient hemodialysis centers, resulting in long waitlists to meet the population's needs. Subjective evidence suggests that increased peritoneal dialysis has reduced the burden on hemodialysis centers.

Peritoneal dialysis is associated with benefits, including the ability to complete treatment at home, which allows people to avoid frequent travel to dialysis centers (Francois & Bargman, 2014). This can lead to significant cost savings for patients and the healthcare system since peritoneal dialysis is less expensive than in-center treatments. Patients using peritoneal dialysis in Newfoundland and Labrador (NL) can travel freely as vendor contracts allow no-charge delivery to preferred addresses. Patients often learn peritoneal dialysis more easily than hemodialysis (Francois & Bargman, 2014). Peritoneal dialysis offers several benefits to patients, such as increased flexibility, cost savings, and the ability to manage their treatment in the comfort of their homes (Francois & Bargman, 2014). The shortage of experienced peritoneal dialysis nurses in NL makes it difficult for patients to access clinics regularly. To ensure patients have access to care, nurses must be proficient in peritoneal dialysis. Therefore, providing resources to enhance nurses' proficiency in peritoneal dialysis would be highly beneficial.

This practicum project aims to create a virtual peritoneal dialysis (PD) workshop. It will cover the basics of PD, associated complications, and patient care. Although this resource is being developed because of the identified barrier for rural patients, the information can be used by all registered nurses caring for people who use PD.

Consultation Objectives

The specific objectives for the consultations were the following:

- To identify the learning needs of registered nurses related to peritoneal dialysis in NL.

- To identify pre-existing peritoneal dialysis education programs that guide the practice of registered nurses and determine to identify the strengths and limitations of these programs.

- To examine nurses' knowledge, attitudes and barriers and facilitators to identifying peritoneal dialysis complications and managing the patient who uses peritoneal dialysis.

- To seek feedback on the most appropriate content and virtual mode of delivery for the peritoneal dialysis workshop.

- To obtain recommendations and feedback from all stakeholders about developing the virtual peritoneal dialysis workshop.

Consultation Participants

The stakeholders selected for these consultations include physicians, management, a patient care facilitator (PCF), peritoneal dialysis nurses, nurses without peritoneal dialysis experience and a vendor that provides peritoneal dialysis supplies. These individuals were chosen to participate in the interview because each had valuable contributions. For example, the management team could discuss the budget for supplies and the possibility of storing them in facilities outside the city. Nurses with experience with peritoneal dialysis could talk about their orientation and the available resources. Nurses without PD experience could share their experiences of performing peritoneal dialysis tasks when unprepared and explain what they had to do to provide appropriate care for the patient. Physicians could discuss when nurses or patients

called them with peritoneal dialysis concerns, and the vendor could discuss the peritoneal

dialysis supply contracts with NL. During the consultation, a nephrologist who had worked with

Newfoundland and Labrador Health Services (NLHS) for three years shared his expertise and

experiences. He had completed a home dialysis fellowship in Toronto, Ontario. The division

manager of the nephrology program was also engaged during these consultations. She had four

years of experience in nephrology. A patient care facilitator (PCF) for the home dialysis unit at

NLHS was also part of the consultation team. She has been a nephrology nurse for 12 years and

a peritoneal dialysis nurse for seven years. She manages all nephrology-related services in the

Eastern urban, Eastern rural, and Central zones, except for the Western zone. During the

consultations, two nurses were involved. One of them was a peritoneal dialysis nurse who had

expertise in this specific area, while the other nurse had 13 years of experience in nephrology

nursing but no experience in peritoneal dialysis. Finally, a registered nurse with ten years of

experience in dialysis was invited to provide information from the vendor's perspective. The

stakeholders were selected based on their expertise in peritoneal dialysis and their ability to

provide insights into the resources available within Newfoundland and Labrador, as well as

nationally. Among them, some can provide information on the financial barriers that may arise,

while others can inform us of the medical issues we might encounter. The vendor representative

can share how other provinces educate registered nurses about peritoneal dialysis. During the

consultation process, there were specific exclusion criteria for consultants (i.e., inability to attend

focus groups). Two nurses without peritoneal dialysis experience were initially invited to

participate but were later excluded as they could not attend sessions in person or virtually. Two

nephrologists were also invited to consult; however, one was excluded as they had little

background in peritoneal dialysis, and their expertise lay in transplantation, which was irrelevant

to the consultation process.

Data Collection

For data collection, an initial email was sent to all stakeholders (Appendix C), inviting stakeholders to participate in the consultation phase of this project. The project's background and objectives were briefly outlined in the body of the email. Stakeholders were told that the project was the development of a comprehensive virtual workshop that can aid registered nurses in providing better care for people who use peritoneal dialysis, particularly those who live outside of St. John's, NL. To ensure participation from all stakeholders, respective dates for consultations were outlined, and stakeholders were invited to add suggestions for potential dates. The management was requested to give institutional-level consent, which was later provided. Consultants were from urban and rural settings and included a variety of peritoneal dialysis professionals and non-peritoneal dialysis nurses. Consultations took place the week of February 15th, 2024, and were completed in person using a semi-structured interview and focus group. One stakeholder, the vendor's representative, attended the focus group virtually using Microsoft Teams because she was out of the province. Consultants were assured that all their responses would remain confidential, so names are omitted from this report.

Consultations consisted of a focus group guided by interview questions to guide the session and ensure that the objectives of the consultation were met. Semi-structured interviews were conducted using the same interview questions online and in-person focus groups using Microsoft Teams. Semi-structured interviews were chosen for their suitability for collecting data on specific topics using a topic guide and interview questions (Polit & Beck, 2020). Focus group interviews were chosen because of their efficiency and ability to quickly obtain many people's viewpoints (Polit & Beck, 2020). The focus group consultation lasted 60 minutes, while the

semi-structured interviews lasted 30 minutes. Field notes were taken and analyzed later to identify themes and needs. Preliminary interview questions were prepared and are listed in Appendix C. During the focus group, there was a Q&A session where attendees inquired about the resource implementation.

Data Management and Analysis

Data analysis involves organizing and structuring information to extract meaning (Polit & Beck, 2020). Analyzing qualitative data can be challenging as there are no universal rules for doing so; therefore, analyzing data from interviews and focus groups can be challenging (Polit & Beck, 2020). The author completed the transcription of field notes and analysis of data. The author also performed inductive coding and analysis. After the data field notes were transcribed, data was formatted into a table using Microsoft Word, highlighting key themes identified during the consultations. The data collected during the consultations were analyzed to ensure that it accurately represented the objectives and questions of the project (Polit & Beck, 2020). The themes that emerged during the semi-structured interviews and focus groups were used to draw conclusions and make recommendations based on the data. These conclusions and recommendations are detailed in Appendix B (Polit & Beck, 2020).

Ethical Considerations

To ensure that all stakeholders are well-informed and have given informed consent, they were provided with detailed information about the project's objectives, the type of data needed, the commitment required to attend the focus group or semi-structured interview, participant selection, possible risks and benefits, confidentiality agreement, voluntary consent, and the right to withdraw and withhold information (Polit & Beck, 2020). Additionally, the focus group facilitator's contact information was required. Prior to consultations, individual and institutional

permission were obtained. Consent forms were distributed, signed by stakeholders, and returned.

A copy of the consent form is available in Appendix E. All information collected, including

names and contact information of stakeholders from semi-structured interviews and focus

groups, was kept confidential on an encrypted USB drive. Once this project is finished, all their

contact details will be deleted. Before commencing this project, the nephrology program's

division manager granted permission to communicate with and consult with employees. As this

practicum project is an educational resource, it does not require review by the Health Research

Ethics Authority (HREA) as per the HREA screening tool (Appendix D).

Results

Once the data was analyzed, common themes were identified, and the results were

grouped into a table in Appendix B.

Existing Peritoneal Dialysis Education Resources

Several educational resources related to peritoneal dialysis are available. Companies such

as Baxter (Kidney Care Campus), Fresenius Medical Care (Advance Renal Education Program),

Mosby's Nursing Skills, British Columbia (BC) Renal, and UpToDate have provided resources

for peritoneal dialysis. However, all stakeholders agreed that these resources were unsuitable for

nurses who lacked fundamental knowledge of peritoneal dialysis. Moreover, many of these

resources are only available at a cost and, therefore, not practical for routine education. More

information about these resources will be available in the environmental scan report.

Outreach of Professionals for Peritoneal Dialysis Information

All stakeholders have agreed that there is a high demand for peritoneal dialysis

information among nurses and other healthcare professionals. Clinical educators, particularly

those from medicine, often struggle to educate nurses who care for patients using peritoneal

dialysis. In addition, a professional practice working group frequently contacts peritoneal dialysis professionals for further insight. Nurses from various settings, including acute care and long-term care facilities and those from different parts of the island, often contact the peritoneal dialysis unit for information. They commonly express concerns regarding microbiology specimens, peritonitis, peritoneal dialysis catheter issues, and inflow and outflow problems.

Peritoneal dialysis nurses provide in-person education to clinical educators and nurses to address issues related to peritoneal dialysis. In cases where in-person education is impossible, educators receive information through videos that peritoneal dialysis nurses record and email. The patient care facilitator (PCF) also provides information and education to people through a PowerPoint presentation. She works to develop policies related to peritoneal dialysis that guide her education sessions, although these policies are not official and are unavailable throughout the organization. The PCF notes that there is often high staff turnover in places outside the city, making it challenging to maintain proficiency in peritoneal dialysis skills. For instance, she once educated an entire unit about peritoneal dialysis. However, six months later, every nurse in that department had moved to new positions, and some new nurses had not received peritoneal dialysis education.

Orientation

Orientation was also a struggle for peritoneal dialysis nurses and non-peritoneal dialysis nurses. The hemodialysis unit has a clinical educator who provides orientation to dialysis nurses. However, this educator has no experience in peritoneal dialysis and is not responsible for training nurses in this area. Instead, peritoneal dialysis nurses are responsible for upskilling and training new nurses. In the past, nurses have gained their peritoneal dialysis education through mentorship and hands-on experience. It was noted that Baxter Medical Care had previously

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trained nurses on peritoneal dialysis. During the nurses' orientation, the vendor provided training on the fundamentals of peritoneal dialysis, which included teaching them how to care for the catheter, identify the symptoms of peritonitis, and address inflow and outflow issues. It is worth noting that training is not the vendor's responsibility. However, since no other support was available during the nurses' orientation, the vendor stepped in to provide the necessary training. It is important to note that the vendor is awarded the contract through a bidding process, which may not guarantee a reliable future source of education. Education has now been delegated to the PCF, but currently, there is no established orientation pathway available for nurses.

Barriers

Several barriers were identified throughout the semi-structured interviews and focus groups. The barriers noted were demographics, the lack of a structured orientation program for new staff, the lack of designated educators, and workload and time constraints.

Throughout the sessions, stakeholders mentioned that demographics are a barrier to obtaining peritoneal dialysis education. It can be challenging for nurses to travel for education or training regarding peritoneal dialysis. It can also be expensive and time-consuming, taking away from their family and work-life balance.

Other barriers to peritoneal dialysis education include the absence of a structured orientation program for new staff and the lack of designated educators. There is no structured orientation program for new peritoneal dialysis nurses in NL, making it challenging for them to acquire knowledge and proficiency with peritoneal dialysis skills. While hemodialysis nurses have a designated educator and orientation manual, those working with peritoneal dialysis lack these resources. Some stakeholders reported learning on the job without a sequential type of learning or a way to evaluate their knowledge.

The stakeholders have identified workload and time constraints as significant challenges in their respective units. Nurses typically work with limited staff and have limited time for education. Due to staffing shortages, it may be impossible for a nurse to attend peritoneal dialysis education in other areas, even if there is an opportunity to travel for education. Finding educational resources can also be challenging and, if time-consuming, may not be feasible to pursue while at work. Time constraints were identified as a significant obstacle to peritoneal dialysis education. Nurses noted that the available resources are not quick to complete, adding another layer of complexity to their learning requirements.

Facilitators

The facilitators associated with peritoneal dialysis education included mentorship, policy development, and a checklist of peritoneal dialysis skills. Previously developed modules, which were the primary education source for the organization, are no longer used as the information provided did not align with best practice guidelines.

Stakeholders identified mentorship as a significant facilitator for peritoneal dialysis education in this area. Experienced nurses take new nurses under their wing and work with them to create a personalized learning plan based on their experience. The mentor can also inform the nurses about available resources and support them as they navigate the learning process. This allows nurses to feel comfortable asking questions about peritoneal dialysis. Another identified facilitator for peritoneal dialysis education is policy development. Although the policies developed by the PCF are not yet finalized and posted for staff, they have been created based on best practice guidelines and have helped nurses learn about peritoneal dialysis. Finally, some nurses have created checklists for peritoneal dialysis tasks to learn and track progress. They

reported that this had facilitated their learning and knowledge related to peritoneal dialysis and helped them to develop and adhere to learning plans.

Impact on Patients

Patients receiving peritoneal dialysis are facing challenges due to the lack of adequate education for nurses. When urgent care is required, patients often face inconvenience and high costs for travel as there may not be any nurse proficient in the procedure. This is especially difficult for patients living in remote areas like fly-in communities or coastal Labrador, where they must travel long distances for a 5-minute procedure. Nurses need to be adequately trained in microbiology specimen testing, catheter care, and the addition of IV medications like antibiotics to dialysate. However, training nurses to be proficient in these areas is time-intensive, and nurses often refuse to help or be upskilled. It is essential to address this issue for the well-being of patients.

Methods for Education Delivery

The group discussed the most effective resources for providing education on peritoneal dialysis during the sessions. They identified webinars, videos, modules, and guidebooks as the most suitable methods for delivering education. Webinars were considered easy to access and effective for educating people within the organization. Videos were preferred over written information because all nurses can access them and be broken down into specific skills. The group also mentioned that videos are less labour-intensive and can be watched by anyone after they are recorded, making the information readily accessible even after a turnover in staff. Although modules are great for educating on theoretical aspects, they were not considered appropriate for novice nurses or those without prior knowledge of peritoneal dialysis. The group suggested a guidebook or pocket handbook with peritoneal dialysis information as another

effective method for educating nurses. Finally, the group identified Microsoft Teams as the most popular software for reaching out to people.

Access to Peritoneal Dialysis Supplies

During the interviews and focus groups, accessing peritoneal dialysis supplies was discussed to ensure that nurses could practice and maintain their proficiency in this area. It was emphasized that access to the necessary supplies is crucial in delivering effective, high-quality patient care. It was concluded that this would add another layer of complexity to the existing problem of a lack of peritoneal dialysis education. It was also determined that stocking routine dialysis supplies in areas with no peritoneal dialysis patients would be uneconomical. However, the peritoneal dialysis supplies can be shipped if a patient comes forward in such areas. It is essential to consider the expiry and recall of supplies while stocking them. The primary unit cannot be held responsible for procuring and maintaining supplies, but they can arrange their delivery when required. It has been suggested that Baxter Medical Care could handle the distribution of supplies, but it needs to be facilitated at the management level. Once this is arranged, nurses outside the city can place their orders directly with Baxter Medical Care. The plan is to deliver the supplies on those days to ensure annual proficiency training.

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Implications for Practicum Project

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Consultations with all stakeholders determined that many distribution methods for educational materials are suitable. However, it was decided that recorded videos and a handbook would be the most effective approach for this practicum project. This approach was chosen after considering all feedback from those involved. The videos will visually demonstrate key concepts, while the handbook will offer additional information and serve as a reference guide. With this approach, nurses will have access to a comprehensive and practical peritoneal dialysis

resource to enhance their skills and education. These consultations have been instrumental in guiding the development of this practicum project.

Conclusion

There is a knowledge gap in nursing education regarding peritoneal dialysis in Newfoundland and Labrador. Key stakeholders were consulted to gather information about nurses' experiences, preferences, and requirements to address the knowledge gap. One proposed solution is to use virtual learning, such as webinars and videos, to facilitate education about peritoneal dialysis. This approach can help enhance nurses' knowledge and skills and enable them to provide better care to patients undergoing peritoneal dialysis. This information will help create a virtual comprehensive peritoneal dialysis education workshop for registered nurses, allowing them to offer better care to patients who use peritoneal dialysis. This practicum project could provide better access to educational peritoneal dialysis resources for all registered nurses in Newfoundland and Labrador.

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Appendix A: Interview Questions

1. Are you aware of or have you used any educational resources for peritoneal dialysis within the organization or elsewhere?

2. Have you ever been contacted by a nurse inquiring about peritoneal dialysis information? If so, how did you provide this information?

3. How is orientation provided to new registered nurses hired for the peritoneal dialysis unit at Newfoundland and Labrador Health Services (NLHS), and who is responsible for providing it?

4. From a registered nursing perspective, what are the facilitators and barriers to providing nurses with peritoneal dialysis education?

5. Without disclosing patient information, have you ever had a peritoneal dialysis patient outside the metropolitan area who needed care but could not be provided because nurses were not educated about peritoneal dialysis?

6. What type of resource is best suited to provide peritoneal dialysis to registered nurses in Newfoundland and Labrador? For example, webinars, written modules, manuals, etc.

7. In your experience, have there been any successfully implemented resources to enhance nurses' education about peritoneal dialysis?

8. Are there stakeholders who are not present today but who could provide valuable information and should be included in this process?

9. Can we ensure that peritoneal dialysis supplies are available province-wide for nurses to practice with and maintain proficiency?

Appendix B: Consultations Results

Interview Questions	Results
Are you aware of or have you used any educational resources for peritoneal dialysis within the organization or elsewhere?	• Education from Baxter (Kidney Campus) • Fresenius Advanced Renal Program • BC Renal • Mosby's Nursing Skills • UpToDate: Evidence-Based Clinical Decision Support at Point of Care
Have you ever been contacted by a nurse inquiring about peritoneal dialysis information? If so, how did you provide this information?	• Frequently contacted by clinical educators, professional practice, floor nurses, and nurses from various acute care centers across the province. • Information has been provided in person and virtually.
How is orientation provided to new registered nurses hired for the peritoneal dialysis unit at Newfoundland and Labrador Health Services (NLHS), and who is responsible for delivering it?	• Currently, no educator for PD nurses • No structured orientation or pathway right now to orientate new PD nurses. • Education falls to the patient care facilitator to coordinate. • Mentorship • Vendor has educated staff in the past
What are the facilitators and barriers to providing nurses with peritoneal dialysis education from a registered nursing perspective?	• **Barriers:** • Workload • Demographics • Lack of structured orientation program for new staff • Lack of designated educator • Time constraints • **Facilitators:** • Mentorship • Development of policies • Skills checklist
Without disclosing patient information, have you ever had a patient outside the metropolitan area who needed care but could not be provided because nurses were not adequately educated about peritoneal dialysis?	• Patients from remote areas (i.e., fly-in communities, coastal Labrador) • Patients from Central NL. • Specific areas of care were related to microbiology specimen collection and adding IV drugs to a PD bag

Interview Questions	Results
What type of resource is best suited to provide peritoneal dialysis education to registered nurses in Newfoundland and Labrador? Examples include webinars, written modules, manuals, etc.	- Webinars - Video - Microsoft Teams Session - Modules - Guidebook - Pocket Handbook
In your experience, have there been any successfully implemented resources to enhance nurses' education about peritoneal dialysis?	- No, not in this region. - Videos were previously developed for Eastern Health, but the information did not align with best practice guidelines
Are there stakeholders who are not present today but who could provide valuable information and should be included in this process?	The group felt the appropriate stakeholders were involved
Can we ensure that peritoneal dialysis supplies are available province-wide for nurses to practice with and maintain proficiency?	- To facilitate training, PD supplies can be sent from St. John's in advance. - Baxter can distribute supplies only after management approval. - Nurses in other regions can plan their yearly proficiency training and have supplies delivered on time by ordering directly from Baxter. - Each region is responsible for ordering their own PD supplies. - There were concerns associated with stocks, such as expiry dates and recalls.

Appendix C: Invitation to Participate in Stakeholder Consultations

Hello:

Re: Development of a Virtual Peritoneal Dialysis Workshop for Registered Nurses

I am Jessica Andrews, the nephrology program's living kidney donor coordinator (LKDC). My background in nephrology is extensive, and I have experience in hemodialysis, peritoneal dialysis, and transplantation. I am enrolled in the Master of Science in Nursing program at Memorial University, where I must complete a practicum project of my choice to graduate.

For my practicum project, I would like to develop a comprehensive virtual workshop to aid registered nurses in providing better care to peritoneal dialysis patients, particularly those in Newfoundland and Labrador. To begin my project, I would like to set up a consultation meeting to understand nurses' needs better, what resources are already available, and what you think would be helpful.

My objective is to arrange meetings with the following individuals: Baxter representative, management, physician, patient care facilitators, peritoneal dialysis (PD) and registered nurses practicing outside of the metropolitan areas.

During our conversation, I can conduct a semi-structured interview or a focus group in person, by phone, or via email.

Your help on this project is greatly appreciated.

Thank you,
Jessica

Jessica Andrews BN RN CNeph(C)
Living Kidney Donor | Transplant Coordinator
Mount Pearl Square – Kidney Care Centre
760 Topsail Rd   Mount Pearl, NL   A1N3J5
Phone: (709) 777 – 3570
Email: jessica.andrews@easternhealth.ca

Appendix D: Health Research Ethics Authority (HREA) Screening Tool

Student Name: Jessica Andrews

Title of Practicum Project: Development of a Virtual Peritoneal Dialysis Workshop for Registered Nurses

Date Checklist Completed: February 15th, 2024.

This project is exempt from Health Research Ethics Board approval because it matches item number __3__ from the list below.

1. Research that relies exclusively on publicly available information when the information is legally accessible to the public and appropriately protected by law or the information is publicly accessible, and there is no reasonable expectation of privacy.
2. Research involving naturalistic observation in public places (where it does not include any intervention staged by the researcher or direct interaction with the individual or groups; individuals or groups targeted for observation have no reasonable expectation of privacy, and any dissemination of research results does not allow identification of specific individuals).
3. Quality assurance and quality improvement studies, program evaluation activities, performance reviews, and testing within standard educational requirements if no research question is involved (used exclusively for assessment, management, or improvement purposes).
4. Research based on a review of published/publicly reported literature.
5. Research exclusively involves secondary use of anonymous information or anonymous human biological materials, so long as data linkage or recording or dissemination of results does not generate identifiable information.
6. Research is based solely on the researcher's reflections and self-observation (e.g., auto-ethnography).
7. Case reports.
8. Creative practice activities (where an artist makes or interprets a work or works of art).

For more information, please visit the Health Research Ethics Authority (HREA) at
https://rpresources.mun.ca/triage/is-your-project-exempt-from-review/

Appendix E: Consent to Participate in Interview

Title: Development of a Virtual Peritoneal Dialysis Workshop for Registered Nurses

Interviewer: Jessica Andrews

You are invited to participate in an interview and focus group. Your participation is voluntary, and you may terminate it at any time. It is important to understand the purpose and potential benefits of participation. This consent form explains the interview process and its impact. Please read this form carefully and ask questions if you do not understand.

Introduction and Background

Currently, in Newfoundland and Labrador, education for registered nurses related to peritoneal dialysis is limited. Resources are available to nurses, but only for a fee. Nurses have reported being unprepared to care for patients who use peritoneal dialysis, so this practicum project aims to develop an accessible resource related to peritoneal dialysis for registered nurses.

Purpose of the Interview

The interview aims to gather insights and ideas from healthcare professionals familiar with peritoneal dialysis. It will focus on experiences, educational resources, and future initiatives related to peritoneal dialysis.

Description of the Interview Procedures: Those who agree to participate will be met in person or online. You may choose between a semi-structured interview and a focus group.

Time Commitment: The interview or focus group will take approximately 30-60 minutes.

Benefit: To improve education related to peritoneal dialysis for registered nurses in Newfoundland and Labrador.

Liability statement: By signing this form, you consent to participate in this interview.

Privacy and confidentiality: Privacy and confidentiality are important; every step will be taken to protect your privacy. Names will not be included in the practicum report, but rather roles (i.e., physician, nurse, manager). Interview results will be transcribed and saved to an encrypted USB drive and destroyed when this practicum project is complete.

Questions: Contact Jessica Andrews BN RN (709) 589 4284

_____   _____   _____

Signature   Printed Name   Date

_____   _____   _____

Signature   Printed Name   Date

Appendix C

Development of a Virtual Peritoneal Dialysis Workshop for Registered Nurses

Environmental Scan Report

A virtual resource is being developed to improve registered nurses' understanding of peritoneal dialysis. An integrative review informed the selection of knowledge delivery methods, supplemented through consultations with key stakeholders. The purpose of the literature review was to assess current evidence on virtual education methods, and the purpose of the consultations was to identify existing education programs, examine nurses' knowledge, attitudes, and barriers associated with peritoneal dialysis education, and seek feedback on developing a virtual workshop for registered nurses related to peritoneal dialysis. The data provided the foundation for an environmental scan, providing insight into effective learning delivery methods and the learning needs of registered nurses in Newfoundland and Labrador (NL) for peritoneal dialysis education. The environmental scan was conducted to collect data, analyze trends and gaps, and guide decision-making for stakeholders related to areas of improvement (Gagnon, 2021). This environmental scan was conducted on Canadian and United States resources to standardize the proposed virtual peritoneal dialysis resource for nurses. Although pre-existing resources were identified, they require modification to meet the needs of the target group. A new virtual resource for peritoneal dialysis education could offer nurses evidence-based education in an accessible, easy-to-navigate format.

Background

In Canada, more than 48,000 people are living with end-stage renal disease (ESRD), and of those, approximately 30,000 people are receiving dialysis (CIHI, 2023). As patients progress through their disease, they must decide on renal replacement therapy (RRT). Options for RRT typically include hemodialysis, home hemodialysis, which includes home hemodialysis and peritoneal dialysis, transplantation, and conservative treatment (Counts, 2020).

The two most used renal replacement therapy (RRT) methods are hemodialysis and peritoneal dialysis. Hemodialysis requires patients to be connected to a dialysis machine at a center for 3-4 hours, 3-4 days per week. In contrast, peritoneal dialysis uses the peritoneal membrane to filter waste products and excess fluids from the blood. Patients can perform this procedure in the comfort of their own homes (Chen et al., 2017; Counts, 2020).

Hemodialysis has challenges, including inflexible schedules, limited patient space in centers, excessive healthcare system costs, travel to dialysis appointments, and caregiver burden (Chen et al., 2017; Counts, 2020; Kidney Foundation, 2024). Peritoneal dialysis is a safe and viable option that has reduced the burden on hemodialysis centers to counteract the challenges associated with hemodialysis.

Peritoneal dialysis is associated with benefits, including the ability to complete treatment at home, which allows people to avoid frequent travel to dialysis centers (Francois & Bargman, 2014). This can lead to significant cost savings for patients and the healthcare system since peritoneal dialysis is less expensive than in-center treatments. Patients using peritoneal dialysis in Newfoundland and Labrador (NL) can travel freely as vendor contracts allow no-charge delivery to preferred addresses. Patients often learn peritoneal dialysis more easily than hemodialysis (Francois & Bargman, 2014). Peritoneal dialysis offers several benefits to patients, such as increased flexibility, cost savings, and the ability to manage their treatment in the comfort of their homes (Francois & Bargman, 2014). The shortage of experienced peritoneal dialysis nurses in NL makes it difficult for patients to access clinics regularly. To ensure patients have access to care, nurses must be proficient in peritoneal dialysis. Therefore, providing resources to enhance nurses' proficiency in peritoneal dialysis would be highly beneficial.

This practicum project aims to create a virtual workshop for nurses on peritoneal dialysis.

It will cover the basics of peritoneal dialysis, associated complications, and patient care. Although this workshop is being developed because of the identified barrier for rural patients, the information can be used by all registered nurses caring for people who use peritoneal dialysis.

Specific Objective(s) for the Environmental Scan

- To identify educational resources for registered nurses related to peritoneal dialysis.

- To identify pre-existing peritoneal dialysis education programs offered by medical supply companies and identify the strengths and limitations of these programs.

- To obtain recommendations and feedback from Baxter Medical Supplies about their virtual peritoneal dialysis resource.

- To identify strategies previously and currently provided to peritoneal dialysis nurses who practice in remote areas or areas with limited nursing resources.

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Data Collection

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This environmental scan aims to find resources to aid in developing a virtual peritoneal dialysis educational resource and to support the usefulness of virtual educational strategies. Seven sources of information were evaluated as part of the environmental scan to determine existing virtual peritoneal dialysis resources. Six sources were online resources, including Kidney Care Campus, Advance Renal Education Program, Mosby's Nursing Skills, University Health Network (UHN), BC Renal, and UpToDate. The other source of information was Baxter Medical Supplies, our primary supplier of dialysis equipment, which was contacted to gather information from their websites and educational resources. An invitation to initiate contact with the vendor and request any additional information on this project was sent before contact and can be found in Appendix B. There were additional discussions with the vendor, who answered

questions related to the environmental scan, which are in Appendix C. Materials of interest include educational materials such as videos and written content that explain peritoneal dialysis, demonstrate how to properly care for an exit site, identify and troubleshoot catheter dysfunction, and assess for signs and symptoms of peritonitis.

Data Management and Analysis

The data was gathered and transcribed into tables using Microsoft Word during the initial phase. Available educational materials, especially video content or PDF materials, were saved on the computer. Content analysis was done thoroughly to ensure that the data collected accurately represents the answers to the objectives and questions of the environmental scan plan (Polit & Beck, 2021). The content analysis aims to categorize data to evaluate the quality and consistency of the educational material related to peritoneal dialysis. Additionally, the analysis ensures that the delivery methods employed in the project are consistent with the intended project objectives. The materials were understandable and contained pictures catered to nurses. Materials were compared with the International Society for Peritoneal Dialysis (ISPD) guidelines to verify their suitability.

Ethical Considerations

This practicum project aims to develop an educational resource, so it is not research. It does not require review by the Health Research Ethics Authority (HREA) as per the HREA screening tool, which can be found in Appendix A. It is important to note that any material gathered from the environmental scan conducted with vendors such as Baxter Medical or Fresenius Medical can only be utilized with their permission. Appropriate vendor consent was obtained during the initial meeting, and copywritten materials will not be used without appropriate consent from the vendor. The searched literature and websites are considered public

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information, and it is assumed that permission to access and share this information has been granted. All data collected has been stored on a password-protected computer to ensure confidentiality and maintain privacy. After completion of this practicum project, data will be destroyed. No identifying details are stored on the computer.

Results

To conduct an effective environmental scan, a plan was developed that involved discussions with a vendor of peritoneal dialysis equipment, followed by searches of websites with virtual peritoneal dialysis resources. Through this process, a range of relevant online resources were identified.

Vendor-Specific Results

Baxter Medical Care provides in-personal and virtual education to help customers (i.e., nurses) learn how to do the basic skills of peritoneal dialysis, including twin-bag exchange, catheter care, and automated peritoneal dialysis (APD). Nurses in urban, rural, and remote locations are provided with this education. In addition to providing education online and virtually through webinars, they also have an online platform called Kidney Care Campus that contains videos related to peritoneal dialysis. This platform is exclusively accessible to Baxter Medical customers, who must sign in using their unique username and password. However, not all nurses in Newfoundland and Labrador have access to this platform. It is also important to note that if the vendor changes in the future, access to this platform will be lost, meaning that the peritoneal dialysis resources will no longer be available. The stakeholder from Baxter Medical Care advised that Fresenius Medical Care offers a free online educational resource. Fresenius Medical Care is an international company specializing in healthcare supplies, particularly dialysis products. The Baxter representative advised of available resources that are not affiliated with their company,

and those results can be found in Appendix D, Table 1. The vendor also recommended creating a

virtual peritoneal dialysis resource accessible throughout the province and easy to navigate. It

was recommended that the resource include videos covering catheter care, peritoneal dialysis

exchange, transfer set change, peritonitis, microbiology, and inflow and outflow complications.

In addition, the suggestion was made to have Webex meetings to consistently deliver high-

quality education to all nurses, regardless of their location.

Online Resources

In addition to consulting with this vendor, a broad online search for peritoneal dialysis

resources was completed. Six online resources that could be beneficial to nurses were identified.

Three resources are available without username and password or subscription, including the

Advanced Renal Program, powered by Fresenius Medical Care, UHN, and BC Renal. More

information about each source of information can be found in Appendix D. Three were identified

but not applicable because they required username and password access, required a subscription,

or did not have videos, including Kidney Care Campus powered by Baxter Medical Care,

UpToDate, and Mosby's Nursing Skill.

Advanced Renal Education Program

Fresenius Medical Care has an online resource related to peritoneal dialysis. It is called

the Advanced Renal Education Program and is available online. It allows users to create an

account with a username and password that is free of charge. Once registered, you can register

for webinars and receive emails about the offered education sessions. There is also the

opportunity to navigate their platform and complete modules. The Advanced Renal Education

Program provides continuing education hours for healthcare professionals who have completed

modules. Modules differ in delivery methods. Some modules are video-based, others are slides

from a PowerPoint presentation, and others are posters. Some modules have case studies and

multiple-choice testing at the end of the module for evaluation. The Advanced Renal Education

Program provides information about renal anatomy and physiology and basic details on

peritoneal dialysis, is available internationally and in multiple languages, and provides users with

a self-directed, anonymous learning environment. In addition, the resource is always available.

The most significant limitation is that the procedure videos are irrelevant to nurses in NL

because their products are not used here and are quite different from those purchased from

Baxter Medical Care.

University Hospital Network

The University Hospital Network (UHN) in Toronto, Canada, offers online resources for

nurses and patients about peritoneal dialysis. Although there was limited information for nurses,

the online resources designed for patients included information relevant to nurses, such as

anatomy and physiology, the principles of peritoneal dialysis, aseptic technique, and peritonitis.

Some policies and procedures were specific to their program, as well as videos and resources for

patients. It was suggested during stakeholder consultations that basic information would be

useful for nurses, as resources can be content-heavy and include irrelevant information. There

were strengths associated with this resource, such as including resources for training and policies

and procedures that were evidence-based and aligned with best practice guidelines. UHN uses

the same vendor for dialysis supplies as NL. Therefore, the information is pertinent. The UHN

resources include assessment tools for fluid removal and peritonitis, and they allow for

anonymous, self-directed learning. The limitations of the resources available at UHN are that

they focus primarily on improving patient education rather than nursing education, which is not

the intended audience for this project. Additionally, no videos or interactive materials were

provided, nor was there any way to assess knowledge.

BC Renal

BC Renal is a resource for nurses that provides written policies and procedures but lacks interactive tools. It is important to note that policies and procedures may be specific to certain locations. For nurses in NL to adopt these policies, they would need to go through the appropriate channels. Policies were readily available regarding peritoneal dialysis, including instructions on performing an exchange, adding medications to a peritoneal dialysis bag, managing patients with peritonitis, and more. This resource focuses on nursing education and offers training materials and additional information to supplement learning. The information provided is evidence-based and aligned with best practice guidelines. Assessment tools for fluid removal and peritonitis are also included. Like other online resources, it is anonymous, self-directed, and always available. However, its website does not have interactive activities or videos available online or any evaluation components. Furthermore, there are no case studies or examples to enhance understanding related to peritoneal dialysis.

Kidney Care Campus

As discussed, Kidney Care Campus is an educational online platform powered by Baxter Medical Care. Strategies of resources include posters, videos, case studies, and PowerPoint presentations. The strengths of this resource are that it provides information related to anatomy and physiology, as well as other information about peritoneal dialysis. The platform is available internationally and in multiple languages. It also allows learners to learn anonymously and in a self-directed way, and if the learner is a customer, the resource is always available. The barriers and limitations associated with this platform are that it is only available to Baxter customers, and customers are required to sign in using a username and password.

UpToDate

UpToDate is an online learning resource that stakeholders and vendors recommend. It provides information and videos on peritoneal dialysis and is highly recommended. Like other resources, its strengths are that it allows for autonomous and self-directed learning and is always available if the user is subscribed. However, it is essential to note that this resource is not readily accessible, non-affordable, and not specific to the NL context.

Mosby's Nursing Skills

Mosby's Nursing Skills is an online resource for nurses focusing on videos and written instructions. The website offers information on various nursing skills, such as peritonitis resource videos and aseptic techniques. This resource allows the learner to engage in self-directed anonymous learning. However, the resource is only accessible via subscription, and its navigation can be challenging. The dialysis information is also not adequately categorized, making it difficult to locate. If the learner has a subscription, the resource will always be available.

Summary of Results

Each resource identified had strengths and limitations. The best resource identified for nurses' learning was the Advanced Renal Education program. The other online resources identified were inadequate because they required subscriptions, were not interactive, did not have videos, and had no evaluation component. Additionally, websites were not always easy to navigate and user-friendly. For example, peritoneal dialysis skills were not properly organized, with information on peritonitis placed before the basics of peritoneal dialysis. However, elements of each resource can be utilized to develop a comprehensive resource appropriate for the target group.

Nurses need high-quality educational materials to effectively care for patients using peritoneal dialysis. To ensure the utilization of resources, resources must be easily accessible and provide nurses with guidelines and educational materials. Education materials must be comprehensive, with accurate and up-to-date information. Low-quality or outdated material can lead to misinformation and inadequate nursing education, resulting in errors and complications.

Implications for Practicum Project

This environmental scan determined that various online resources related to peritoneal dialysis are available for nurses. Nurses have specific needs that may not be fully met by the existing resources. For instance, they require the ability to evaluate their learning, observe tasks being completed, and have their questions answered. Ensuring these needs are met is critical for successful learning. Each identified resource was evaluated, but none fully met the needs of the nurses practicing in NL. Based on this, it was decided to modify the proposed resource to encompass aspects from each resource, for example, videos, supplemented by a handbook that will be used as a reference guide. The handbook will provide comprehensive information on the basic principles of peritoneal dialysis, catheter care, performing a peritoneal dialysis exchange, and the management of peritonitis. The handbook will contain a list of skills with detailed step-by-step instructions on how to perform them. Photos will be included to supplement the instructions, and at the end of each section, an evaluation component will be provided in the form of multiple-choice questions. Answers to the multiple-choice questions will be available at the end of each section. With this approach, nurses will have access to a comprehensive and practical peritoneal dialysis resource to enhance their skills and education. This environmental scan has been informative in that it reveals the limited amount of peritoneal dialysis readily accessible for nurses, guiding the development of this practicum project.

Conclusion

Based on the environmental scan, a virtual peritoneal dialysis workshop for registered nurses is needed. The proposed virtual resource offers nurses evidence-based knowledge in an accessible, easy-to-navigate format. The environmental scan identified preexisting resources, but they will need to be modified to meet the needs of this specific group. The virtual workshop will cover the basics of peritoneal dialysis, associated complications, and patient care and will benefit registered nurses caring for people who use peritoneal dialysis.

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Appendix A: Health Research Ethics Authority (HREA) Screening Tool

Student Name: Jessica Andrews

Title of Practicum Project: Development of a Virtual Peritoneal Dialysis Workshop for Registered Nurses

Date Checklist Completed: February 19th, 2024.

This project is exempt from Health Research Ethics Board approval because it matches item number __1 & 2__ from the list below.

1. Research that relies exclusively on publicly available information when the information is legally accessible to the public and appropriately protected by law; or the information is publicly accessible and there is no reasonable expectation of privacy.
2. Research involving naturalistic observation in public places (where it does not involve any intervention staged by the researcher, or direct interaction with the individual or groups; individuals or groups targeted for observation have no reasonable expectation of privacy; and any dissemination of research results does not allow identification of specific individuals).
3. Quality assurance and quality improvement studies, program evaluation activities, performance reviews, and testing within normal educational requirements if there is no research question involved (used exclusively for assessment, management or improvement purposes).
4. Research based on review of published/publicly reported literature.
5. Research exclusively involving secondary use of anonymous information or anonymous human biological materials, so long as the process of data linkage or recording or dissemination of results does not generate identifiable information.
6. Research based solely on the researcher's personal reflections and self-observation (e.g. auto-ethnography).
7. Case reports.
8. Creative practice activities (where an artist makes or interprets a work or works of art).

For more information please visit the Health Research Ethics Authority (HREA) at
https://rpresources.mun.ca/triage/is-your-project-exempt-from-review/

Appendix B: Information Letter to Participate in Environmental Scan

Hello:

Re: Development of a Virtual Peritoneal Dialysis Workshop for Registered Nurses

I am Jessica Andrews, the nephrology program's living kidney donor coordinator (LKDC). My background in nephrology is extensive, with experience in hemodialysis, peritoneal dialysis, and transplantation. I am enrolled in the Master of Science in Nursing program at Memorial University, where I must complete a practicum project of my choice to graduate.

For my practicum project, I would like to develop a comprehensive virtual workshop to aid registered nurses in providing better care to peritoneal dialysis patients, particularly those in Newfoundland and Labrador. I am conducting an environmental scan of peritoneal dialysis suppliers, including Baxter Medical Inc. and Fresenius Medical Care, to determine whether they provide virtual education or training programs for nurses and other healthcare professionals.

Understanding the education offered in other areas is crucial to ensuring that education in Newfoundland and Labrador is inclusive and comprehensive. By better understanding available resources, I can develop a peritoneal dialysis resource that considers the Canadian context for Newfoundland and Labrador.

If you want to discuss this, please let me know a time that works for you. Your help on this project is greatly appreciated.

Thank you,
Jessica

Jessica Andrews BN RN CnephI
Living Kidney Donor | Transplant Coordinator
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Appendix C: Questions for Environmental Scan

1. What educational resources for registered nurses for peritoneal dialysis do you offer? What format are they in? (e.g., in-person, online, videos, etc.)

2. What regions do you offer peritoneal dialysis resources to? Does a facility have to have a contract with the company (i.e., Baxter Medical or Fresenius Medical) to access educational material?

3. Are peritoneal dialysis resources available to the public? Is a username and password required to access the available resources?

4. What strengths and limitations have you identified with these programs and their format? Have you had greater success with one over the other? Have you received feedback from nurses about which format best suited them?

5. Can you offer recommendations for a virtual peritoneal dialysis resource?

6. Are there other strategies you have provided to peritoneal dialysis nurses who practice in remote areas or areas with limited nursing resources?

Appendix D: Environmental Scan Results

Table 1

Summary of Vendor-Specific Responses

Environmental Scan Questions	Results
What educational resources for peritoneal dialysis do you offer registered nurses? What format do they take? (e.g., in-person, online, videos, etc.)	• Baxter provides in-person and virtual education to help customers learn how to use the twin bag, catheter, and automated peritoneal dialysis equipment. We also offer a kidney campus website that contains videos related to peritoneal dialysis, which is available to our customers. The aim is to keep our customers informed and upskilled and to help them use our equipment.
What regions do you offer peritoneal dialysis resources to? Does a facility have to have a contract with the company (i.e., Baxter Medical or Fresenius Medical) to access educational material?	• Baxter Medical is a global company that provides healthcare supplies and resources worldwide. In Canada, Baxter services several provinces, including Newfoundland and Labrador. To access the educational material, a facility must be a Baxter customer, and a valid username and password are required. • Fresenius is also an international company that offers healthcare supplies, particularly dialysis, to all of Newfoundland and Labrador. Fresenius provides an educational resource for all healthcare professionals at no cost.
Are peritoneal dialysis resources available to the public? Is a username and password required to access them?	• UpToDate – Username and password needed. Not available without a subscription. • Kidney Care Campus – Username and password required. Not available unless customer of Baxter. • Advanced Renal Program – No username or password required. Available to the public. • Mosby's • BC Renal - – No username or password required. Available to the public. • UHN – No username or password required. Available to the public (but

Environmental Scan Questions	Results
	information not related to nursing, rather patient-specific)
What strengths and limitations have you identified with these programs and their format? Have you had greater success with one over the other? Have you received feedback from nurses about which format best suited them?	Strengths: • Anonymous learning • Self-directed • Available always • Examples and case studies • Included videos for training and additional information. • Do's and Don't • For all employees • Available for patients and families Limitations: • Difficult to navigate. • Broad information. • Needs to be supplemented with exercise to solidify learning. • No interactive component • Few exercises or examples to enhance training. • No assessment or evaluation tools
Can you offer recommendations for a virtual peritoneal dialysis resource?	• Recommend a series of videos available to people within the province that are easy to navigate. • Video 1 – Catheter care • Video 2 – Exchange • Video 3 – Transfer set change • Video 4 – Peritonitis • Video 5 – Microbiology • Video 6 – Inflow/Outflow Complications
Are there other strategies you have provided to peritoneal dialysis nurses who practice in remote areas or areas with limited nursing resources?	Our primary methods of educating peritoneal dialysis nurses in remote or metropolitan areas are in-person visits, Webex meetings, and videos on our Kidney Care Campus. These are the only strategies we provide to consistently deliver high-quality education to all our nurses, regardless of location.

Table 2

Summary Table for the Online Resources

Source of Information	Strategies/Focus of Resource	Strengths	Barriers
Kidney Care Campus, Baxter Medical Care	• Posters • Videos • Case Studies • PowerPoint Presentation	• Provides information about anatomy and physiology. • Provides basic information about peritoneal dialysis. • Available internationally and in multiple languages • Autonomous, self-directed learning • If subscribed, the resource is always available.	• Only available to customers of Baxter • Customers need to sign in using a username and password
Advanced Renal Education – Fresenius Medical Care *International*	• Posters • Videos • Case Studies • Modules • PowerPoint Presentation	• Provides information about anatomy and physiology. • Provides basic information about peritoneal dialysis. • Available internationally and in multiple languages • Autonomous, self-directed learning • Resource is always available.	• Procedure videos are irrelevant to nurses in Newfoundland as the products are not in use there.
Mosby's Nursing Skills *Ontario*	• Videos • Written instruction	• Provides information about anatomy and physiology. • Peritonitis resource videos and instruction • Aseptic technique videos and instructions • Autonomous, self-directed learning	• Only available by subscription • Difficult to navigate. • Dialysis information not categorized. • No assessment tools.

Source of Information	Strategies/Focus of Resource	Strengths	Barriers
		• If subscribed, the resource is always available.	
BC Renal *British Columbia*	• Policies • Procedures • Videos	• Focus on nursing education. • Includes resources for training and additional information. • Evidence included for each recommendation, policy, and procedure. • BC Renal uses the same vendor as us. Therefore, information is pertinent. • Includes assessment tools. • Autonomous, self-directed learning • Resource is always available	• No interactive component • A few exercises or case studies to enhance understanding of peritoneal dialysis
University Health Network – Unity Health Program *Ontario*	• Policies • Procedures • Videos • Patient Resources	• Includes resources for training and additional information. • Evidence included for each recommendation, policy, and procedure. • UHN uses the same vendor as us. Therefore, information is pertinent. • Includes assessment tools. • Autonomous, self-directed learning • Resource is always available	• Primary emphasis is on enhancing the quality of patient education rather than concentrating on nursing education. • Could benefit from case studies to assist with nursing education.
UpToDate	• Procedures • Videos	• Autonomous, self-directed learning • If subscribed, the resource is always available	• Only available by subscription.

Appendix D

Development of a Peritoneal Dialysis Handbook for Nurses

This handbook on peritoneal dialysis (PD) is a resource for nurses and healthcare professionals seeking to improve their proficiency in PD techniques. It is designed to help nurses understand the essential principles of PD and perform it effectively. The handbook is easy to navigate, with clear illustrations, step-by-step instructions, and safety precautions. Regular updates based on the latest evidence and feedback are necessary. Continued up-to-date, evidence-based research and collaboration with nephrologists, nurses, and patients during the development of this resource will ensure its effectiveness and relevance.

Peritoneal Dialysis Handbook Contents

Module 1: Basics of Peritoneal Dialysis	• Basic Anatomy & Physiology of Kidney & End-Stage Renal Disease (ESRD)
	• Transport Processes in Peritoneal Dialysis
	• Ultrafiltration in Peritoneal Dialysis
	• Fluid Assessment
	    o Dry Weight
	    o Vital Signs
	    o Fluid Overload
	    o Fluid Depletion

Module 2: Catheter Care	• Exit-site Care/Dressing Change • Mini-Cap Change • Catheter Flush to Maintain Patency • Transfer Set Change • Exit-site Infections
Module 3: Peritoneal Dialysis Prescription	• Dialysate Types • Dialysate concentration • Fill Volume • Dwell Time • Exchange Frequency
Module 4: Peritoneal Dialysis Medications	• Heparin • Alteplase (Cathflo) • Antibiotics
Module 5: Peritoneal Dialysis Exchange	• Supplies • Exchange Technique (drain, fill, dwell)
Module 6: Complications	• Dry Contamination • Wet Contaminations • Inflow/outflow issues • Titanium change • Increased Intraperitoneal Pressure (IIP)

Module 7: Peritonitis	• Signs & Symptoms of Peritonitis
	• Microbiology Specimens
	○ Culture & Sensitivity
	• Treatment

Table of Contents

Module 1: Basics of Peritoneal Dialysis

This module will cover the following:

- Basic Anatomy & Physiology of Kidney & End-Stage Renal Disease (ESRD)

- Transport Processes in Peritoneal Dialysis

- Ultrafiltration in Peritoneal Dialysis

- Fluid Assessment

    - Dry Weight

    - Vital Signs

    - Fluid Overload

    - Fluid Depletion

Basic Anatomy & Physiology of the Kidney

- The kidneys are bean-shaped organs in the upper abdominal cavity. They function as the primary excretory organ and are the major system responsible for getting rid of waste through the formation and excretion of urine (Count, 2020).

- Excretion of metabolic wastes includes eliminating urea, creatinine, uric acid, bilirubin, metabolites, and drugs. In one day, the kidneys filter almost 200 litres of fluid from the blood (Counts, 2020).

- Each kidney comprises a large mass of nephrons, which are the functioning units. Nephrons play a crucial role in maintaining the body's internal environment, helping to keep fluid volumes and electrolyte concentrations within a narrow range. They also regulate acid-base balance, synthesize hormones, and sometimes produce glucose (Counts, 2020).

- The cortex is the outer rim of the kidney. It receives significant blood; approximately 90% of the renal blood flow goes to the cortex. It is the most highly perfused tissue per gram of any organ in the body (Counts, 2020).

- The medulla is the inner portion of the kidney and extends to the renal pelvis. It receives about 10% of the renal blood flow and contains pyramids and renal columns, loops of Henle, vasa recta, and medullary collecting ducts (Counts, 2020).

- Pyramids are triangular-shaped structures composed of nephrons and their blood vessels (Counts, 2020).

- Renal columns are cortical tissue between the pyramids. Calyces are branches enclosing the papilla or points of the pyramids, and they collect urine (Counts, 2020).

- Nephrons are the workhorses of the kidney, comprised of cortical and juxtamedullary nephrons. The nephron's collecting system consists of structures that collect and transport urine but do not alter its volume composition. Once urine exists in the renal pelvis, it is transported via urine to the ureters, the bladder, and the urethra (Counts, 2020).

Chronic kidney disease (CKD) is a common condition characterized by evidence of kidney damage or dysfunction and affects millions of people worldwide (Counts, 2020). Criteria for patients to meet the definition of CKD are as follows: duration of more than three months based on documentation of inference; glomerular filtration rate (GFR) less than 60 mL/min per $1.73m^2$; kidney damage as defined by structural or functional abnormalities other than decreased GFR, less than 15 mL/min per $1.73m^2$ is defined as kidney failure; other common markers include albuminuria and abnormal urine sediment (Counts, 2020). People with a GFR greater than 90 are considered normal, but those with a GFR over 60 mL/min per $1.73m^2$ have normal kidney function despite being technically at stage 2 CKD or mildly decreased (Counts, 2020).

Table 1

GFR Stages in CKD

GFR Stages in CKD		
Stage	**GFR** **mL/min per 1.73m²**	**Terms**
Stage 1	90 or above	Normal or high
Stage 2	60 to 89	Mildly decreased
Stage 3a	45 to 59	Mildly to moderately decreased
Stage 3b	30 to 44	Moderately to severely decreased
Stage 4	15 to 29	Severely decreased
Stage 5	Less than 15	Kidney Failure

Note. Table adapted from Core Curriculum for Nephrology Nursing, by C. Counts, 2020, p.229.

- End-stage renal disease (ESRD) develops when the kidneys' function is severely impaired, necessitating renal replacement therapy such as dialysis or transplantation. ESRD is classified as stage 5 CKD (Counts, 2020).

What is Peritoneal Dialysis?

PD is a renal replacement therapy used to treat kidney failure or end-stage renal disease (ESRD). It utilizes the peritoneal membrane, the abdominal cavity's lining, as a natural filter for waste removal and fluid balance (Counts, 2020). PD serves two primary purposes: clearing waste, which removes products like urea, creatinine, and potassium from the blood, and helping regular fluid balance by removing excess fluid from the body. The PD catheter is surgically placed into the peritoneal cavity (Counts, 2020).

Transport Processes in Peritoneal Dialysis

The peritoneum is a serous, semipermeable, bidirectional membrane that covers the abdominal organs and lines the abdominal wall (Counts, 2020). It is composed of thin layers of connective tissue covered with mesothelium (Counts, 2020). The transport processes that occur during peritoneal dialysis treatment are **diffusion** and **ultrafiltration** (Counts, 2020).

- **Diffusion** is the movement of solutes (e.g., urea, creatinine) from an area of higher concentration (blood) to an area of lower concentration (dialysate) across the peritoneal membrane (Counts, 2020).

- **Ultrafiltration** refers to removing excess fluid from the blood into the dialysate due to osmotic pressure gradients (Counts, 2020). Fluid removal or ultrafiltration in PD is a two-step process, which includes water transport from the peritoneal capillaries to the interstitium and transport across the peritoneal membrane into the peritoneal cavity (Counts, 2020).

Ultrafiltration in Peritoneal Dialysis

- Factors that affect fluid removal in PD are peritoneal membrane permeability and surface area, hydrostatic gradient, type and concentration of the osmotic pressure gradient, amount of dextrose in the dialysate, and dwell time (Counts, 2020).

- The Ultrafiltration Rate (UF) refers to the rate at which fluid is removed during PD exchanges (Counts, 2020). The UF rate is affected by the type and strength of the prescribed solution. Increasing the dextrose content in the dialysate will result in an increased UF rate. Typically, individuals using PD experience ultrafiltration (UF) of one to two litres per 24-hour period. This translates to 200mls to 400mls per exchange, with 700mls to 1000mls being removed when Icodextrin is used for extended dwells. The physicians typically determine the appropriate UF rate for the patient.

Fluid Assessment

Before starting a peritoneal dialysis (PD) treatment, it is important to conduct a fluid assessment to ensure that the dialysis solution being used is suitable. If the patient is determined to be significantly below or above their dry weight, for example, 1-2 kg below or 3 kg above, if their vital signs are unstable, or if they appear to be fluid-overloaded or depleted, you should notify the nephrologist.

The nephrologist will then determine the most appropriate dialysis solution (Counts, 2020).

- **Dry Weight** is the optimal weight for a patient's fluid balance (neither fluid overloaded nor depleted). Achieving and maintaining dry weight is crucial for overall health and preventing complications (Counts, 2020). The dry weight is a number that is assigned by the nephrologist.

- **Vital Signs** should be measured before every dialysis treatment. A full set of vitals is required, including temperature, blood pressure, heart rate, and respiration.

Fluid Overload:

- Signs and Symptoms: pitting edema, shortness of breath, weight gain, elevated blood pressure (i.e., 170/100 mmHg).

- Management: adjust or decrease patient fluid intake and optimize dialysis prescription.

Fluid Depletion:

- Signs and Symptoms: thirst, dry mouth, low blood pressure, decreased urine output.

- Management: Ensuring adequate fluid intake and assessing ultrafiltration adequacy. Assess fluids and continuously provide individualized care for each patient (Counts, 2020).

Module 2: Catheter Care

Proper care of the PD catheter and exit site is crucial for optimal function, infection prevention, and prompt addressing of any issues to prevent complications (Counts, 2020).

The module will cover the following topics:

- Exit-site Care/Dressing Change

- Mini-Cap Change

- Catheter Flush to Maintain Patency

- Transfer Set Change

- Exit-site Infections

Exit Site Care/Dressing Change

Exit site care and PD catheter assessment must be done **daily.** Care should be performed in the morning, allowing time to address identified issues (BC Renal, 2024). If you notice any problems or concerns, contact the peritoneal dialysis unit or a nephrologist. Do not use sharp objects (scissors, safety pins, etc.) on or around your catheter or transfer set.
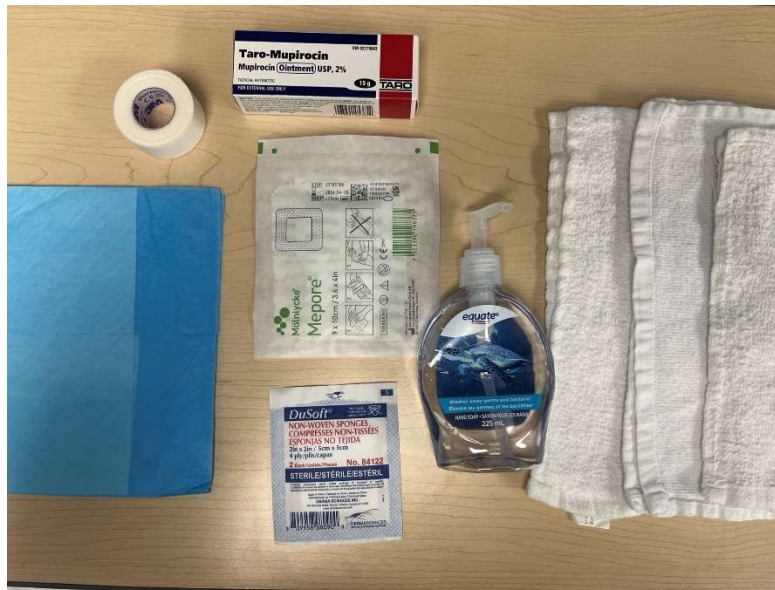
Supplies:

- 1 (2x2) gauze
- Tape or Immobilizer
- Antibacterial liquid soap
- Bactroban (Mupricion) ointment (or other ointment as prescribed)
- Mepore Dressing (or other dressing as per policy or prescribed)
- Three facecloths

Procedure:

1. Wash hands and don clean gloves.

2. Remove the dressing from around the catheter. Secure the transfer set with tape so it does not dangle or tug.

3. Inspect the exit site, ensuring tubing is attached to the titanium adaptor and tighten if it appears loosened.

   Check for the following:

   - Redness
   - Drainage
   - Scabbing or "crusting"
   - Swelling
   - Pain
   - Note: None of the above is normal. If noted, contact the nephrologist.

5. Open a 2x2 gauze and separate it into two pieces.

6. Put a small amount of Bactroban (or other prescribed ointment) on the 2x2.

7. Apply sparingly around the exit site and wipe off any excess ointment.

8. Fold the other 2x2 and place it under the catheter tubing by the exit site.

9. Apply a Mepore Dressing (or other dressing as prescribed as per organization policy) over the exit site.

10. Stabilize your catheter and transfer the set using an immobilizer or tape.

11. Document the condition of your exit site in the patient's chart.

Exit sites can be:

- Clean: The exit site should always be clean.

- Drainage, redness, swelling, or tenderness: If any of these symptoms are noticed, especially along the catheter tunnel, notify the nephrologist.

- Never pull or tug on a peritoneal dialysis catheter, as this may disturb the surrounding tissue and cause problems with the exit site.

- Never apply powder to the exit site.

- Never use non-prescribed ointment or lotions at the exit site.

Mini Cap Change

The Mini Cap must be replaced with a new one if it is removed for any reason, becomes loose, or

falls off (BC Renal, 2024).
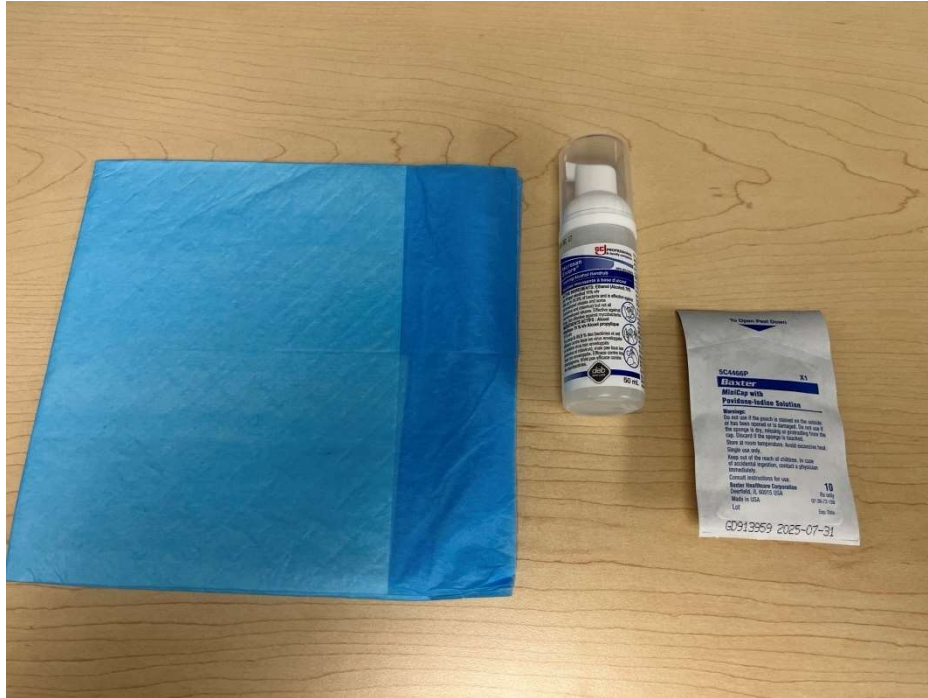
Supplies:

- Hand Sanitizer

- Mini Cap

Procedure:

1. Place a blue pad beneath the peritoneal dialysis catheter.

2. Open the Mini Cap with the package's "pouch" against the working surface, with the

   label side facing up. This will create a pocket of space to prevent the Mini Cap from

   rolling onto a contaminated surface.

3. Check that the sponge is present and wet. If the sponge is missing or dried up, get a new

   Mini Cap.

4. Ensure the transfer set is closed.

5. Unscrew the mini-cap or twin bag connector from the transfer set and let it go.

6. Holding the transfer set in your hand, immediately apply a new Mini Cap.

Catheter Flush to Maintain Patency

Flushing is essential for maintaining catheter patency after insertion. It clears intraperitoneal blood and fibrin, minimizing omental adhesion. It also helps assess catheter functioning and identify potential complications (Counts, 2020).

Supplies:

- 20g needle
- 3mL syringe
- Mini Cap
- Mask
- Red clamps
- 2 – Alcohol swabs

Procedure:

1. Mask up and wash your hands thoroughly.

2. Gather your supplies on a clean surface.

3. Check the dialysis solution for:

    - Strength (as ordered by nephrologist)

    - Volume (usually 1000mL – 2000mL)

    - Heparin concentration (usually 500units/mL - 1000units/mL)

4. Connect the dialysis solution to the transfer set using an aseptic technique.

5. Open the twist clamp on the transfer set to allow drainage. If there is no flow, close the twist clamp.

6. Ensure all steps have been taken to maintain catheter patency, including checking for clamps and catheter kinks.

7. Break the green seal on the fill line.

8. Perform a flush before the filling procedure (approximately 5 seconds)—this will ensure that all lines of the PD bag are primed to prevent air from instilling into the patient's abdomen.

9. Place a clamp on the drain line.

10. Using an aseptic technique, draw up the prescribed amount of heparin.

11. Swab the medication port on the peritoneal dialysis solution bag and inject the medication.

12. Gentle mix the bag to distribute the medication and label the bag with a medication label.

13. Open the twist clamp on the transfer set.

14. Perform an in-and-out exchange (zero dwell time) with the patient in a supine position. Module 5 provides more instruction about PD exchange.

15. When the drain is complete, cap the transfer set with a Mini Cap.

16. Assess the drained effluent's appearance, color, and clarity.

17. Document in the patient's chart.

Transfer Set Change

Transfer sets should be changed periodically according to the manufacturer's recommendations.

To determine when to change the transfer set, refer to the product insert of your specific product.

Additionally, transfer sets should be changed if they are damaged or not working correctly (BC

Renal, 2024).
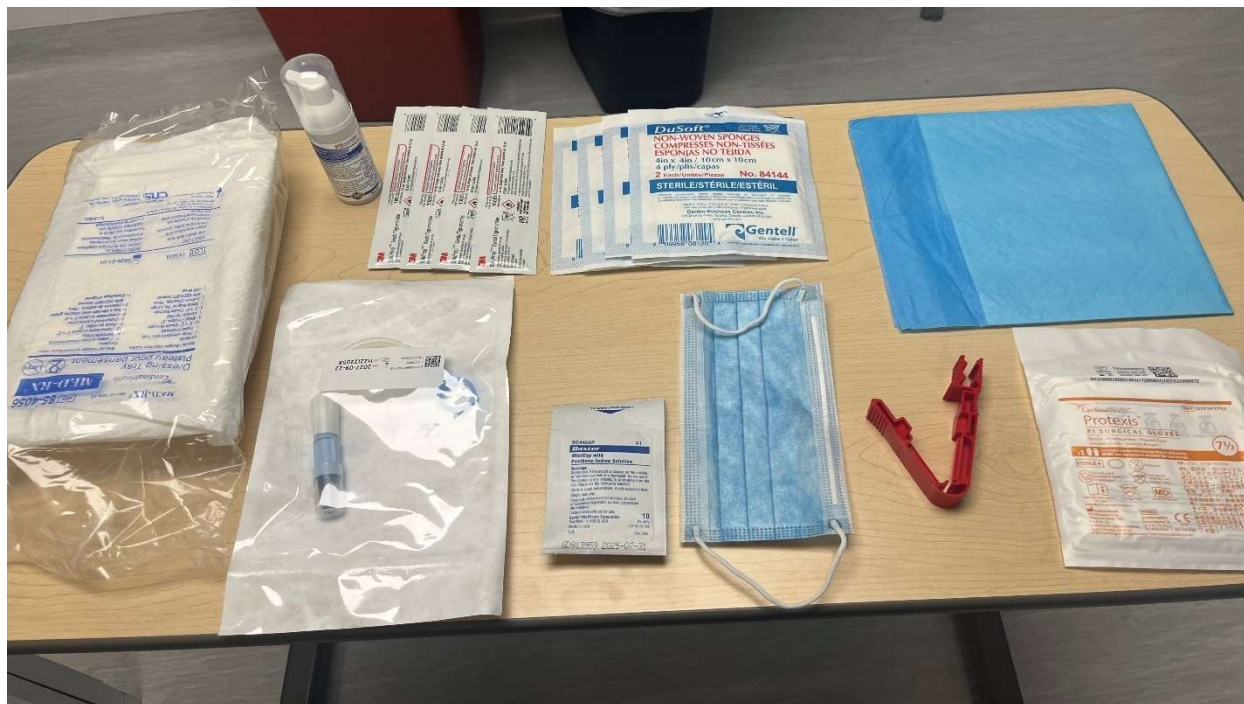
Supplies:

- Transfer set
- Mini cap
- Red clamp
- Chlorhexidine 2% in 4% isopropyl alcohol
- Mask
- Sterile gloves
- Sterile dressing tray
- 4 - sterile 4x4 gauze
- Blue pad

Procedure:

1. Mask self and patient. Masking can prevent the spread of airborne organisms.

2. Hand hygiene.

3. Ensure the patient's transfer set clamp is closed.

4. Clamp the PD catheter with a clamp approximately 4" away from the connection to the transfer set. This will prevent dialysis fluid from draining from the PD catheter during the transfer set change.

5. Open the sterile dressing tray and add the transfer set and Mini Cap to the dressing tray.

6. Saturate 4 x 4 gauze on the dressing tray with chlorhexidine or swabs/sticks.

7. Wash hands and don sterile gloves.

8. Attach Mini Cap to transfer set.

9. Holding the transfer set and catheter with gauze, scrub the catheter adapter at the connection site with chlorhexidine solution-soaked gauze and swabs/sticks. Ensure that chlorhexidine only touches the titanium adapter. Avoid contact with the transfer set to maintain tubing integrity.

10. remove and discard the old transfer set from the catheter using sterile gauze. Hold the open end of the catheter in one hand to avoid touch contamination.

11. Using a sterile hand, pick up the new transfer set and remove the blue protective cover from the end. Carefully connect it by twisting it to the catheter connector, preventing cross-threading. Ensure the tight connection prevents the transfer set from accidentally falling off.

12. Ensure the transfer set roller clamp is closed.

13. Remove the clamp from the catheter.

14. Secure the transfer set and catheter to the patient's skin with tape, a PD belt, or a stabilization device (i.e., immobilizer).

Exit Site Infections

Peritoneal dialysis (PD) exit site infections can occur around the area where the PD catheter exits the skin (BC Renal, 2024). Signs and symptoms include:

- **Redness and Swelling**: The skin around the exit site may become red, swollen, or warm to the touch.

- **Pain or Tenderness**: Discomfort or pain at the exit site.

- **Drainage**: Pus or bloody discharge from the exit site.

- **Overgrown Granulated Tissue**: Excessive tissue growth around the exit site.

- **Fever and Chills**: Elevated body temperature and rigours.

- **General Discomfort**: Feeling unwell, nauseous, or vomiting.

If you notice any of these symptoms, notify the nephrologist promptly. The nephrologist will order the appropriate diagnostic tests and treatment. Early detection and proper management are crucial to prevent complications related to exit site infections in PD (Counts, 2020).

Module 3: Peritoneal Dialysis Prescription

The dialysis prescription should be tailored to each patient, considering peritoneal transport rate, residual kidney function, size (e.g., the volume of urea distribution or total body surface area), medical conditions, and personal preference (Counts, 2020).

This module covers the following topics:

- Dialysate Types

- Dialysate Concentration

- Fill Volume

- Dwell Time

- Exchange Frequency

Dialysate Types

- A variety of dialysis solutions are available. These solutions are sterile, nonpyrogenic, and contain no bacteriostatic or antimicrobial agents. They contain sodium, calcium, magnesium, chloride, and lactate.

- Dextrose is added to each solution to increase the osmolarity and enhance UF. The concentrations frequently used are 0.5%, 1.5%, 2.5%, and 4.25% dextrose concentration. It is important to note that exposure of the peritoneal membrane to high glucose concentrations and glucose degradation products may contribute to structural and functional changes in the peritoneal membrane (Counts, 2020). The lowest concentration that allows adequate fluid removal should be used.

- Icodextrin solution of 7.5% is an alternative non-glucose osmotic agent. This solution removes fluid by colloid osmotic pressure. It is typically used for patients with insufficient peritoneal UF and those where excessive exposure to glucose should be limited (Counts, 2020).

Dialysate Concentrations

Table 2

Dialysate Concentrations

Dialysate Concentration	0.5% Dextrose	1.5% Dextrose	2.5% Dextrose	4.25% Dextrose	7.5% Icodextrin
When to use solution.	Fluid depleted (nausea & vomiting)	At or below dry weight.	Weight is elevated 0.5-1.5kg above dry weight.	Weight is elevated 2kg above dry weight.	This solution is used for extended dwell (i.e., overnight)
Blood Pressure & Weight	Decreased blood pressure and weight.	Normal Blood pressure.	Blood pressure is elevated (e.g., 150/90)	Blood pressure is significantly elevated (e.g., 170/100)	This solution is used for long dwells.
Edema	No Edema	No Edema	1+ Edema	2+ Edema and shortness of breath	Solution for long dwells. 8-12 hrs (CAPD) 8-16hrs (APD)
Calories	24 kCal	72 kCal	119 kCal	203 kCal	0 kCal
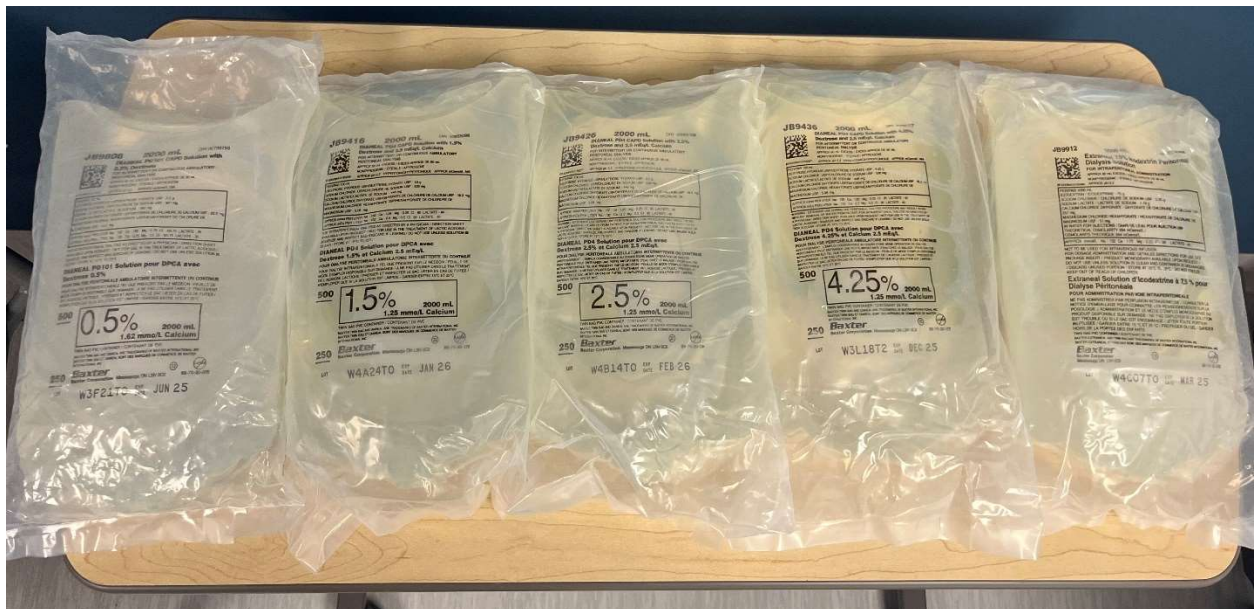
Fill Volume

The fill volume required for peritoneal dialysis varies depending on the individual's size. For instance, pediatric patients typically use lower fill volumes, such as 500mls, while the usual adult fill volume is 2000mls. The nephrologist can adjust the fill volume if necessary to ensure adequate clearance (Counts, 2020).

Dwell Time

The dwell time provides time for diffusion and osmosis to take place. A typical dwell time for acute intermittent PD is 30 to 60 minutes. In APD, the cycler dwell time is 1.5 to 2.0 hours. CAPD daytime exchanges typically last 4 to 6 hours, and overnight exchanges for 8 to 10 hours (Counts, 2020). The nephrologist prescribes the dwell time.

Exchange Frequency

The dialysis solution is constantly present in the peritoneal cavity, except for short breaks to drain the cavity and infuse fresh dialysate or dialysis solution. Dialysis is performed 24 hours a day, seven days a week, with 4 to 5 daily exchanges. A typical schedule involves exchanging the solution in the morning, at lunchtime, before or after dinner, and at bedtime (Counts, 2020). The nephrologist prescribes the exchange frequency.

Module 4: Peritoneal Dialysis Medications

This module provides instructions on adding medications to peritoneal dialysis bags and

administering medication through the peritoneal dialysis catheter (BC Renal, 2024).

- Heparin

- Alteplase (Cathflo)

- Antibiotics

Adding Heparin to Peritoneal Dialysis Bag

Heparin may need to be added to the bag if fibrin (white strands/strings) are noted in your effluent bag or if you have a peritonitis infection (BC Renal).

Supplies:

- Heparin (dosage as per physician orders)

- Sterile 3mL syringe with pre-attached needle

- 2 - Chlorhexidine/Alcohol swabs

- Tape

Procedure:

1. Ensure a clean surface and gather supplies.

2. Hand hygiene.

3. Remove the cap from Heparin and swab the top of the vial with an alcohol swab.

4. Open a 3 mL dry syringe with a pre-attached needle.

   - Tighten the attached needle.

   - Remove the plastic cap.

- Pull back approximately 1 mL to fill the syringe with air.

5. Insert the needle into the heparin vial.

   - Flip over syringe and needle.

   - inject the air.

   - withdraw 1 mL of heparin and apply the needle cap.

6. Perform hand hygiene.

7. Connect your patient to the peritoneal dialysis bag and drain your effluent. Once drained, do the 5-second "flush before fill" to prime the line.

8. Clean the medication port of the dialysate bag with an alcohol swab. Allow to dry.

9. Add medication through the port while maintaining the aseptic technique.

10. Gently mix the bag to ensure medication distribution in the fluid.

11. Label the bag with a medication label.

12. Proceed with the peritoneal dialysis exchange and allow the solution to dwell for the appropriate amount of time.

Adding Antibiotics to Peritoneal Dialysis Bag

Antibiotics may be added to a peritoneal dialysis bag if a patient is diagnosed with or suspected of having peritonitis. A nephrologist will prescribe the medication and dosage (BC Renal).

Supplies:

- Dialysis solution
- Antibiotic medication
- Reconstitution solution (if applicable)
- Syringe with a pre-attached needle.
- 20g needle
- 2 – alcohol swabs

Procedure:

1. Check the dialysate solution for volume, expiry date, strength, and clarity and remove the outer wrapper.

2. Check medication for 7 rights of administration (right patient, right drug, right time, right dose, right route, right reason, and right documentation).

3. Clean the medication vial top with alcohol swabs and allow the top(s) to dry. An aseptic technique is required to prevent infection. If any of the objects become contaminated, discard them and start over.

4. Reconstitute the medication if required based on the product monogram.

5. Using an appropriate needle, draw up the prescribed amount of medication.

6. Connect your twin bag and drain your effluent. Once drained, perform the 5-second "flush before fill" to prime the line.

7. Clean the medication port of the dialysate bag with an alcohol swab. Allow to dry.

8. Add medication through the port while maintaining the aseptic technique.

9. Gently mix the bag to ensure medication distribution in the dialysis bag.

10. Label the peritoneal dialysis bag with a medication label.

11. Proceed with the peritoneal dialysis exchange and allow the solution to dwell for

   the appropriate amount of time.

Administering Alteplase (Cathflo)

Adding Cathflo (alteplase) to a PD exchange is a specific procedure to restore patency to a PD

catheter obstructed by fibrin or blood clots (BC Renal). A nephrologist will prescribe the dosage.

Supplies:

- Cathflo
- Sterile Water
- Alcohol Swab
- 2 - 3mL syringes
- 1 – 10mL luer-lock syringe
- 1 – 60mL luer-lock syringe
- 1 – 18g needle
- Mini Cap

Procedure:

1. Reconstitute Alteplase as per product monogram. The common dosage is 4 mg of Alteplase, but nephrology will order the dose.

2. Aseptically withdraw 2.2 ml of sterile water for injection and inject it into each 2 mg vial of alteplase.

3. Gently swirl the vial until the contents are completely dissolved (usually within 3 minutes).

4. Prepare the Transfer Set and Catheter:

    a. Connect the 60mL syringe to the transfer set.

    b. Inject the combined volume of alteplase and sterile water into the transfer set and peritoneal catheter.

    c. Allow the solution to dwell for 1-2 hours or as indicated by the physician's order.

5. Attempt to drain the peritoneal cavity after a specified time using the PD exchange technique.

6. If unable to drain, use a 60-cc syringe and attempt to withdraw the exact amount of alteplase instilled.

7. Monitor the patient for any adverse reactions or complications related to the use of Cathflo.

8. Notify the nephrologist if the catheter remains blocked after the procedure.

Module 5: Peritoneal Dialysis (Twin Bag) Exchange
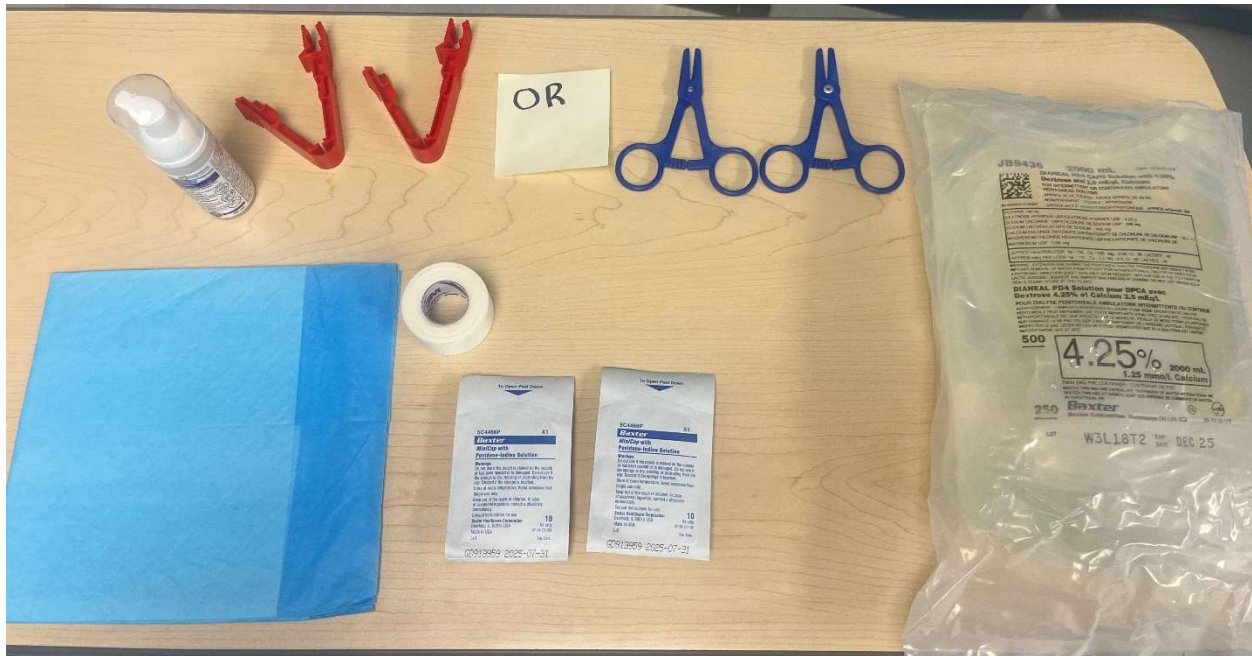
Supplies:

- PD Solution

- Clamps (x2)

- Hand Sanitizer

- Tape

- Mini Cap

- Blue Pad

Procedure:

1. Hand hygiene.

2. Clean your working surface with a disinfectant wipe and allow it to dry.

3. Gather supplies.

4. Remove over pouch from the dialysis solution bag (this can be done by using the end of the clamp or by tearing the pre-cut slit).

5. Check the bag for leaks by applying pressure and running your hand along all four sides to ensure it is not "extra wet."

   Check for SEAL- Solution strength, expiry date, amount of solution, and leaks (Counts, 2020).

6. Tape the dialysis solution bag connecting the port to the working surface.

7. Sanitize your hands.

8. Remove the pull ring from the dialysis solution bag connector.

9. Expose your transfer set and check that the twist clamp is closed.

10. Remove the Mini Cap from the transfer set. Continue to hold the transfer set with one hand.

11. Immediately attach the dialysis bag connector to the transfer set.

12. Hang the full bag on the top of an IV pole and place the empty bag in the drain position or on the floor.

13. Open the transfer set and twist the clamp to drain.

14. Allow 20-30 mins to **drain.**

15. After draining, place a red clamp on the drain line.

16. Close transfer set twist clamp

17. Check drained fluid for:

    a. Clarity

    b. Blood

    c. Fibrin

18. Break the "green seal" on the fill line (bend, snap and pull apart). The fill line is the "blue" line.

19. Open the clamp on the drain line for 5 seconds, flushing fluid into the drain bag to remove air.

20. Close the clamp on the drain line.

21. Ensure all the air is out of the fill line.

22. Open transfer set twist clamp to **fill.**

23. All 20 mins to fill.

24. After filling, place the second clamp on the fill line.

25. Close transfer set twist clamp.

26. Sanitize your hands.

27. Open the Mini Cap "pouch" of the package against the working surface, label side facing up).

28. Check that the sponge is present and wet**.**

29. Unscrew the dialysis bag connector from the transfer set and let it go.

30. Keeping the transfer set in your hand, **immediately** apply a new Mini Cap to the transfer set.

31. Allow the dialysis solution to **dwell** for the appropriate amount of time.

32. Allowing some "slack," secure the catheter to your belly/chest with tape, immobilizer, or belt.

33. Clean the workspace, wash hands, and document in the patient chart.

Module 6: Complications

Topics in this module will include:

- Dry Contamination

- Wet Contamination

- Inflow/outflow Issues

- Catheter Damage

- Titanium Change

- Increased Intraperitoneal Pressure (IPP)

Dry Contamination

Dry Contamination, also known as touch contamination, occurs when you touch the part of the transfer set in a sterile PD catheter (Counts, 2020). If you accidentally touch the sterile part of the PD catheter, please continue performing the subsequent actions.
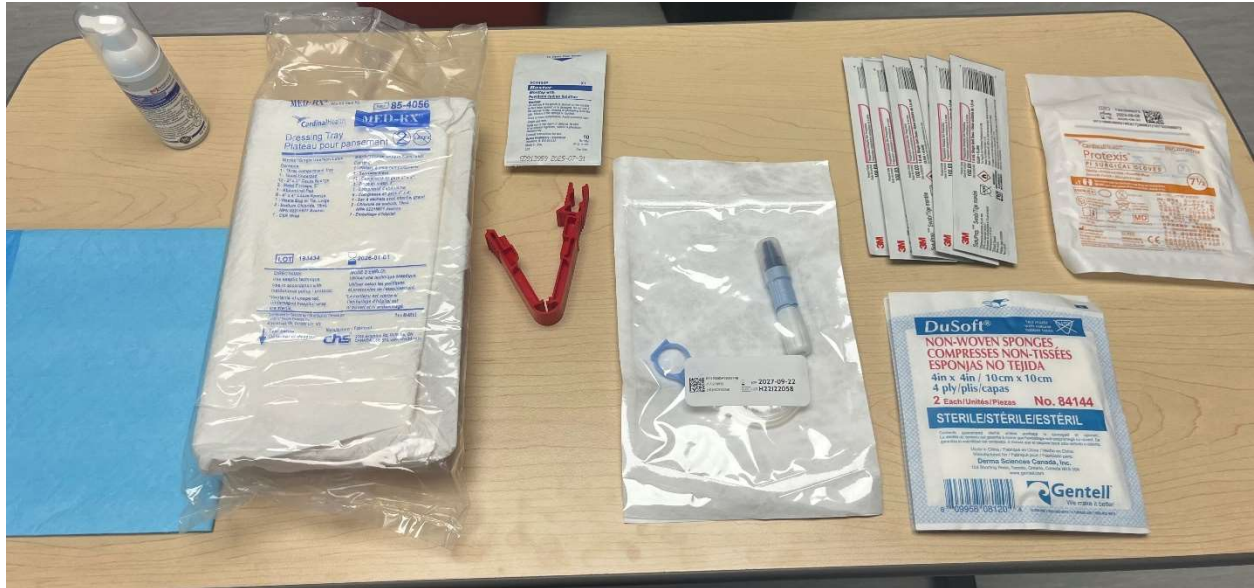

Supplies:

- 2 – Mini Caps

Procedure:

1. Place the new Mini Cap on the end of the transfer set.

2. Allow the Mini Cap to sit for 15 minutes.

3. After 15 minutes, remove the Mini Cap and replace it with a new one.

4. Monitor for signs and symptoms of peritonitis.

Wet Contamination

Wet contamination is also called an accidental disconnect, which occurs when the transfer set is inadvertently dislodged from or falls off the peritoneal dialysis catheter (Counts, 2020).

Supplies:

- 70% alcohol and paper towel

- Red clamp

- Transfer Set

- Mini Cap

- Dressing Tray

- Chlorhexidine 2% Solution (or as per manufacturers' recommendations)

- Sterile gauze

- Sterile Gloves

Procedure:

1. Immediately clamp the catheter with a red clamp (pinch catheter if clamp is unavailable).

2. Wrap the end of the catheter in sterile gauze while you prepare your supplies.

3. Gather supplies.

4. Place a clean towel or a blue pad at the end of the catheter.

5. Clean the working surface using a disinfectant wipe per organization policy.

6. Prepare supplies using an aseptic technique.

7. Pour Chlorhexidine 2% solution onto gauze in a sterile dressing tray.

8. Mask and perform hand hygiene for 1 minute.

9. Don sterile gloves.

10. Close the clamp on the new Transfer Set.

11. Apply a sterile drape over the patient and expose the catheter.

12. Wrap the first chlorhexidine-soaked gauze around the exposed catheter adapter, scrub for 1 minute, and hold it in place.

13. Clean with a second chlorhexidine-soaked gauze from the exposed catheter adapter towards the patient up to the red clamp and discard.

14. Attach a new Transfer Set to the patient's catheter.

15. Remove the red clamp and open the Transfer Set twist clamp, allowing fluid to drain and displace the air.

16. Close the twist clamp of the Transfer Set.

17. Attach new Mini Cap to Transfer Set.

18. Attach the Transfer Set to the peritoneal dialysis catheter. After applying the new Transfer Set, monitor for signs or symptoms of peritonitis and contact the nephrologist for further direction.

19. Document this procedure as per the organization's policy.

Inflow & Outflow Issues

Non-infectious complications of PD include catheter obstruction, which can be inflow or outflow obstruction (Counts, 2020). When this happens, effluent may not be able to be drained from the abdomen, or fresh fluid will not be able to be instilled. If patency is not restored after troubleshooting techniques, notify the nephrologist for direction. Troubleshooting techniques are listed in the table below:

Table 3

Catheter Obstruction

Catheter Obstruction		
Inflow or Outflow Obstruction	Cause	Intervention
	• External kinks or clamps. • Kinks in the catheter subcutaneous tunnel. • Kink in the intrabdominal segment. • Clots/Fibrin • Constipation	• Make sure proper clamps are open. • Ensure no kinks in the catheter or tubing. • Change position (i.e., side to side, sit up, lay down) • Change the entire setup. • Administer Alteplase/Heparin (as ordered). • Ensure the patient is not constipated.

Note. Adapted from Core Curriculum for Nephrology Nursing, by C. Counts, 2020, p. 1166

Note. There are clamps on both the fill line and the drain line, which means the fluid cannot fill
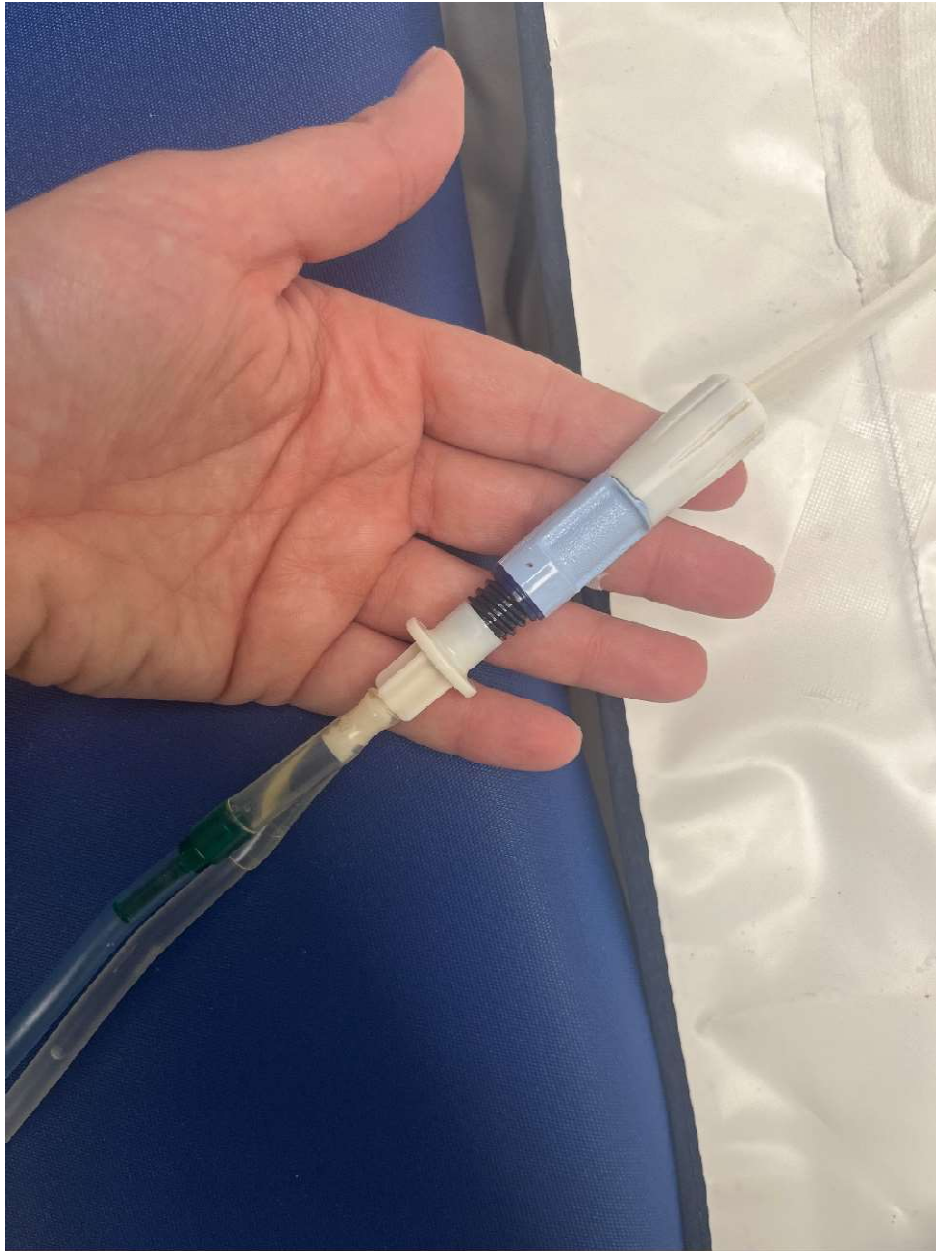
or drain.

Note. The transfer set is closed, which means that fluid cannot fill or drain.

Titanium Adapter Change

Reasons for changing the peritoneal dialysis catheter adapter include the original adapter being

cracked or damaged, the adapter being loose or disconnected from the PD catheter, and a hole in

the catheter tubing near the adapter (BC Renal, 2024; Counts, 2020).

Supplies:

- Chlorhexidine gluconate 2%, chlorhexidine 2% swaps/sticks or hospital-approved

  antiseptic solution

- Sterile tray

- Transfer Set

- Mask

- Mini Cap

- Locking Titanium Adapter

- Sterile Scissors

- Sterile Gloves

- Sterile Metal Forceps or Tweezers

- Smooth-edged scissor clamp or red clamp

Procedure:

1. Apply mask to nurse and patient.

2. Perform hand hygiene.

3. Open the sterile tray and add all supplies.

4. Place a clamp on the catheter above the adapter or damaged area of the catheter. Ensure the twist clamp is closed on the transfer set.

5. Don sterile gloves.

6. While holding the transfer set in one hand, scrub the titanium with chlorhexidine-soaked gauze or swabs for approximately 30 seconds.

7. Dry the connection with sterile gauze.

8. Perform hand hygiene and don sterile gloves.

9. Holding the old transfer set with sterile gauze, drape the abdomen to create a sterile field and place a clean catheter on the drape.

10. Carefully remove the old titanium.

    NOTE: If the adapter cannot be removed without damaging the PD catheter, it may need to be cut off. If a leak in the catheter has been detected, cut the catheter 1cm proximal from the adapter, crack, or perforate using sterile scissors. Do not stretch the catheter tubing when attempting to remove the adapter. Ensure the

edges of the catheter are cut straight and smooth to permit easier insertion of the new adapter.

11. Insert new adapter Titanium adapter:

    - insert the small non-threaded end of the locking adapter sleeve onto the catheter.

    - Insert the titanium adapter into the catheter up to the shoulder until the entire tail is covered. Inspect the catheter for any tears in the PD catheter end to ensure a secure fit.

    - Slide the sleeve portion of the titanium adapter onto the catheter and screw the sleeve onto the titanium adapter until firmly seated and the connection is tight.

12. Aseptically attach the new transfer set with a new minicab to the new adapter and close the roller twist clamp on the transfer set.

13. Remove the clamp on the PD catheter.

14. Remove the sterile drape and perform exit site care and dressing change if applicable.

15. Secure the catheter to the abdomen with tape.

Increased Intraperitoneal Pressure (IPP)

Peritoneal dialysis fluid can cause an increase in intraabdominal pressure proportionate to the volume of dialysis solution instilled (Counts, 2020). **If you suspect IIP, notify the nephrologist immediately.**

Increased intraabdominal pressure is a risk factor for:

- Dialysate leaks

- Hernias

- Hemorrhoids

- Compromised pulmonary function.

- Vagal stimulation, leading to bradycardia.

Common symptoms include:

- Feeling full, bloated, or overfull

- Abdominal pain or discomfort

- Expanded or tense abdomen

- Vomiting

- Nausea

- Decreased appetite

- Localized swelling around the PD catheter exit site, belly button, groin, or genital area.

- Leakage of fluid from the PD catheter exit site.

- Difficulty breathing

- Sudden increase in blood pressure

- Overfilling or not draining adequately may result in excess fluid in the abdomen.

Module 7: Peritonitis

Peritonitis is an infection of the peritoneum or the membrane lining of the abdominal cavity. Over 50% of peritonitis infections happen because of a break in technique during CAPD exchanges (Counts, 2020). Intestinal irritation (cysts or constipation), untreated exit sites, tunnel infections, or dental infections can also lead to peritonitis (Counts, 2020).

This module covers the following topics:

- Signs & Symptoms of Peritonitis
- Microbiology Specimens
    - Culture & Sensitivity
   - Treatment

Signs of Peritonitis

- Cloudy Effluent

- Abdominal pain, tenderness, or cramping.

- Possible fever.

- Nausea, vomiting.

Per physicians' orders or organizations' policies, samples of cloudy effluent must be collected and processed at the microbiology laboratory.

Microbiology Specimens

Typical tests completed to diagnose peritonitis are:

1. Cell Count & Differential

2. Culture and sensitivity (C&S)
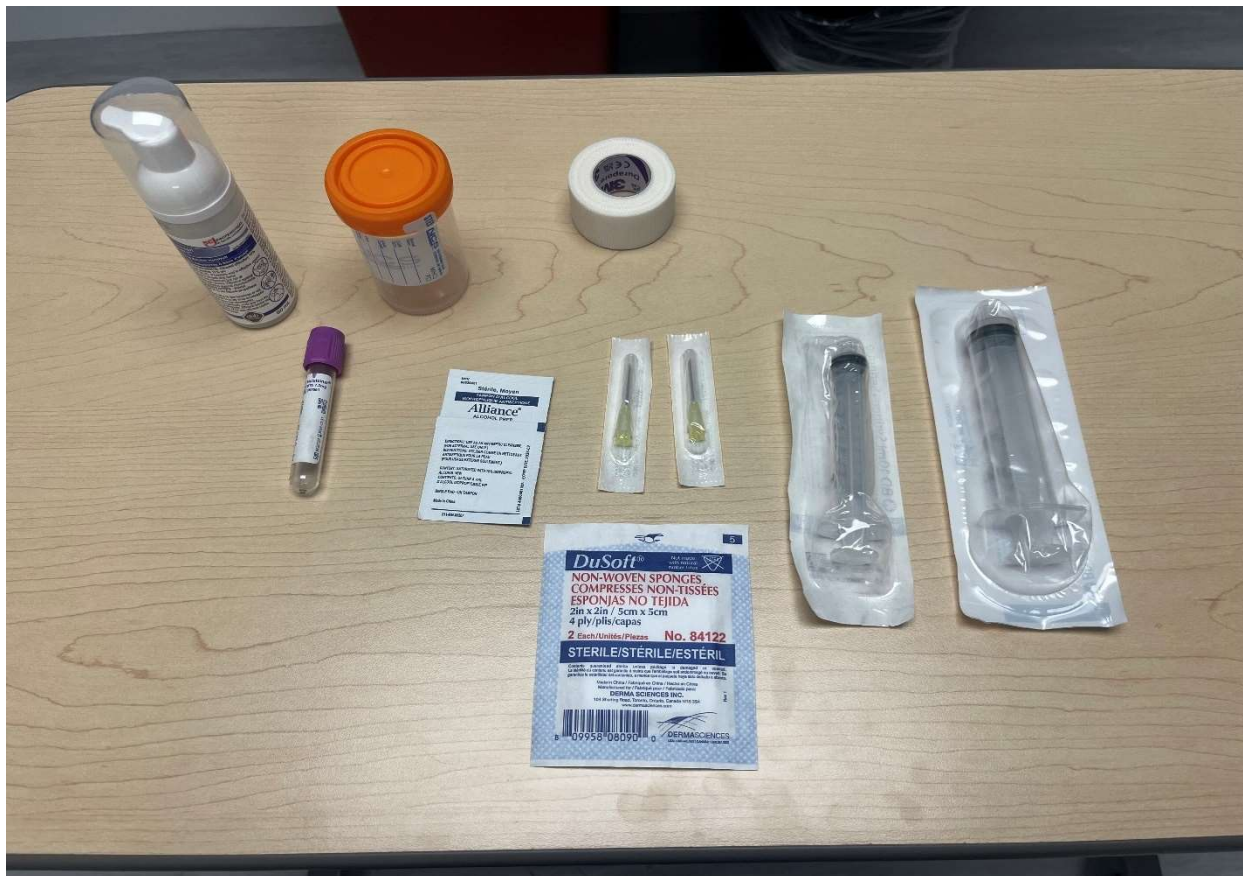
Supplies:

- Pink top specimen bottle (as per organization)

- Lavender top tube (as per organization)

- 2 - Needles

- 2 - Alcohol swabs

- Tape

- 2x2 gauze

- 30 ml syringe

- 10ml syringe

Procedure:

1. Perform hand hygiene and collect supplies needed.

2.. Place the drain bag on a clean table.

3. Attach a needle to the 30ml syringe.

4. Remove the pink cover of the specimen bottle and place the cover face up on the table.

5. Using an alcohol swab, swab the sample port of the effluent bag.

6. Using a 30ml syringe with an attached needle, withdraw 30ml from the clean port of the bag, put it in the pink-topped specimen bottle (or whatever the organization uses), and tightly cover the bottle. This is your **C&S** sample.

7. Clean the port again with an alcohol swab. Using the 10ml syringe, withdraw 5ml from the clean port of the bag and put it in a lavender top tube (or whatever the organization uses). This is your **cell count and differential**.

8. Label your tubes and collection containers per the organization's policy and send them to the laboratory.

8. Peritonitis is typically **treated with antibiotic therapy**. The nephrologist will prescribe the drug and dosage. Please refer to Module 4 for instructions on administering medications via peritoneal dialysis (BC Renal, 2024; Counts, 2020).

References

BC Renal (2024). *Peritoneal Dialysis*. BC Renal. Retrieved May 22, 2024, from

   http://www.bcrenal.ca/health-professionals/clinical-resources/peritoneal-dialysis

Counts, C. S. (2020). *Core Curriculum for Nephrology Nursing,* (7th ed., Vol. 2).

   American Nephrology Nurses' Association.

Appendix E

Development of Peritoneal Dialysis Videos for Registered Nurses

Peritoneal Dialysis Videos

Video: Catheter Care	• Exit-site Care/Dressing Change • Mini-Cap Change • Transfer Set Change • Exit-site Infections
Video: Peritoneal Dialysis Prescription	• Dialysate Types • Dialysate Concentration • Fill Volume • Dwell Time • Exchange Frequency
Video: Peritoneal Dialysis Medications	• Heparin • Alteplase (Cathflo) • Antibiotics

Video: Peritoneal Dialysis Exchange	• Exchange Technique
	   o Drain
	   o Fill
	   o Dwell

Video: Complications	• Dry Contamination • Wet Contaminations • Inflow/outflow issues • Titanium Change/Catheter Damage • Increased Intraperitoneal Pressure (IIP)
Video: Peritonitis	• Signs & Symptoms of Peritonitis • Microbiology Specimens o Culture & Sensitivity • Treatment

References

BC Renal (2024). *Peritoneal Dialysis*. BC Renal. Retrieved May 22, 2024, from

http://www.bcrenal.ca/health-professionals/clinical-resources/peritoneal-dialysis

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