PROVINCIAL STANDARDS & GUIDELINES

BCRenal

Peritoneal Dialysis Resources
for Rural Remote Community Care Facilities

Created May 2020

Approved by the BC Peritoneal Dialysis Committee

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Section 1:
Introduction to Peritoneal Dialysis

This learning resource and accompanying care paths, video modules and procedure templates have been developed to assist non-renal clinical staff who may be required to treat peritoneal dialysis patients exhibiting dialysis associated complications in the community environment.

The role of normal kidney functions includes:

- Regulation of electrolytes
- Maintenance of acid base balance
- Regulation of fluid balance
- Removal of waste products
- Production of hormones

Some factors which may contribute to the decline of renal function include:

- Diabetes
- Surgery (aneurysm, cardiac related)
- Drug toxicity (anti-inflammatory, antibiotic, radiologic dye)
- Cancer
- Hypertension
- Genetically inherited diseases
- Ischemic nephropathy (cardiovascular disease, myocardial infarction)

When kidneys are damaged, normal kidney function is impaired. Treatment for early stages of kidney disease consists of medication and diet management. However, if the kidney function continues to deteriorate to less than 10 - 15%, treatment options such as dialysis, transplant or conservative management will be required. The two types of dialysis options are peritoneal dialysis and hemodialysis.

What is Peritoneal Dialysis (PD)?

When normal kidney function fails, the regulation of acid base balance becomes problematic and the process of removing waste products, excess water, and electrolytes is impaired. These processes are replaced by a medical treatment referred to as dialysis. Peritoneal dialysis works inside the body, using the peritoneal membrane as a natural filter to remove wastes, water and adjust blood chemistry. PD is the process of instilling a solution called dialysate, into the peritoneal cavity via a catheter. The dialysate stays (dwells) inside the body to allow time for dialysis to occur. In PD the capillaries in the peritoneal membrane act as the semi permeable membrane.

Peritoneal dialysis is considered a self-care treatment performed daily by the patient or their support in the home environment.

Benefits of home-based therapy:

- Flexibility
- Ability to travel
- More autonomy in care
- Higher transplant rates
- Less prohibitive in terms of dietary restrictions
- Less time travelling to treatment centre
- Less morbidity

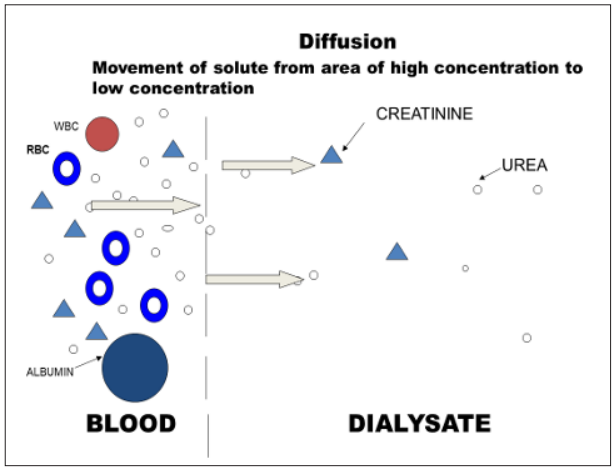
How does Peritoneal Dialysis work?

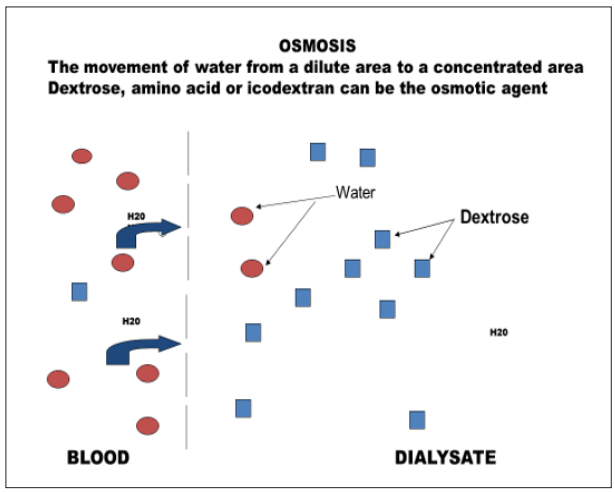
PD works inside the body using the peritoneal membrane as a natural filter to remove wastes from the bloodstream. The lining of the abdominal/ peritoneal cavity is made of capillaries, connective

tissue and cellular layers which all act as a selective permeable membrane. Different sized pores allow molecules of different size to pass through via diffusion and osmosis.

Diffusion is the movement of small and middle-sized molecules and is referred to as clearance. The primary biochemical changes that occur through diffusion are: potassium, phosphate, urea, and creatinine which move from the bloodstream to the dialysate in the peritoneal cavity. Bicarbonate and to some degree calcium move from the dialysate to the bloodstream.

Osmosis is the movement of water and is referred to as ultrafiltration. Water will move depending on the concentration the bag – this will be discussed later in the module.

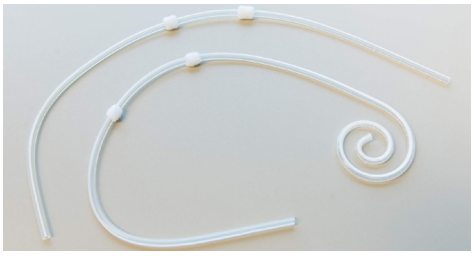




Key Learning Points

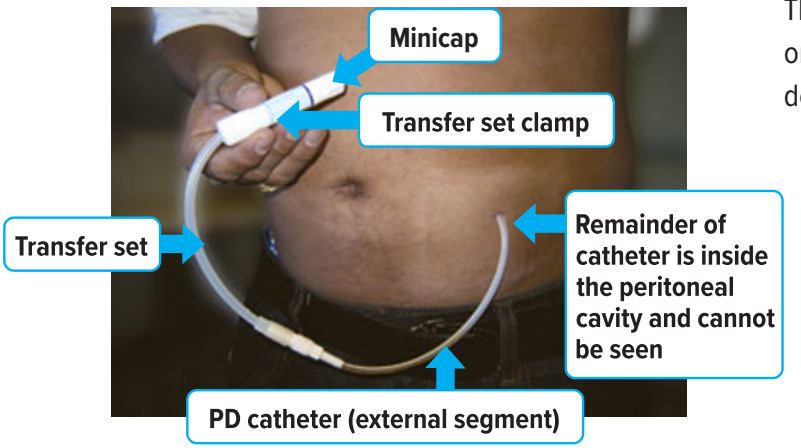
- PD is a life-sustaining therapy for those with end-stage renal disease. PD helps to filter waste products and fluid removal which the kidneys would usually do.
- The solutes and water move down a concentration gradient and will eventually reach equilibrium.
- PD is a form of dialysis in which diffusion and osmosis occurs inside the body.
- Dialysate is instilled into the peritoneal cavity and left to dwell.
- The peritoneal membrane acts as the semi-permeable membrane and allows small and middle sized molecules and water to cross.
- In biochemical terms dialysis will correct electrolytes and acid base balance, and regulate volume (and subsequently blood pressure)

PD Access

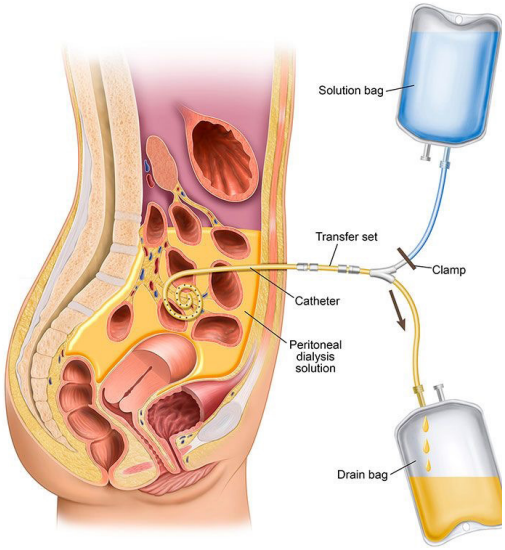


A silicone catheter is inserted laparoscopically or percutaneously into the peritoneum to allow access to the peritoneal cavity for instillation and removal of dialysate. The PD catheter is typically double cuffed, with the interior cuff placed deep in the abdominal wall and the external cuff in the subcutaneously tissue. The cuffs cause fibrosis to develop around them which helps the catheter stay in place.

This catheter is the patient's lifeline and patients are educated to treat it this way. Specific education is provided focusing on correct catheter care and monitoring. The PD catheter is attached to a transfer set which reduces wear and stress on the PD catheter and helps regulate the flow of dialysate fluid in and out of the peritoneal cavity. The transfer set facilitates a safe and easy connection to both CAPD and CCPD systems. The end of the transfer set is protected between uses by a sterile minicap. The minicap is lined with a small betadine-soaked sponge and is replaced by the client with each exchange.



In a process called an exchange, dialysate fluid is instilled into the peritoneal cavity via the PD catheter. The dialysate fluid is left to dwell for several hours to allow dialysis to occur. After a specific dwell time, the effluent is drained from the peritoneal cavity. This process is repeated over a 24 hour time period 7 days/week. PD solutions called dialysate and ancillary equipment are required to perform an exchange.



The two methods of performing peritoneal dialysis are Continuous Ambulatory Peritoneal Dialysis (CAPD) and Continuous Cycling Peritoneal Dialysis (CCPD). There may be clinical indications to recommend one over the other, but ultimately it is the patient's decision. Most patients in BC are on CCPD.

CAPD and CCPD

Continuous Ambulatory Peritoneal Dialysis (CAPD)

CAPD is a continuous daily process. CAPD exchanges are generally performed 4 times per day. The fluid is left to dwell in the peritoneal cavity for 4-6 hours during the day and longer overnight to allow for sleep. Each exchange typically takes about 45 minutes in total.

There is always fluid in the patient's abdomen 24 hours/day. CAPD utilizes a twin bag PD system. Outlined below is the typical procedure of an exchange:

1. **Connect to the twin bag system.**
2. **Drain** – draining the dialysis solution out of the peritoneal space through a catheter into a drain bag. This process drains existing fluid and waste products from the peritoneal cavity
3. **Fill** – instilling the peritoneal cavity with fresh dialysis solution fluid from a fill bag. Solution enters through a catheter that has been surgically placed through the wall of the abdomen and into the peritoneal cavity.
4. **Disconnect /Dwell** – the dialysate is allowed to remain in the cavity for a specific period of time. During this time, waste products and fluid pass from the bloodstream through the peritoneal membrane and into the dialysis solution.

CAPD can be done without electricity and all patients are trained on CAPD so that they have a backup system, in case of prolonged electrical outages. The number or frequency of exchanges, how long the dialysate remains in the peritoneal cavity, and the type of dialysate is determined by the nephrologist.

1. Connect

2. Drain

3. Fill

4. Disconnect/Dwell

Continuous Cycling Peritoneal Dialysis (CCPD)

All peritoneal dialysis techniques that use a cycler to perform exchanges are referred to as Automated Peritoneal Dialysis (APD). CCPD is one form of APD that involves the use of a cycler that automatically controls the exchange process. CCPD is performed at night while the patient is sleeping, and the number of exchanges, length of dwell, and fill volumes are preset into the cycler. The cycler follows the same exchange sequence as a CAPD exchange and is specifically programmed for the patient's needs. The cycler runs continuously on average each night for 8 – 9 hours. At bedtime, patients attach the cycler tubing to their peritoneal catheter and turn on the cycler. The cycler then performs dialysis exchanges during sleep. In the morning, patients disconnect themselves and go about their day. In some cases, patients may be required to have an additional PD exchange during the day to ensure that they are receiving an adequate amount of dialysis to keep them as healthy as possible.

Key Learning Points

- There are two PD modalities – CAPD and CCPD.
- CAPD involves the patient manually doing their exchanges, usually 4 times per day.
- CCPD involves a programmed machine at night to deliver dialysis leaving the day free.
- There are a few clinical situations where one modality would be medically recommended over the other, but in most situations the patient decides which they prefer.

The PD prescription

The PD prescription is individualized for each patient and considers several different factors. The prescription will be ordered by the patient's nephrologist and will identify:

- Dialysate solution type
- Dialysate solution strength
- Dialysate solution volume
- The number of exchanges to perform
    - The patient and their support person have been taught how to adjust the strength of solution to be used based on their fluid status

Dialysate solutions

There are different types of dialysate solutions which help to enhance fluid removal, neutralize pH, and meet nutritional needs in the body. There are two main types of dextrose based dialysate solutions. Dianeal and Physioneal. Each type comes in various dextrose concentrations. Extraneal 7.5% or Icodextrin is an additional specialty solution. Each patient has a unique dialysis prescription decided by the nephrologist which includes the volume, frequency and concentration of the dialysate solutions to be used.

Dianeal

- Most commonly used dialysis solutions are available in a variety of concentrations and volumes. The concentrations reflect the amount of dextrose in each bag: 0.5%, 1.5%, 2.5%, and 4.25%.
    - 1.5% will remove very little fluid from the patient. This solution is commonly used to maintain a patient at their target weight.
    - 2.5% will remove more fluid from the patient. This solution can remove up to 500 mL of fluid per dwell and may be ordered if the patient is above their target weight.
    - 4.25% will remove larger amounts of fluid from the patient. This solution may remove up to 1000 mL of fluid per dwell and may be ordered if the patient is above their target weight.
- Dianeal is available in bags that range from 1500cc – 5000cc in volume.

Physioneal

- Physioneal has a neutral pH which is clinically beneficial for patients who experience pain associated with inflow of dialysate.
- Physioneal is different from Dianeal as the fill bag has two chambers with a breakable seal between them. This seal must be broken to allow mixing of the compartments prior to filling the patient. Once mixed the dialysate solutions will become unstable over time and must be infused within 4 hours.
- Available in dextrose concentrations of 1.36%, 2.27%, and 3.86% and comes in volumes from 2000ml to 2500ml.
    - 1.36% will remove very little fluid from the patient. This solution is commonly used to maintain a patient at their target weight.
    - 2.27% will remove more fluid from the patient. This solution may remove up to 500cc per dwell and may be ordered if the patient is above their target weight
    - 3.86% will remove larger amounts of fluid from the patient. This solution may remove up to 1000cc per dwell and may be ordered if the patient is above their target weight.

Extraneal or Icodextrin 7.5%

- Used to increase fluid removal. Prescribed as the daytime dwell for the patient on CCPD or the night dwell for CAPD
- Prevents carbohydrate absorption which may be beneficial for management of diabetes

Key Learning Points

- Peritoneal dialysis is a home-based therapy with many benefits including lifestyle flexibility and autonomy in care.
- Peritoneal dialysis involves instilling dialysate into the peritoneum via a catheter
- There is a short period of training involved which allows patients to develop skills in a structured manner under supervision
- Patients are taught to perform all aspects associated with performing PD therapy.
- A dialysis prescription includes information specific to dialysate volume, concentration of dialysate as well as number and timing of exchanges

Section 2:
Assessing and Managing the Patient on Peritoneal Dialysis

PD patients may seek out medical support in the community when experiencing health concerns that may be 1) PD-related or 2) non PD-related. Section 2 provides information to assess and treat patients assessed with PD related complications. Refer to the website for information and care paths to assess and treat patients with PD related complications. BCRenalAgency.ca ▶ Health Professionals ▶ Clinical Resources ▶ Peritoneal Dialysis ▶ Rural Remote

Clinical Care Path:
Assessment and Management of a PD Patient for PD vs. Non PD-related Complications

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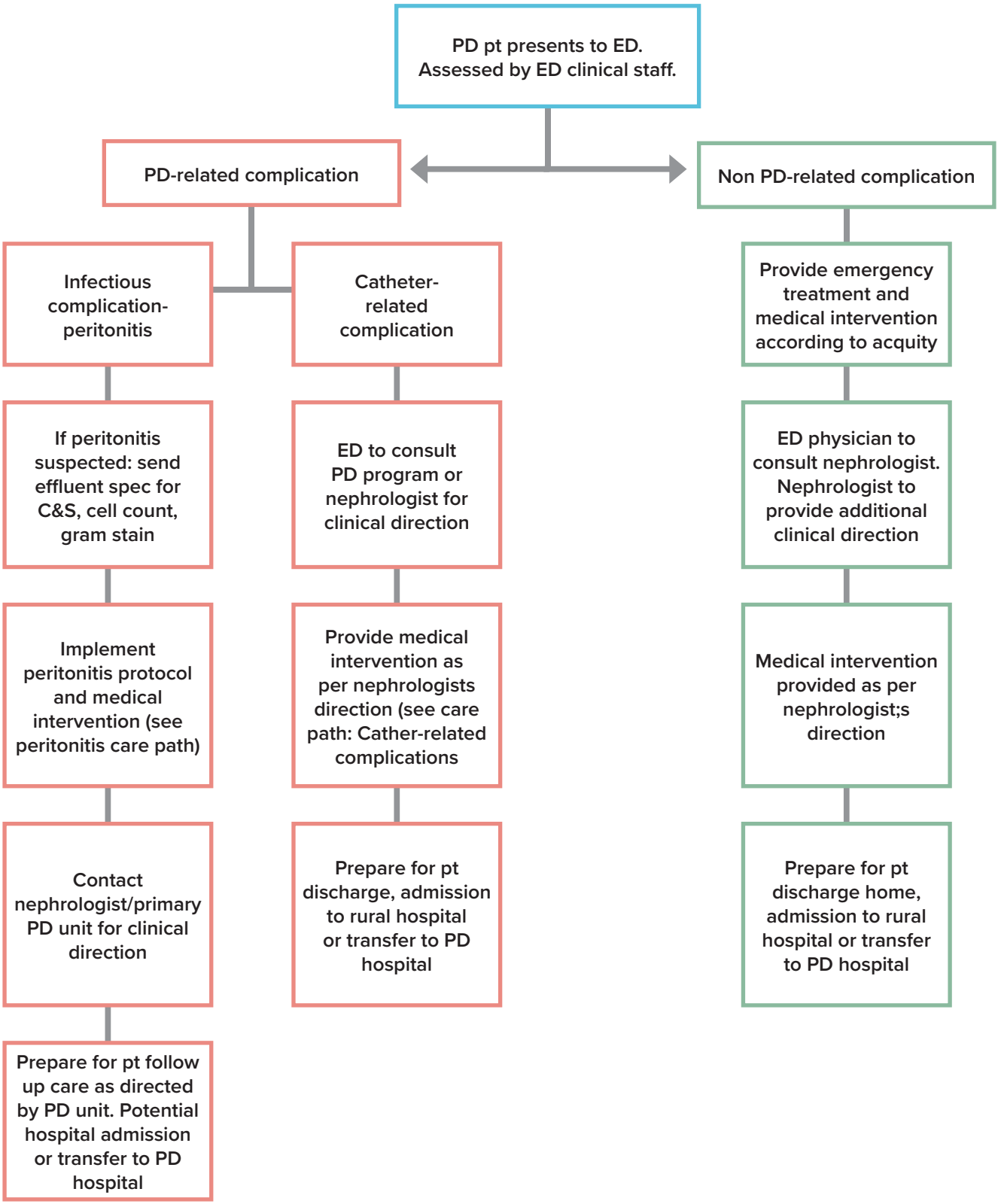

Flow-related Complications

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Flow-related Complications

- In flow/out flow problems
  - Mechanical issues (often catheter related)
  - Constipation (bowel management)
  - Hernias
  - Leaks
- Patient technique failure
- Fluid management

Mechanical Complications

Catheter mechanical complications fall into 2 primary categories:

- inflow and outflow problems
- catheter malfunction

The PD catheter is positioned to sit low in the pelvic brim to allow minimal discomfort and maximal function. In this position, gravity will assist draining of the PD fluid with less likelihood of omental wrapping. The most common problems of catheter malfunction are issues with inflow and outflow. The diagnosis can often be found with history, examination and watching the patient perform a PD exchange.

The inability to either drain or infuse dialysis solutions can be caused by:

  - Constipation
  - Blood or fibrin clots
  - Air lock
  - Catheter tip migration
  - Omental wrap
  - Kinked or clamped catheter
  - Intraperitoneal adhesions
- Outflow failure – the drainage volume is substantially less than the inflow volume and there is no evidence of pericatheter leakage. Usually occurs soon after catheter placement. Often preceded by irregular drainage, increased fibrin in the dialysate or constipation
- Inflow failure – solution will not flow from the dialysate bag into the peritoneal cavity.

Most of the complications of catheter dysfunction are related to outflow issues and often result from inadequate bowel activity. (see bowel management care path) However, there are other causes that should be considered, especially if no improvement is seen with good bowel activity. Commonly these include hernias and leaks.

Hernia

- Hernia formation is a mechanical complication of PD that occurs as a result of intra abdominal pressure (IIP) from instillation of dialysis fluid into the peritoneal cavity. The increased pressure leads to increased tension of the abdominal wall and the potential for hernia formation in areas of weakness. Inguinal (direct and indirect), pericatheter, ventral, umbilical and epigastric are common locations for hernia formation.

Risk factors for hernia formation may be related to:

- Large dialysis solution volumes
- Sitting position
- Isometric exercise
- Valsalva maneuver
- Recent abdominal surgery
- Previous hernia repair
- Obesity
- Congenital anatomical defects

Dialysate leak

A dialysate leak is the loss of dialysate outside the peritoneal cavity through a route other than the lumen of the peritoneal catheter. The loss of dialysate from the peritoneal cavity occurs as the result of a loss of integrity of the peritoneal membrane.

Dialysate leaks may occur:

- From catheter exit site
- Extravasation into the subcutaneous tissues resulting in abdominal wall or genital edema.

Risk factors for leakage may be related to:

- Catheter insertion technique
- Catheter design
- Time between catheter insertion and initiation of PD
- Condition/weakness of the abdominal wall

Increased intra-abdominal pressure (IIP)may exacerbate the potential for both hernias and leaks. IIP may result from the instillation of dialysate into the peritoneal cavity.

The magnitude of the increase in intra-abdominal pressure depends upon:

- Volume of dialysate instilled
- Position of the patient (sitting>standing>supine)
- Age, body mass index
- Coughing, lifting, straining

Clinical Care Path:
Flow-related Complications

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Patient presents with difficulty draining, difficulty filling, difficulty filling and draining

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Assess patient exchange technique: are all clamps open? Is there fluid in the abdomen to drain? Consider a trial of filling patient with 500 ml of 1.5% PD dialysate and try to drain

Difficulty draining (technique OK)

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Assess bowel function. Initiate bowel care path if required

↓

Book x-ray to determine catheter position and consult primary PD unit

↓

Assess for hernias and other signs of dialysate leaks (swelling, bulging, pitting edema, weight gain, moisture at ES

↓

Consult primary PD unit if leaks/hernia is suspected or present.organize imaging if there are signs of leak or hernia

↓

If bowels are moving and no signs of leak, consult primary PD unit for treatment direction

Difficulty filling (technique OK)

↓

Consider that catheter may be blocked, most commonly with fibrin

↓

Consult primary PD unit for treatment direction

Difficulty filling and draining (technique OK)

↓

Consider that catheter is occluded or wrapped in omentum

↓

Book x-ray to confirm catheter placement

↓

Consult primary PD unit for treatment direction

Mechanical Complications Related to Constipation: Bowel Management

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A primary cause of mechanical complications resulting in difficulty filling or draining is constipation. The position of the PD catheter is maintained low in the pelvis by peristalsis of the intestines. Gut health and regular bowel movements are crucial to maintain catheter function and position. Unfortunately, constipation is very common in patients on peritoneal dialysis caused by dietary and fluid restriction, medications, potentially older age of some patients, and a more sedentary lifestyle.

Patients on peritoneal dialysis are expected to have a bowel movement at least daily with the aim of soft stool but not diarrhea. (i.e. Bristol Stool Scale 3 or 4) Patients are instructed to use medication in a stepwise manner if required to ensure proper bowel function. The following care path suggests management of non-emergent constipation.

If the patient presents with acute absolute constipation with any red flag features; severe pain, vomiting, signs or symptoms of peritonitis, or per rectal bleeding they should be treated as an acute abdomen and managed and investigated appropriately.

Clinical Care Path:
Bowel Management

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Step 1: Ensure adequate hydration with enough dietary fiber within restrictions.
Recommendation for daily fiber intake is 20-38g. If this cannot be achieved through diet fiber, supplements such as psyllium husk can be utilized with success. This is less likely to affect phosphate absorption but recommend dietary consultation as soon as able.

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Step 2: Stool softeners
Increases the amount of water in stool to make it easier to pass. Most patients will be on daily stool softeners
Typical regimes: Docusate 200mg PD daily

↓

Step 3: Stimulant laxatives;
Irritates sensory nerve endings to stimulate colonic motility and reduce water absorption.
Typical regimes: Sennosides 2 tabs at night

↓

Step 4: Osmotic laxatives
Draws water into intestine to hydrate and soften stool (more aggressive than softeners). Patients have access to these at home. Patients will not require daily use but may have a regime with regular use of an osmotic agent.
Typical regimes:
PEG 17g (1 sachet) - 2 sachets daily
Lactulose 10ml - twice daily
These can be escalated until bowels are working well.

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Step 5: Suppositories/enemas
Additional suppositories such as bisacodyl and glycerol can be utilized if bowels have still not moved. Enemas can also be utilized but phosphate containing enemas such as Fleet™ should be avoided.

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Step 6: Further investigation/hospital admission.
Investigating mechanical bowel issues should be explored if bowels have not moved after above input with subsequent inflow/outflow problems. If there are any clinical concerns an abdominal X-ray will provide quick screen - this will hopefully clarify presence of fecal loading versus other intra-abdominal pathology. The patient may require a hospital admission. The PD Unit should be informed.

Catheter Integrity Malfunction

Catheter integrity malfunction can include breaks or leaks on the catheter or transfer set.

A crack or tear in the PD catheter is less common and more difficult to manage. Sometimes the catheter can be shortened but this is a procedure that would only be undertaken by a PD nurse or nephrologist. In some circumstances, the catheter may need to be replaced. **The primary PD team or on-call nephrologist should be contacted urgently.** They may recommend a sterile temporary patch and delivery of intraperitoneal antibiotics or may request intravenous antibiotics.

- A soft toothed clamp (or forcep protected with 4x4 gauze) should be placed between the patients exit site and the catheter tear.

Cracks involving the transfer set or leaks at the connection site are more common and can be dealt with more easily. The patient should be treated as having a contamination and the transfer set should be changed. The patient should have a transfer set in their emergency kit. The primary PD unit should be notified.

Contamination

Related links:

- Performing a Twin Bag Exchange video & procedure
- Transfer Set Change video & procedure
- Collecting a Dialysate Effluent Specimen procedure

Contamination resulting from a break in technique is defined as either a wet contamination or dry contamination. Contamination at the time of a PD treatment can lead to peritonitis. Contamination occurs when sterile connections are exposed to pathogens either by touch or by air.

Contamination in the PD procedure is considered a wet contamination when a break in aseptic technique results in fluid flowing into or out of the transfer set. This may occur when the fluid filled tubing system is accidentally opened or unclamped.

- Examples:
  - Disconnection between the transfer set and the catheter at the connector
  - Leak or break in the in the transfer set or the catheter
  - Any time the twist clamp on the transfer set is not closed and fluid escapes
  - Leak in the CAPD or APD dialysate solution bags or tubing resulting in the possibility of contaminated fluid infused into the patient

Dry contamination occurs when:

- The sterile ends of the PD tubing come in contact with non-sterile surfaces. There has been no fluid flowing into or out of the transfer set during this break. Examples include:
- Exposed end of clamped transfer set is dropped
- Exposed end of clamped transfer set is touched by non-sterile surface such as hands, clothing, bed sheets, table etc.
- Disconnection of the minicap

A dry contamination can generally be managed by placing a new minicap on the end of the transfer set and allowing it to remain in place for 10 minutes.

A wet contamination may require:

- A transfer set change,
- Effluent sent for cell count, differential and culture
- Empiric dose of intraperitoneal antibiotics as per peritonitis pathway.
- Notification of PD unit for treatment direction

Fluid Assessment and Management

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Peritoneal dialysis (PD) is a form of renal replacement therapy that enhances or replaces some of the kidney's functions in individuals with renal failure. This includes:

- salt and water balance
- blood pressure control both directly and indirectly.

As a person's residual renal function declines (which often correlates with the length of time they have been on PD) the role of dialysis in salt and water regulation increases. This can lead to clinical hypo or hypervolemia. Careful prescription management of the PD therapy is required as the patients clinical setting changes. Close assessment of the patients target or dry weight, BP and evidence of edema ensures that the patient maintains euvolemia.

TARGET or Dry Weight

Dry weight is weight without the excess fluid that accumulates between dialysis treatments. This weight is similar to what a person with normal kidney function would weigh after urinating. It is the lowest weight that can safely be reached after dialysis without developing symptoms of low blood pressure such as cramping and dizziness. These types of symptoms can occur when too much fluid is removed. Dry or target weight is determined by the nephrologist and can change depending on the patient's symptoms.

The PD prescription is composed of:

- A number of exchanges (regardless of CAPD or CCPD)
- Volume of PD solution. PD solutions are available in volumes from 1000cc to 3000cc. Most patients use 2000cc or 2500cc volumes
- Concentration or strength of PD solutions. Relates to the amount of dextrose in the PD solution which will result in the creation of a concentration gradient where water will move via osmosis into the peritoneum. Typically, higher concentrations of dextrose in the solution bags will allow more water to be removed from the body. This process is called ultrafiltration.

The standard PD solution concentrations are:

- 0.5% - (white pull ring) - 10g dextrose/2L - this is an uncommon concentration that is unlikely to be found outside of the peritoneal dialysis unit
- 1.5% - (yellow pull ring) - 30g dextrose/2L – commonly prescribed
- 2.5% - (green pull ring) - 50g dextrose/2L – commonly prescribed
- 4.5% - (red pull ring) - 70g dextrose/2L - less common but patients who have issues with fluid overload may use regularly
- 7.5% - (purple pull ring) bag - starch-based product which contains no sugar. Many patients use over a long dwell period of 12 hours. Icodextrin 7.5%/Extraneal will not move across the peritoneum because it is not a dextrose based solution. Most patients on PD in British Columbia will use 1 Icodextrin /day over a long dwell period of up to 12 hours. The remainder of the exchanges will be dextrose based regardless of whether they are on CAPD or CCPD.

A fluid assessment should be performed prior to performing a PD exchange. Patients are taught to assess their weight, BP, and fluid status to determine the correct solution to use. In an emergency, the PD patient may require assistance in selecting the appropriate solution from the community facility care team.

Clinical Care Path:
Fluid Assessment and Management

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Patient presents with fluid related complications:

- Hypovolemia:
  - Dry mucous membranes, increased tissue turgor, thirsty, underweight, hypotensive with orthostatic drop
- Hypervolemia:
  - Increased weight, decreased ultrafiltration, SOB, respiratory distress, hypertension, evidence of edema, raised JVP

Assess volume status:

Establish current prescription and goal weight from patient or primary PD unit

- General appearance: check mucous membranes, tissue turgor, thirst, weight
- Respiratory status: dyspnea, rate, O2 requirements, air entry
- Cardiovascular status: heart rate/rhythm, BP (lying and standing), edema (peripheral, sacral, facial)

Hypovolemia

- Investigate underlying causes
- Hold diuretics and antihypertensives
- Consider IV fluids/ boluses

- d/c use of any hypertonic PD solutions. Use 1.5% solutions

Hypervolemia

- Investigate for underlying cause
- Consider large dose of IV diuretics if pt produces urine (e.g. 120 mg furosemide trial)

- Use hypertonic PD solutions (2.5% or 4.25%)
- Ensure dwell times are at least 2 hours to ensure maximum ultrafiltration
- Consider addition of icodextrin 7.5%

Consult primary PD unit for prescription direction

Euvolemia- No obvious signs of hypo or hypervolemia

- Investigate alternative causes of systemic symptoms

- Continue with current PD prescription

Glycemic Control

The most common osmotic agent that allows for fluid removal via peritoneal dialysis is dextrose. Dextrose is biochemically identical to glucose. When higher strength concentrations need to be used for volume management a significant glucose dialysate/plasma concentration gradient is created which can result in glucose entering the body and leading to hyperglycemia. Similarly, if the patient is already hyperglycemic, using lower strength concentrations may cause water to move from the dialysate into the patient, especially if the dwell time is prolonged. This is called absorption.

As a rough guide 4g of dextrose is equivalent to 1 teaspoon of sugar.

The standard concentrations of PD solutions:
0.5% - dialysate bag with white ring pull - 10g dextrose/2L equivalent to blood sugar level of 27.8mmol/L

1.5% - dialysate bag with yellow ring pull - 30g dextrose/2L – equivalent to blood sugar level of 83.3mmol/L

2.5% - dialysate bag with green ring pull- 50g dextrose/2L – equivalent to blood sugar level of 139mmol/L

4.25% - dialysate bag with red ring pull - 70g dextrose/2L – equivalent to blood sugar level of 194.6mmol/L

Peritoneal dialysis can significantly impact glycemic control in people with diabetes. Diabetic PD patients are encouraged to check their capillary blood glucose regularly and will often need up titration of oral hypoglycemics and/or insulin after commencing peritoneal dialysis. Glucose is best managed by the patient's endocrinologist/diabetic nurse educator or family practitioner; however, a diabetic patients blood sugar level should be assessed when presenting to a community facility.

Catheter-related Infections

Dialysis related infections are complications in peritoneal dialysis patients that require immediate attention. Infections may be catheter related (CRIs) and/or peritoneal dialysis related peritonitis (PD peritonitis).

Catheter related infections:

- **Exit site infection** - infection around the area where the catheter exits the skin
- **Tunnel infection** - infection along the catheter tract that runs subcutaneously from the surface of the skin to the peritoneal membrane. It can lead to development of biofilm which can be difficult to treat.

Exit site and tunnel infections can occur simultaneously. Organisms that cause these infections are typically commensal skin organisms. CRIs can lead to PD related peritonitis.

Patients are taught to recognise the signs and symptoms of infection and are often the local experts! With patient consent it is often useful to take photographs to send to the primary PD unit. Patients clean their exit site daily and apply antimicrobial ointment, typically mupirocin or gentamicin as part of the exit site cleaning procedure.

Exit Site Infection - the presence of purulent discharge, with or without erythema of the skin at the catheter-epidermal interface. NOTE: erythema without other signs of infection may represent early infection or an allergic response. A positive culture without pus may represent colonisation - the local PD unit will help coordinate ongoing care.

Assessment:

- The area should be examined prior to cleaning. It should be assessed for: swelling, crusting, redness, pain, and drainage.
- Purulent discharge should be swabbed for **microscopy** (gram stain), **culture** (speciation) and (antimicrobial) **sensitivity**.
- Empiric oral antibiotics to cover staphylococcus aureus should be started in the presence of purulent drainage and particularly if there may be a delay in the gram stain result. This would typically be a penicillinase-resistance penicillin or first-generation cephalosporin.

Tunnel Infections - clinical inflammation or ultrasonographic evidence of abscess/collection along the catheter tunnel. Infection may start at the exit site and track up toward the peritoneum. This infection causes increased risk of developing PD associated peritonitis. Severe tunnel infections, especially with concurrent peritonitis can result in the need to remove/resite catheter. Primary PD units should be involved early if there is concern for a tunnel infection.

Assessment:

The patient may complain of pain, swelling or redness of tunnel over catheter with or without obvious discharge or exit site involvement. Initial assessment should focus on careful inspection and palpation of tunnel, including an attempt to “milk the catheter” to express purulent drainage from the exit site. Drainage should be swabbed and sent to microbiology for culture and sensitivity.

- Initial management and choice of empiric antibiotics is as per exit site infection.

If possible, the tunnel should be imaged by ultrasound or dedicated CT. If the patient consents, photographs can be helpful to monitor progress.

Related links:

- Collecting a Dialysate Effluent Specimen procedure
- Exit Site Care video & procedure
- Adding Medications video & procedure

Clinical Care Path:
Catheter-related Infection Management

BCRenal
Provincial Health Services Authority

Patient presents with exit site or tunnel related concerns.
- Exit site is assessed to have erythema, tenderness, bledding/crusting or purulent drainage.
- Tunnel has overlying edema, erythema or tenderness with evidence of drainage.

Tunnel Involvement

- Attempt to express drainage and swab for C&S
- Commence empiric antibiotics as per suggested regime below. Continue antibiotic coverage for 7 days and reassess
- Assess for S&S of peritonitis. Perform a CAPD exchange to determine if effluent is cloudy
- Send effluent specimens to lab if required as outlined in peritonitis care path.
- Notify primary PD unit

Exit Site: with drainage

- Swab for C&S
- Perform standard exit site care
- Commence empiric antibiotics as per regime below
- Notify primary PD unit

Exit Site: without drainage

- Often general inflammation/ allergy/granulation tissues can cause similar features Treat accordingly
- Recommend swabbing and starting empiric antibiotics if there are clinical concerns
- Notify primary PD unit

Most common antibiotic regimes for catheter-related infections:

Antibiotic	Dose	Frequency
Amoxicillin/clavulante	875mg/125mg	BID
Cephalexin	500mg	BID
Ciprofloxacin	500mg	Daily
Erthyromycin	250mg	QID

Peritonitis

Peritonitis is infection and inflammation of the peritoneal membrane and is a clinical diagnosis supported by microbiological testing. It is a complication of peritoneal dialysis and associated with high morbidity and even mortality. It can result in systemic infection, add to decreased longevity of the peritoneal membrane, or necessitate transition to hemodialysis, which in patients who do not live near a hemodialysis unit can mean a (potentially permanent) relocation.

The definition of peritonitis is a dialysate effluent white cell count of greater than 100 with 50% or more neutrophils/polymorphs in the context of the clinical suspicion.

The most common clinical signs of peritonitis are cloudy effluent (drained dialysate) and abdominal pain. Less commonly patients may also present with fever and other signs of systemic infection such as nausea or vomiting.

Patients are taught to examine the appearance of drained effluent for cloudiness if they have any abdominal pain. Patients are asked to present to the closest clinical facility if they are concerned about peritonitis. At the same time, they are instructed to notify the peritoneal dialysis unit. Ideally, they will present with a pre-drained bag of effluent.

If the patient presents with a clinical concern for peritonitis, effluent should be sent for microscopy sensitivity and culture. Empiric intraperitoneal (IP) antibiotics must be administered as early as possible and includes gram positive and gram-negative coverage. The antibiotic loading dose is generally instilled in a 2000cc, 1.5% Dianeal solution and left to dwell for at least 4 hours in the patient's peritoneal cavity to ensure absorption.

Like catheter related infections, most organisms resulting in peritonitis are gram positive commensal skin organisms or water borne organisms. The choice of antibiotic profile is PD unit specific, however the 2 most common regimes in British Columbia (and worldwide) are either: cephalosporin based regime which is dosed daily OR vancomycin and aminoglycoside based regime which is dosed every 3-5 days.

If there is concern that follow-up may not occur within 24 hours, a vancomycin-based regime should be considered.

The majority of patients with peritonitis can be managed as an outpatient. Reasons for admission would include signs of sepsis, inability to manage at home, severe pain, need for surgical intervention, uncontrollable glycemia, etc. The primary PD unit should be notified as early as possible. The PD unit will be able to provide advice for ongoing antibiotic therapy if they cannot provide the follow up themselves.

Related links:

- Collecting a Dialysate Effluent Specimen procedure
- Exit Site Care video & procedure
- Adding Medications video & procedure

Clinical Care Path:
Peritonitis Management

BCRenal
Provincial Health Services Authority

Patient presents with clinical concern of peritonitis.
Abdominal pain, cloudy effluent, fever, systemic features of infection.

Has the pt brought a bag/sample of effluent that has been dwelling for at least 2 hours?

Yes

Using aseptic technique, withdraw 100 ml of effluent into (2) 50cc sterile containers or follow PD unit directions

Send specimens to microbiology lab for: cell count and differential, gram stain, C&S. Label specimens as PD effluent peritonitis

Notify nephrologist on call or primary PD unit when results of STAT cell count are available

Administer IP antibiotics as per primary PD unit advice wherever possible. Contact should not lead to delay in administration of antibiotic loading dose.

No

Ask patient to do CAPD exchange and leave PD solution to dwell for at least 2 hours

Drain effluent and collect specimens

Typical antibiotic loading dose regimes are:

A) Vancomycin 30mg/kg up to 3g IP – round to nearest 250mg AND Tobramycin or gentamicin 1.5 mg/kg up to 160mg IP – round to nearest 40 mg
OR
B) B.Cefazolin 1-2gm (20mg/kg) and Ceftazidine 2 gm (20 mg/kg) AND Tobramycin or gentamicin 1.5mg/kg

Allow antibiotics to dwell for 4-6 hours

In some cases IV or PO antibiotics may be given. Contact Nephrologist for treament direction.

Notify the primary PD unit ASAP to arrange for ongoing antibiotic coverage and care

Section 3:
PD-related Procedures

Section 3 outlines the steps involved when performing the following PD-related procedures. A video and associated written procedure format is provided on the website. The patient/support should be encouraged to perform their own CAPD exchanges and exit site care when possible.
BCRenalAgency.ca ▶ Health Professionals ▶ Clinical Resources ▶ Peritoneal Dialysis ▶ Rural Remote

PD Procedures:
Adding Medication to Dialysate Solutions

VIDEO: *Adding Medication to Dialysate Solutions* video of this procedure can be found at: bcrenalagencymedia.ca/adding-medications

1.0 Practice Standard

The following procedure will be followed by the Health Care professional when adding medications to PD solution. Intraperitoneal or IP medication administration is an effective route for medication administration. The most common medications given by the intraperitoneal route are: antibiotics and heparin. Medications are added as per physician order to dextrose based solutions such as Dianeal or Physioneal unless otherwise ordered.

2.0 Supplies

- Sterile syringe of appropriate size
- 18g blunt needle or 21/22 gauge 1 inch sterile needle
- Alcohol swabs
- Medication to be added
- Medication label
- PD solution

3.0 Procedure

1. Gather supplies.
2. Choose the correct dialysate solution for strength, volume, expiry date, and clarity.
3. Warm the dialysate solution using a dry heat source. Do not heat the solution using water.
4. Remove the outer wrapper of the dialysate solution. Check clarity of the solution and ensure that there are no leaks.
5. Wash hands thoroughly.
6. Check that you have the correct medication by checking for the 7 rights of administration.
7. Prepare the medication as per facility policy.
8. Withdraw the prescribed amount of medication.
9. Using an alcohol swab, clean the medication port of the dialysate bag and allow to dry.
10. Inject the medication through the port of the dialysate bag maintaining aseptic technique confirming that the medication is injected fully into the PD solution bag.
11. Gently agitate the dialysate solution bag to distribute medication in the dialysate.
12. Label the dialysate solution bag indicating medication, dose, and time of instillation.
13. Proceed with the CAPD exchange using the dialysate solution with the instilled medication. Encourage the patient or caregiver to perform the CAPD exchange if possible. Notify the PD program to receive direction if the patient or family is unable to proceed with performing the CAPD exchange.
14. Allow the dialysate solution with antibiotics to dwell in the peritoneal cavity for 4-6 hours or as prescribed to ensure adequate absorption of the medication.
15. Document the procedure and medication added as per facility policy.

Disclaimer: Patient and PD program specifics must be considered when implementing procedures.

PD Procedures:
Exit Site Care

VIDEO:
Exit Site Care video of this procedure can be found at: bcrenalagencymedia.ca/exit-site-care

1.0 Practice Standard

The following procedure outlines the steps involved to perform a basic PD dressing change on a healed exit site. Indwelling catheters are at risk for the development of infections. Performing the outlined procedure promotes wound healing and minimizes the risk of infection of the peritoneal catheter exit site. The dressing for a healed exit site should be performed daily or a minimum of 3 times per week. It is important to encourage the PD patient or their family member to perform their own PD catheter exit site care when possible.

The PD unit will provide specific direction regarding the procedure for a sterile dressing change and the appropriate treatment for an infected exit site.

2.0 Supplies

- Chlorhexidine liquid soap or non antibacterial liquid pump soap
- Alcohol hand sanitizer
- Sterile 4x4
- Sterile 2x2
- Mepore dressing
- Cleansing agent (chlorhexidine soap, saline spray, non antibacterial liquid pump soap)
- Tape
- Immobilization device
- Antibiotic cream/ointment if ordered
- Swab for C&S if necessary

3.0 Procedure

1. Wash hands thoroughly using chlorhexidine pump soap on non-antibacterial liquid pump
2. Remove the old dressing gently using aseptic technique. Never use scissors or sharp objects to remove the dressing.
3. Assess the external exit site and the visible sinus and tunnel for: drainage type and amount), erythema, swelling, leakage, pain/tenderness, catheter integrity for holes, cracks or loose connector.
4. Re-cleanse hands with hand sanitizer.
5. Cleanse the exit site and under the catheter with the cleansing agent and gauze or saline spray and gauze using a circular motion.
6. Dry the exit site thoroughly with gauze.
7. Obtain culture swab for C&S if there are any signs of exudate. Label the specimen and send to the lab with the correct requisition.
8. Using a sterile gauze, apply a pea sized amount of antibacterial cream or ointment such as mupirocin or gentamycin if ordered.
9. Allow the catheter to assume a natural lie on the abdomen ensuring there are no kinks in the tubing and that the connector is not lying on the exit site. Cover with a dressing.
10. Firmly secure the PD catheter and transfer set to the skin with tape or immobilizing device.
11. Document the procedure and your assessment.

Disclaimer: Patient and PD program specifics must be considered when implementing procedures.

PD Procedures:
Dialysate Effluent Collection

1.0 Practice Standard

The following procedure will be followed when collecting a dialysate effluent specimen. The collection of dialysate effluent specimens requires meticulous care in order to avoid contamination of the fluid. Specimens are collected when peritonitis is suspected. Identification of appropriate antibiotic therapy is dependent on accurate collection methodology. The patients first cloudy effluent bag has the greatest probability of an accurate cell count. A minimum dwell time of at least 2 hours is preferred.

- Obtain specimen(s) from drained peritoneal dialysate effluent provided by patient
  OR

if not available, collect specimen(s) from the drained dialysate effluent that has dwelled in the patients peritoneal cavity for at least 2 hours. **Note:** if the patient does not have fluid in their peritoneal cavity you will need to instill minimum of 1L of 1.5% dialysate and allow to dwell for 1-2 hours. You can then drain the effluent and collect the specimens

2.0 Supplies

- Syringe(s): Size dependent on PD program/Health authority recommendation. See chart
- Needle(s): 21/22 g or 18 gauge blunt needle
- Sterile specimen container(s) as per PD program/ Health authority recommendation. See chart
- Requisitions as per PD program/Health authority recommendation. See chart
- Alcohol/betadine swab
- Non sterile gloves
- Patient labels

3.0 Procedure

1. Wash hands and glove.
2. Swab the sample port of the dialysis drain bag with alcohol or betadine and allow to dry.
3. Using aseptic technique, withdraw peritoneal dialysate effluent from the sample port using sterile syringes as per chart. Separate syringes should be used to collect all specimens to ensure no contaminants are in the culture specimen.
4. Insert correct amount of dialysate effluent into each of the sterile containers as per chart
5. Label each of the sterile containers and send to the lab STAT with the appropriate requisitions. Ensure that each requisition indicates that the specimen is PD dialysate effluent.
6. Document the procedure and actions taken

Health Authority	Total volume of dialysate effluent to collect	Lab test/requisition required	Specimen container required
NHA	2 x 50ml	C&S and gram stain STAT cell count & differential	2 x sterile orange top specimen containers
FHA	60ml	C&S and gram stain Cell count and differential	Orange top sterile C&S container
VIHA	110ml	C&S and gram stain Cell count and differential: (same req as for u/a and other fluids)	3 MSU containers with pink lid: • 50 ml in two containers • 10ml in the third container
IHA	75ml	• C&S and gram stain • Aerobic and anaerobic culture • Cell count and differential	• 50ml in sterile container • 8-10ml in each aerobic/ anaerobic bottle • 3-5ml in light purple top blood vacutainer
VCA (VGH)	100-120ml	C&S and gram stain Cell count and differential	2 x 90ml sterile specimen containers
SPH	2 x 60ml	C&S and gram stain Cell count and differential	2 x 90ml sterile specimen container

Disclaimer: Patient and PD program specifics must be considered when implementing procedures.

PD Procedures:
Transfer Set Change

VIDEO: *Transfer Set Change* video of this procedure can be found at:
bcrenalagencymedia.ca/transfer-set-change

1.0 Practice Standard

Changing a PD transfer set is a procedure that is to be performed by a healthcare team member after consultation with the patient's primary PD program. The PD transfer set is to be changed:

- Every 6 months as recommended by the manufacturer
- After contamination following accidental disconnection from the PD catheter
- After identification of leakage, crack , or broken twist clamp

2.0 Supplies

- Transfer set
- Mini cap
- Beta clamp or soft toothed clam
- Chlorhexidine solution
- 2 masks
- Sterile gloves
- Sterile dressing tray
- 4x4 gauze
- Tape

3.0 Procedure

1. Gather supplies on a clean surface.
2. Expose the patient's abdomen. Check that the twist clamp is closed on the transfer set.
3. Mask self and patient.
4. Wash hands.
5. Place beta clamp or soft toothed clamp on the PD catheter approximately 4inches from the transfer set. Protect the PD catheter using a 4x4 gauze when placing the clamp.
6. Open the sterile tray and add the transfer set and minicap.
7. Soak 2x2 gauze with chlorhexidine.
8. Wash hands with hand sanitizer.
9. Mask self and patient.
10. Wash hands with sanitizer and glove
    Note: if the patient has a dry abdomen, fill a 10cc syringe with saline and connect to the transfer set and prime the transfer set.
11. Attach minicap to the end of the transfer set
12. Place sterile drape under the patient's PD catheter and transfer set.
13. Hold the transfer set and catheter and scrub at the connection site with the chlorhexidine-soaked gauze.
14. Remove the old transfer set at the connection. Continue to hold the PD catheter in one hand to maintain sterility.
15. Pick up the new transfer set and connect to the PD catheter. Ensure the connect is tight.
16. Ensure the minicap is tight and transfer twist clamp is closed. Remove the clamp from the patient's PD catheter.
17. Perform exit site care and change the dressing if necessary.
18. Document the procedure and notify the PD program of the transfer set change.

Disclaimer: Patient and PD program specifics must be considered when implementing procedures.

PD Procedures:
Performing a Twin Bag Exchange

VIDEO: *Performing a Twin Bag CAPD Exchange* video of this procedure can be found at: bcrenalagencymedia.ca/performing-twin-bag-exchange

1.0 Practice Standard

The PD patient and/or their family member who has been trained in PD should be encouraged to perform all of their CAPD exchanges. Contact the PD program if the patient and or family member is unable to perform their own CAPD exchanges to obtain further direction. The patient's PD prescription is ordered by the Nephrologist. The prescription includes:

- Number of exchanges/day
- Solution type
- Solution volume
- Solution strength
- Medications

2.0 Supplies

- (2) masks
- Hand sanitizer
- PD solution that has been ordered
- Mini cap
- 4x4 gauze
- (2) clamps
- IV pole

3.0 Procedure

1. Wash hands. Gather supplies on a clean surface.
2. Check the PD solution for solution strength, volume, expiry date.
3. Heat the PD solution using dry heat as per PD program policy.
4. Open the PD solution overpouch and dry the bag. It is normal to find a small amount of condensation that forms during the sterilization process.
5. Check the solution bag for leaks. Check the medication port, the pull ring and the green seal and Y area to ensure they are intact.
6. Add medications to the solution bag if ordered
7. Hang the fill bag on an IV pole and place the drain bag on the floor.
8. Ensure the y portion of the tubing with the pull ring is easily accessible and kept clean.
9. The patient may choose to perform the exchange position, sitting, lying or standing. Expose the patients transfer set and check that the twist clamp is closed.
10. Wash hands with hand sanitizer. Mask self and patient.
11. Remove the pull ring from the end of the twin bag and keep the end sterile by holding in one hand.
12. Remove the mini cap from the patients transfer set keeping end sterile
13. Immediately attach the twin bag connector to the patients transfer set. Use a twisting motion to ensure that the two ends are connected tightly. Use the 4x4 to wipe off any iodine.
14. Open the twist clamp on the transfer set to begin draining.
15. Draining is complete when the drain bag is full and there is no fluid moving from the fill line into the drain line and bag. After draining is complete close the twist clamp on the patients transfer set.
16. Place a clamp on the drain line.

17. Break the green seal located at the Y connection point using a back and forth snapping motion.
18. Open the clamp on the drain line and count for 5 seconds. During the 5 seconds a small amount of the PD solution will flow from the solution bag into the drain bag.
19. Close the clamp on the drain line after 5 seconds.
20. Open the twist clamp on the patients transfer set to begin filling.
21. Once filling is complete, close the twist clamp on the patient transfer set.
22. Place a clamp on the fill line.
23. Mask self and patient. Wash hands with hand sanitizer.
24. Check the expiry date on the minicap package. Open the minicap package.
25. Unscrew the twin bag connector from the transfer set. Keep the transfer set in one hand.
26. Immediately apply new minicap to the patients transfer set. Ensure that it is secure.
27. Check the drained fluid in the drain bag for: clarity, fibrin, blood. If present, call the PD unit for further direction.
28. Dispose of effluent and plastics.
29. Document the procedure as per policy.

Disclaimer: Patient and PD program specifics must be considered when implementing procedures.

Section 4: Glossary of Frequently Used PD Terminology

Catheter irrigation: A procedure using a large syringe containing heparinized dialysis solution or normal saline in a push/pull technique in attempts to flush the blockage in a PD catheter. The blockage is frequently created by fibrin formation or omentum blocking the PD catheter.

Catheter (PD): A small flexible tube surgically placed in the abdomen that allows dialysate to move in and out of the peritoneal cavity.

Cell count: A measure of the number of white blood cells in a specimen such as dialysate effluent.

Chronic kidney disease (CKD): Kidney function that is less than normal and will never get better. It may be mild or progressive.

Clean: free from foreign or extraneous matter

Continuous ambulatory peritoneal dialysis (CAPD): Manual form of peritoneal dialysis that requires no machine. The client performs 4 (or more) manual PD exchanges per day .

Continuous cycling peritoneal dialysis (CCPD): uses a machine called a cycler to perform the PD exchanges. CCPD is performed at night when the patient is sleeping. Also referred to as automated peritoneal dialysis (APD) or cycler dialysis.

Culture and sensitivity: Identification of microorganisms in a clinical specimen such as dialysate effluent to determine the type of microorganism present and the susceptibility of the microorganism to specific antibiotics.

Dextrose: A substance found in PD solution that enables removal of fluid from the blood.

Dialysis: A treatment that removes the waste products and excess fluid from the blood by using a filter, or membrane, in much the same way kidneys would. The patient's peritoneal membrane acts as the semi permeable membrane in peritoneal dialysis.

Dialysate: A solution used to draw waste products and extra fluid out of the blood.

Drain: The process of removing the used dialysate solution form the peritoneal cavity.

Drain bag: The bag into which fluid (effluent) from the peritoneal cavity drains.

Dwell: The period of time that the solution (dialysate) remains inside of the peritoneal cavity. This is when dialysis is occurring.

Effluent: The drained fluid that has dwelled in the patient. It contains waste products from the client.

End stage renal disease (ESRD): Stage 5 chronic kidney disease requiring treatment such as dialysis, transplant to live. Conservative management may be an option for some patients if they do not choose dialysis treatment or transplant.

Exchange: Refers to PD cycles that include a fill, dwell and drain phase/cycle.

Exit site: The area surrounding the peritoneal catheter where it exits the abdomen.

Fill: The process of filling the patient's peritoneal cavity with new dialysate solution.

Fill volume: The amount of fluid to be delivered to the patient's peritoneal cavity during each exchange/ cycle.

Fibrin: A stringy substance, often described as cotton like fibers, or cooked egg whites that can block the catheter.

Gram stain: A lab test used to detect bacteria or fungi in a sample such as dialysate effluent taken from the site of a suspected infection. Distinguishes and classifies bacterial species into gram positive and gram negative.

Inflow failure: PD solution will not flow from the dialysate bag into the peritoneal cavity.

Kidney: One of two organs at the back of the abdominal cavity on each side of the spinal column. Kidneys remove water and waste, produces hormones, regulates blood pressure, and makes red blood cells.

Medication port: A re-sealable rubber injection site for adding medications into the PD dialysate solution bag.

Nephrologist: Doctor who specializes in diseases of the kidneys.

Outlet port clamp: Clamp used to prevent the out flow of solution.

Outflow failure: The dialysate or effluent drainage volume is substantially less than the dialysate inflow volume with no evidence of pericatheter leakage. Usually occurs soon after catheter placement. Often preceded by irregular effluent drainage, increased fibrin in the dialysate or constipation.

Pericatheter leakage: Evidence of leakage of PD solution around the PD catheter exit site.

Peritoneal cavity: An enclosed cavity which contains all the abdominal organs (except kidneys). The peritoneal cavity holds the fluid for PD to take place.

Peritoneal dialysis (PD): A form of dialysis that uses the peritoneal membrane to filter wastes and excess fluid. The form of dialysis most often occurs in the patient's home and is performed daily.

Peritoneal membrane: A thin membrane that lines the abdominal and pelvic cavities. This membrane acts as a filter to remove waste products and excess fluid from the blood in PD.

Peritonitis: An infection of the peritoneal membrane lining the peritoneal cavity. It is a serious complication of peritoneal dialysis which occurs when bacteria enters the peritoneal cavity.

Phase: A part of a cycle. Each cycle is divided into a fill phase, a dwell phase and a drain phase.

Pull ring: A color coded rubber covering that protects the sterile patient connector on the solution bag.

Solution bags: Solution bags contain the dialysate that is delivered to the peritoneal cavity during therapy. Solution types manufactured by Baxter are:

- **Dianeal:** The standard type of solution that allows dialysis to occur. Dianeal is supplied in various strengths/concentrations and volumes.
- **Extraneal/icodextrin:** A special type of solution that removes more fluid and requires a dwell time of 8 hours or more. Used as the last fill for patient's who are on CCPD.
- **Nutrineal:** A special type of solution that removes minimal fluid from the patient while providing extra protein.
- **Physioneal:** A bicarbonate based solution which also contains dextrose.

Sterile: Free from living germs as a result of a sterilization process that kills all forms of life from an item or field.

Strength: Used to refer to the concentration or percentage of dextrose in the dialysate. Examples of PD solutions strengths are: 0.5%, 1.5%, 2.5%, and 4.25%.

Target weight: Patient's ideal weight with no evidence of excess fluid or dehydration.

Transfer set: A disposable plastic tube that is attached to the end of the patient's PD catheter. It has a twist clamp and the sterile end is always covered with a minicap.

Ultrafiltration (UF): Refers to the additional fluid that was removed from the patient's body as part of dialysis therapy.