PERITONEAL DIALYSIS (PD) FOLLOWING CONGENITAL HEART SURGERY IN PICU - CHW

PRACTICE GUIDELINE ©

DOCUMENT SUMMARY/KEY POINTS

- Early implementation of renal replacement therapy (RRT) in the form of acute peritoneal dialysis (PD) is usually effective in maintaining electrolyte and fluid balance and avoiding uraemia.
- The decision to initiate PD will be made by the intensivist usually following consultation with the other consultants involved in the patients care.
- PD is ideally implemented early, when the child's renal function is first showing a deterioration.
- Indications for commencement of treatment include, but are not limited to:
  - Anuria/oliguria resistant to either fluid challenge or diuretic therapy
  - Fluid overload
  - Uraemia (plasma Urea >10 mmol/L).
  - Hyperkalaemia (plasma Potassium > 6 mmol/L) (but implement the Potassium management protocol immediately)
- A new prescription must be written whenever the prescription is changed.
- The prescription must include:
  - Patient's weight
  - Base dialysis fluid (Dianeal® or Hemosol B0®)
  - Bag size of dialysis fluid (3 litre for Dianeal®, 5 litres for Hemosol B0®)
  - Glucose concentration in dialysis fluid (1.5% or 2.5% to start, or prescribe as additives for Hemosol B0®)
  - Additives to the dialysis fluid (as grams/L or units/L or mmol/L and per bag for Hemosol B0®)
  - Cycle volume (starts at 10 mL/kg)
  - Cycle interval (starts at 60 minutes)
  - Dwell time (starts at 40 minutes)

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CHANGE SUMMARY

- Document due for mandatory review
- Change of equipment and process to align with SCHN ANTT Policy and Procedure Surgical ANTT to replace “sterile procedure”.
- Update to hyperlinks

READ ACKNOWLEDGEMENT

Outline who needs to read or know about the document (roles only - do not use names).

- Training/Assessment Required – New clinical staff.
- Read Acknowledge Only – Existing clinical staff.

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Glossary

- K Potassium.
- RRT Renal Replacement Therapy
- CVVH Continuous Veno-Venous Haemofiltration
- eMR Electronic Medical Records
- NaCl Sodium Chloride
- U Urea
- PD Peritoneal Dialysis
- K Potassium
- Cl Chloride
- Ca Calcium
- Mg Magnesium
- PO_4 Phosphate
- KH_2PO_4 Potassium Dihydrogen Phosphate
- M, C & S Microscopy, Culture and Sensitivities
- ECG Electrocardiogram
- CVP Central Venous Pressure
- ANTT Aseptic Non-Touch Technique

Introduction

- Renal replacement therapy may occasionally be required following cardiac surgery for congenital heart disease. The myocardium is particularly sensitive to electrolyte imbalances and fluid overload caused by the cardiopulmonary bypass, and the patient's condition may often become further complicated by any degree of acute kidney injury.
- Early implementation of renal replacement therapy (RRT) in the form of acute peritoneal dialysis (PD) is usually effective in maintaining electrolyte and fluid balance and avoiding uraemia.
- The decision to initiate PD will be made by the intensivist usually following consultation with the other consultants involved in the patients care. PD is ideally implemented early, when the child's renal function is first showing a deteriorating trend, but their electrolytes are not very deranged. This is done because of the slower treatment time of PD and the fact that renal function is anticipated to deteriorate further before the beneficial effects of PD are seen.

Principles of Peritoneal Dialysis

- Dialysis refers to the removal of fluid and waste products of metabolism from the body by osmosis and diffusion, in the absence of adequate renal function. Peritoneal dialysis uses the peritoneum as the dialysis membrane to remove fluid and solutes slowly.
- Peritoneal fluid is in a state of chemical and osmotic equilibrium with plasma - as the peritoneum is a semi-permeable membrane where small molecules, or solutes and water are able to move freely across. These solutes will move from regions of high concentration to regions of low concentration by the process of diffusion and water will move from areas of low osmolality to areas of high osmolality by the process of osmosis. Therefore, solutes such as sodium, potassium, chloride, calcium, magnesium, sulphate, urea, creatinine and uric acid move freely across the membrane and are removed from the body when the dialysate fluid is expelled (drained) during a dialysis cycle. Larger molecules and substances bound to plasma proteins are not able to diffuse across the peritoneal membrane.
- The fluid (Dialysate) instilled in the peritoneal cavity is of a higher osmolality than plasma and contains no urea, uric acid, creatinine, phosphate or other by-products of metabolism, so these are drawn across the peritoneal membrane into the fluid and then removed from the body by draining away the fluid. The higher osmolality draws water across the peritoneum, thus allowing for a negative water balance. If the patient is hyperkalaemic, then the dialysate should contain no potassium so that potassium is drawn out of the body. Potassium may be added to the dialysate if the patient is in a neutral potassium balance (serum potassium < 4.5 mmol/L).
- The peritoneum has limited capacity for solute removal in case of low cardiac output (low peritoneal perfusion). PD is also limited by the small volumes of Dialysate which are tolerated by cardiovascularly unstable patients (we usually limit this to 10 or 15 mL/kg per hour). Maximum urea clearance is less than 10 mL/kg/hr, i.e., 0.17 mL/kg/min which is less than a quarter of normal glomerular filtration rate.
- PD is a gentle form of dialysis and is therefore suited to patients who are sensitive to intravascular volume changes, more cardiovascularly unstable and requiring inotropic support or who have deranged coagulation and are at risk from the insertion of a double-lumen access catheter for haemodialysis/filtration. Large rapid fluid shifts are not possible with PD.
- Cycle times are usually based on a 60 minute time period for ease of nursing management. This consists of a 10 minute drain in, 40 minute dwell and 10 minute drain out time. Dwell/diffusion time is the ordered period of time that the fluid remains in the peritoneal cavity and is when movement of fluid and solutes occurs. This period is usually 30-60 minutes however maximal solute movement occurs at the beginning of the dwell phase and therefore there is often little benefit in dwell times longer than 30-40 minutes.
- For increased water/electrolyte/urea removal, cycle time can be shortened to 30 minutely by the intensivist.

- All instilled fluid should be warmed to 37ºC via an in-line fluid warmer to prevent abdominal pain, discomfort, vasoconstriction and shock to the patient.

Indications for commencing Peritoneal Dialysis

- Many patients undergoing complex cardiac surgery will have a peritoneal drain inserted 'routinely' at the end of the procedure. This is for peritoneal drainage (peritoneal fluid may accumulate due to capillary leak after bypass) and in case PD is required. This means that PD can be commenced without delay. In those patients without a PD catheter, a decision on the mode of RRT (PD vs. CVVH) will need to be made.
- Overall fluid balance, urine output, electrolyte levels, urea and creatinine levels are the main factors that will be assessed and investigated when PD initiation is being discussed.
- Indications for commencement of treatment include, but are not limited to:
  - Anuria/oliguria resistant to either fluid challenge or diuretic therapy
  - Fluid overload
  - Uraemia (plasma Urea >10 mmol/L).
  - Hyperkalaemia (plasma Potassium >6 mmol/L) (but implement the Potassium management protocol immediately)
  - Metabolic acidosis pH <7.2 (this is only rarely the sole indication).
- The aims of PD are to support the existing failing renal function, remove waste products, correct acidosis, and remove excess fluid from the patient.
- Prior to commencement, serum Na, K, Cl, Ca, Mg, PO_4, Osmolality, Urea, Creatinine, Glucose and urine Na, K, Cl, Osmolality, Urea, Creatinine should be sent to pathology. The urine sample should preferably be before any diuretic is given.

Contraindications

- Although PD is not absolutely contraindicated by the following, careful consideration of treatment should be made in patients with:
  - Peritonitis
  - Peritoneal adhesions
  - Diaphragmatic defect/injury
  - Recent abdominal surgery.

Commencing treatment

- To initiate PD a peritoneal catheter is required to allow fluid to be drained in and then drained out from, the peritoneal cavity. Most post-operative patients return from theatre with a peritoneal catheter and hence initiating PD is quite easy. Should a PD catheter not be present one will be inserted via sterile surgical or transcutaneous (Seldinger) technique by an intensivist or surgeon either in PICU or in the operating theatre.
- The type of fluid to be used and the amount (10-40 mL/kg) to be instilled each cycle must be ordered by a medical officer. All PD starts with 10 mL/kg cycles. These may be increased to 15 or 20 mL/kg by the intensivist if there is no concern about ventilatory compromise by the distended abdomen. Rarely, cycle volume can be increased to 30 or 40 mL/kg, but only in spontaneously breathing and haemodynamically stable patients.
- Dialysate fluid is similar in composition to normal serum, the main difference being that dialysate contains no potassium, urea or creatinine and so these are readily cleared from the body. It also contains no protein because this does not cross the peritoneum (however, some protein is lost as exudates – see below). The dialysate fluid also contains lactate as a buffer. If the patient's lactate is elevated or they have liver failure or damage which places them at risk of not being able to metabolise lactate, then a bicarbonate-based solution should be considered (see appendix 2 below for formula).
- Dialysate fluid is available as 1.5% and 2.5% glucose solutions. The glucose concentration determines the osmolality and hence affects the amount of fluid (also referred to as free water) that is drawn across the peritoneum. Higher glucose concentrations draw off more water but may lead to hyperglycaemia and the possibility of fluid moving into the veins rather than into the peritoneal cavity. Therefore, the patient's blood glucose levels should be monitored carefully during PD. Hyperglycaemia is usually only temporary until the pancreas increases insulin production to counteract the detected rise in sugar.

1.5% Glucose solution will not initially result in the removal of much fluid from the patient. If there is insufficient fluid/water removal with the 2.5% Dianeal® then discuss with the intensivist and consider a bicarbonate dialysis with a higher glucose concentration (see Appendix 1).

- Other solutes can be added to the dialysate as required:
  - Potassium (1-4 mmol/L, never >4 mmol/L): once the patient's potassium is stable a serum level of 3.5-4.5 mmol/L should be aimed for.
  - Phosphate (as part of the potassium complement) 1 mmol/L Potassium Dihydrogen Phosphate (KH_2PO_4).
  - Heparin (range 100-1000 units/L): added to prevent fibrin clots forming and blocking the catheter. Starting dose of Heparin is usually 500 units/L.
  - 1% Lidocaine (1-2 mL/L, i.e., 10-20 mg/L, patient gets 100-400 micrograms/kg per cycle if 10-20 mL/kg cycles): added to decrease patient discomfort from abdominal distension as required on an individual patient basis.

The Prescription

A new prescription must be reordered whenever the prescription is changed.

The prescription must include (see Appendix 1):

- Patient's weight
- Base dialysis fluid (Dianeal® or Hemosol B0® – see Bicarbonate Dialysis below)
- Bag size of dialysis fluid (3 litres for Dianeal®, 5 litres for Hemosol B0®)
- Glucose concentration in dialysis fluid (1.5% or 2.5% to start, or prescribe as additives for Hemosol B0® – see Bicarbonate Dialysis below)
- Additives to the dialysis fluid (as grams/L or units/L or mmol/L and per bag for Hemosol B0® – see Bicarbonate Dialysis below)
- Cycle volume (starts at 10 mL/kg)
- Cycle interval (starts at 60 minutes)
- Dwell time (starts at 40 minutes)

Peritoneal Dialysis Cycle Management and Care of the Patient undergoing PD

- As with any other patient, a patient undergoing PD should be continually monitored and regularly assessed (see complications of PD) including:
  - Haemodynamic status - hourly vital signs
  - Respiratory status
  - Neurological status
  - Pain score and level of comfort /toleration of treatment.

Any changes or concerns should be reported immediately to the medical officer.

- Blood gases, Na, K, Cl, Glucose, Ca, Mg and PO_4 should be checked - 6 hourly. Urea, creatinine, protein and albumin should be checked twice daily.
- Documentation is crucial to management and therefore a strict fluid balance should be kept including the number of cycles, timing of cycles, type of dialysate used and drainage achieved with each cycle.
- If the PD fluid colour or appearance changes significantly the medical officer should be informed and a sample of fluid sent for analysis (M, C & S). Macroscopic blood or faecal content in the drained fluid is of particular concern.
- A freshly drained dialysate specimen should be sent daily for M, C & S.
- Pharmacy should be consulted regarding medication doses for the patient receiving dialysis. Some medications will need to be increased as they are removed by dialysis,

whereas others may need to be decreased to prevent toxic levels as they are not cleared adequately with poor renal function and dialysis. Administration times may also change if the medication is removed by dialysis.

- If there is excessive fluid leak from the PD catheter insertion site or the patient retains fluid for more than two cycles the medical team should be informed and troubleshooting avenues explored.
- In some cases, intraoperative communication between the peritoneum and pleural space may be inadvertently created. This can become evident by increased drainage from the chest drains. If this occurs it should be reported to medical staff and PD therapy reviewed.

Complications of Peritoneal Dialysis

Although regarded as a gentler treatment compared to other forms of dialysis there are complications associated with peritoneal dialysis

- Respiratory: Increased abdominal distension can compress the diaphragm, limiting functional residual capacity. This can predispose the patient to atelectasis, intrapulmonary shunting and increased work of breathing. Fatigue from increased work of breathing also compromises the patient's ability to compensate for associated alterations in oxygenation and ventilation from the increased abdominal distension.
- Cardiac: Venous return and cardiac output can become compromised especially when intravascular volumes are also limited. Close cardiovascular monitoring should be observed, particularly during the instillation period when abdominal distension is likely to occur. Electrolytes can be depleted and lead to potentially life-threatening ECG changes if regular serum electrolytes are not monitored.
- Some patients become hypotensive during draining if they are particularly unstable as they do not tolerate the fluid shifts. If this occurs the drainage time may need to be increased so that it drains slower, they may be intravascularly dry and require an IV fluid bolus, inotropic support may need to be titrated to the patient's blood pressure during the drain time.
- CVP readings may not accurately reflect preload during the dwell period as elevated abdominal pressure will temporarily augment the CVP, therefore preload should be assessed at the same time in each PD cycle to avoid confusion about intravascular volume.
- Protein loss: The patient's nutritional state should be carefully discussed with a renal dietician, as some protein (0.2 – 8 g/L) is lost in the dialysate. Ongoing protein loss can cause further respiratory complications.
- Infection: There is a risk of peritonitis as fluid and a foreign body (catheter) has been introduced into a usually sealed and sterile area. The PD catheter should be cared for in the same way as a central venous line and always accessed using Surgical ANTT Principles. It is paramount that the drainage bag remains below the level of the patient

at all times to prevent back flow of drainage. Signs of peritonitis include fever, cloudy drainage, pain, and abdominal tenderness.

- Bowel perforation can also occur during PD catheter insertion. Signs of bowel perforation include sudden and severe abdominal pain, nausea and vomiting, fever, chills, abdominal distension, tenderness and rigidity.

Comparative overview of PD, Haemodialysis and CVVH

	Advantages	Disadvantages
PD	Gradual, gentle treatment	Low clearance of solutes
	Can be used in haemodynamically unstable patients	Does not quickly lower K^+ in hyperkalaemia crisis
	Vascular access is less of an issue	Risk of sepsis from peritonitis
	Less expensive	Compromise from abdominal distension
	Does not require systemic heparinisation	Large protein losses
CVVH	Effective for hypervolaemia	Requires large vein access
	Can be used in unstable patients, readily adjustable	Complications of vascular access, CVVH (embolus, clots, bleeding)
		Requires heparinisation
	Allows ability to optimise parenteral nutrition	Requires constant monitoring and immediate action for a blockage
Haemodialysis	Quick and effective in fluid and catabolic overload	Specialised – needs Renal Treatment Centre nurses
	Intermittent treatment	Results in hypotension and fluid shifts (disequilibrium syndrome)
		May require heparinisation

Procedure for Set up and commencement of Gravity Feed PD

Equipment

- Dressing pack + extra gauze squares
- Large Antiseptic Wipes containing 2% chlorhexidine with 70% Alcohol
- Dressing trolley
- Plastic drape - sterile field
- Ordered dialysis fluid with additives as per medical order (Appendix 1)
- Sterile gloves
- Sterile specimen container

- PD kit - Manual PD set with burettes
- Fluid warmer
- Tubing for fluid
- Portable IV stand

Preparing the Dialysis fluid

- Refer to the written medical prescription and add any additives to the bag of dialysis fluid via the injection port using Aseptic Non-Touch Technique (ANTT)
- Place an additive label on the fluid bag FOR EACH additive that is added - according to medication administration policy
- Hang bag of fluid on the portable IV pole

Preparing the PD circuit

- Wash hands and prepare the sterile working surface and equipment employing surgical ANTT
- Open dressing pack and open chlorhexidine wipes into one receptacle of dressing pack
- Complete 3-minute hand wash and don sterile gloves
- Ensure all roller clamps on PD circuit are in the off position
- Add heater coil to circuit between the burettes and the Y piece on the line
- Using a chlorhexidine wipe, remove the protective cover on the “entry” point of the bag of dialysis fluid, discard wipe. Clean this port using a scrubbing technique for 15-20 seconds with a new chlorhexidine wipe.
- Place spike from the burette into the entry point of the dialysis fluid bag
- Ensuring that the circuit remain sterile (leave on trolley or hold with sterile gloves) release the roller clamps allowing fluid to run into the burette and down ONE of the circuit lumens which is not connected to the waste bag
- Once this lumen is primed replace the roller clamp and release the roller clamp on the other lumen resulting in all of the circuit being primed with fluid and fluid being expelled into the waste measuring container
- Empty waste measuring container of fluid and ensure all clamps are in the off position
- Second nurse to assist by placing tubing into chosen fluid warmer. If using the “Astotube” fluid warmer, wind the tubing around the heater coil from bottom to top as per instructions on unit and then placing the cover on top
- Ensure the fluid warmer is turned on and set to 37 degrees Celsius

Preparing the patient and connecting the circuit

- Explain the procedure to the patient and their family
- Position child supine
- Ask the second nurse to ensure the peritoneal catheter in situ is clamped

- Ask the second nurse to expose the end of the peritoneal catheter at the Luer lock connection
- Using chlorhexidine wipes to clean the connection point of the peritoneal catheter as well as a part of the PD catheter and old collection bag. Drape area with sterile field
- Disconnect old waste bag using sterile gauze to touch line and PD catheter
- Release the clamp on the peritoneal catheter and collect a sample of peritoneal fluid (free drain 2mL of fluid into a sterile specimen container). This is sent to pathology for MCS analysis
- Connect the end of the dialysis circuit to the peritoneal catheter using the Luer lock connection (i.e., not the lumen attached to the waste bag)
- This completes the surgical ANTT procedure of connecting the patient
- Using tape secure the burette to the portable IV pole in a way that the prescribed cycle volume marks are not obscured
- Label the two lumen of the circuit “In” and “Out” according to which way the fluid runs. I.e., “In” is the lumen where fluid flows from the burette to the patient and “Out” is the lumen which allows fluid to flow from the patient (peritoneal cavity) to the waste bag
- Once a medical prescription is completed in the eMR (Appendix 1), Peritoneal Dialysis will automatically be generated in the I/O section of the chart and in the specific PD band in iview

Commencing Treatment

For ease of nursing management cycles should be started on the hour (or half hour) to avoid confusion.

- Ensure all clamps are on, preventing fluid flow
- Fill the burette with the prescribed cycle volume of dialysis fluid as per medical order.
- Release the clamp on the “In” lumen and allow the fluid in the burette to flow (via gravity) into the patients peritoneal cavity. (This should not take more than 5 minutes).
- Clamp all lumens and allow the fluid to dwell for the prescribed period of time
- At the completion of the dwell time release the clamp on the “Out” line and allow fluid to drain into the waste measurement chamber over a period of 10 minutes.
- Clamp the “Out” line at the end of this 10 minute period
- Empty the fluid from the measurement chamber into the attached waste bag and ensure tap/clamp to large drainage bag is turned off once you have removed the fluid from the measurement chamber
- Record in the fluid balance chart on the eMR the amount of fluid drained in and the amount of fluid drained out once time is complete.
- This completes one peritoneal dialysis cycle which will have taken one hour from instillation
- Repeat process for subsequent cycles

Troubleshooting

- Fluid drains in but not out:

This is a common problem that can be caused by catheter migration or blockage from either omentum or external forces.

  - Check catheter position on abdominal X-ray
  - Check that all outflow clamps are unclamped
  - Check that tap on measurement chamber to bag is closed
  - Reposition patient (roll side to side, elevate head)
  - Using surgical ANTT, flush the catheter with 10mL of 0.9% Saline after consulting doctor
  - Fibrin clots may be forming and causing blockage (add heparin to dialysate if not done already)

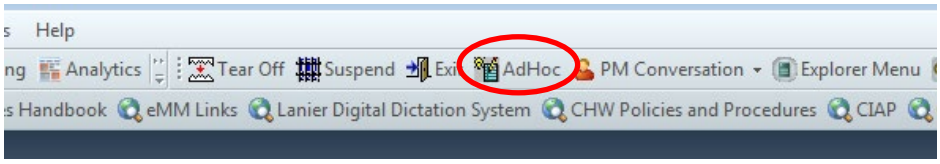
- Less fluid drained out than instilled:
  - May be due to a blockage occurring at the end of the drain cycle, treat as above
  - External blockage of tubing (i.e., kink caused by position change)
  - Less fluid drained in than you thought (common with large cycles)
  - Patient is intravascularly dry and absorbing some fluid
  - Check that PD fluid is not running out into the chest drains. (Potential communication via diaphragm with PD catheters inserted during cardiac surgery)
  - Patient's serum glucose level (and serum osmolality) is higher than dialysate causing fluid shift away from dialysate into the patient's serum
  - Patient may be constipated. Fluid pockets exist in abdomen (gently press to expel fluid)
  - If this happened for the first time and MOST of the fluid drained out, inform the MO and proceed with the next cycle. Two positive cycles (fluid retention) warrant investigation and review of therapy.

- Leakage around insertion site:
  - Catheter displacement (check with an X-ray)
  - Abdominal distension causing stretching (review volume of cycles)
  - Gaping insertion site (may require a suture to close)

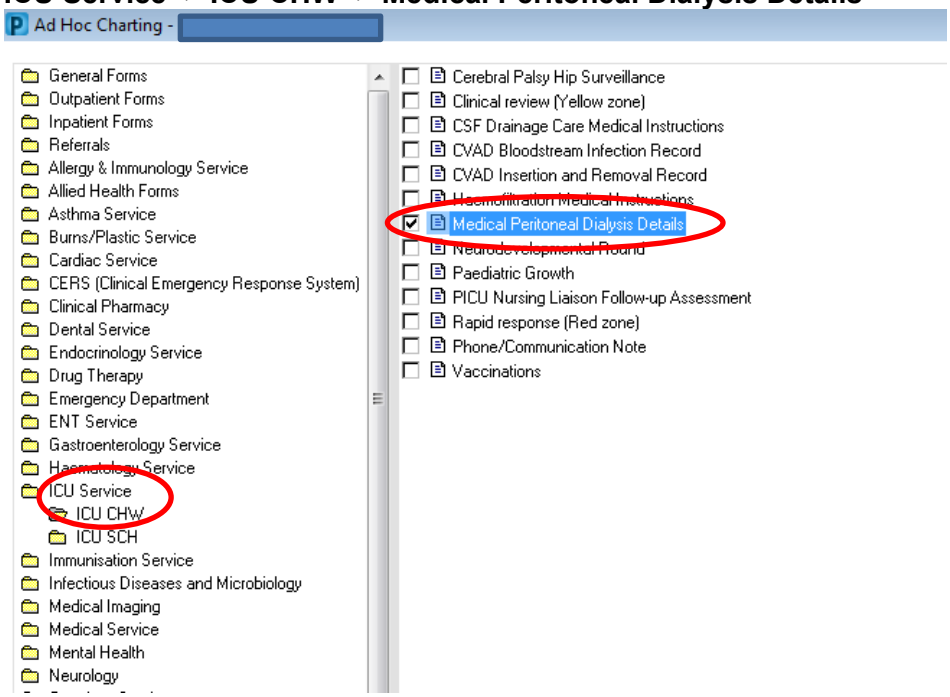
- Fluid won't drain in:
  - Clamps are still on circuit lumen

Appendix 1 – PD Medical Order and Charting in PowerChart

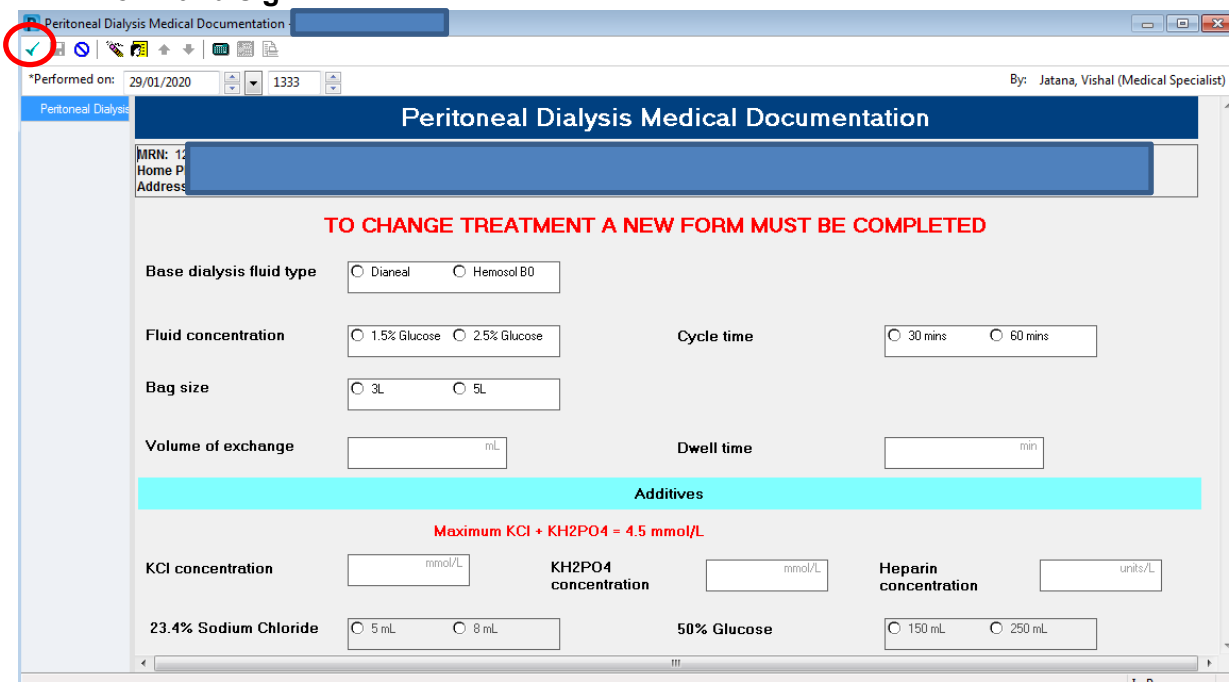
1. AdHoc charting



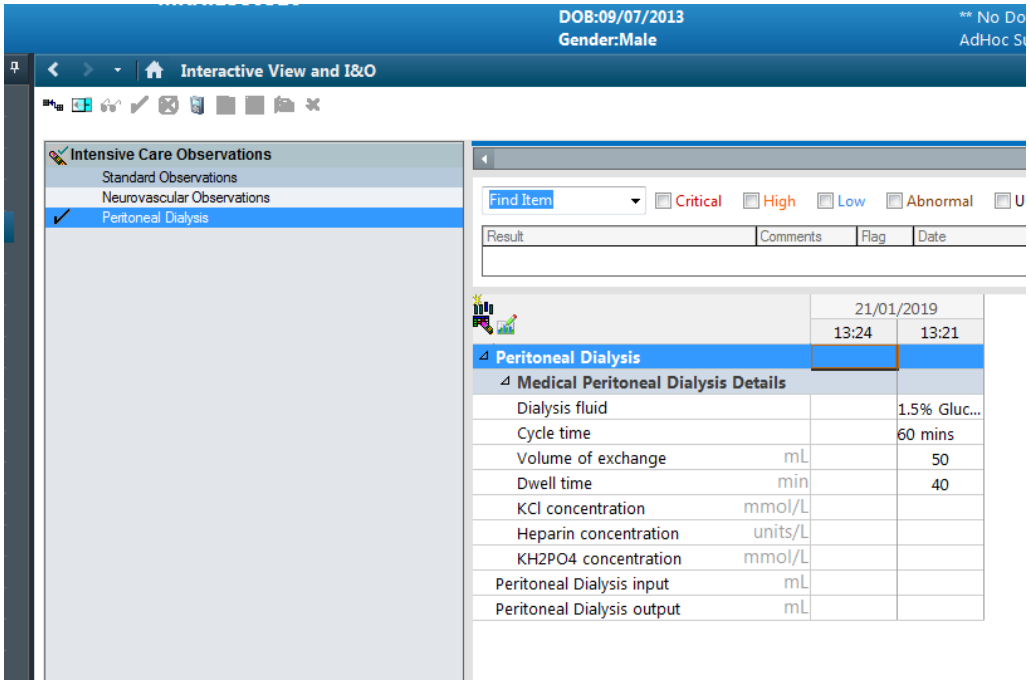
ICU Service -> ICU CHW -> Medical Peritoneal Dialysis Details



2. Fill in form and sign



3. **Form will then populate through to Intensive Care observations in iview. PD input and PD output can be entered via this view and will populate through to fluid balance. (A new navigator band is not required to be added for Peritoneal Dialysis).**



Appendix 2 – Bicarbonate Dialysis

- In the presence of liver failure or high blood lactate it is preferable for the dialysate to contain bicarbonate instead of lactate as the buffer.
- Use the bicarbonate- and calcium-containing hemofiltration replacement fluid – Hemosol B0®.
- Mix the two partitions. The final solution contains 32 mmol/L of bicarbonate, plus 3 mmol/L of lactate, but no glucose.
- It also contains a higher concentration of sodium and chloride than Dianeal® (Sodium 140 mmol/L instead of 132 and Chloride 110 instead of 95).
- Add potassium if necessary, just as you would for Dianeal® (Hemosol B0® contains no potassium). Use potassium chloride or potassium dihydrogen phosphate according to whether hyperphosphataemia is a problem, never to greater than 4 mmol/L of potassium and never greater than 1.5 mmol/L of phosphate as for Dianeal®.
- Glucose must be added as 50% glucose solution (0.5 grams/mL). Note that the addition of 50% glucose dilutes the base fluid by 3%, 5% or 9%. Therefore add sodium chloride as 23.4% solution (4 mmol/mL).
    - For a 1.5% glucose dialysis solution add 15 grams/L of glucose (75 grams per 5 litre bag, i.e. 150 mL of 50% glucose), plus 4 mmol/L sodium chloride (5 mL of 23.4% sodium chloride per 5 litre bag)

- For a 2.5% glucose dialysis solution add 25 grams/L of glucose (125 grams per 5 litre bag, i.e. 250 mL of 50% glucose), plus 7 mmol/L sodium chloride (9 mL of 23.4% sodium chloride per 5 litre bag)
- For a 4.5% glucose dialysis solution add 45 grams/L of glucose (225 grams per 5 litre bag, i.e. 450 mL of 50% glucose) plus 12 mmol/L sodium chloride (15 mL of 23.4% sodium chloride per 5 litre bag).

Appendix 3 – Composition of Dialysants

Note: these solutions are for intraperitoneal use only

	Dianeal® PD4 1.5%	**Dianeal® PD4 2.5%**	**Hemosol B0® with additives as per Appendix 1 1.5%**	**Hemosol B0® with additives as per Appendix 1 2.5%**	**Hemosol B0® with additives as per Appendix 1 4.5%**
Glucose	76 mmol/L (15 g/L)	126 mmol/L (25 g/L)	74 mmol/L (14.5 g/L)	120 mmol/L (23 g/L)	206 mmol/L (41 g/L)
Sodium	132 mmol/L	132 mmol/L	140 mmol/L	140 mmol/L	140 mmol/L
Calcium	1.25 mmol/L	1.25 mmol/L	1.7 mmol/L	1.65 mmol/L	1.6 mmol/L
Magnesium	0.25 mmol/L	0.25 mmol/L	0.5 mmol/L	0.48 mmol/L	0.46 mmol/L
Chloride	95 mmol/L	95 mmol/L	110 mmol/L	110 mmol/L	110 mmol/L
Lactate	40 mmol/L	40 mmol/L	2.9 mmol/L	2.8 mmol/L	2.7 mmol/L
Bicarbonate	0	0	31 mmol/L	30 mmol/L	29 mmol/L
Osmolality	345 mOsm/kg	395 mOsm/kg	360 mOsm/kg (approx.)	410 mOsm/kg (approx.)	510 mOsm/kg (approx.)

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