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Ministry of Health

دائرة الأمراض غير المعدية
Department of Non-Communicable Diseases

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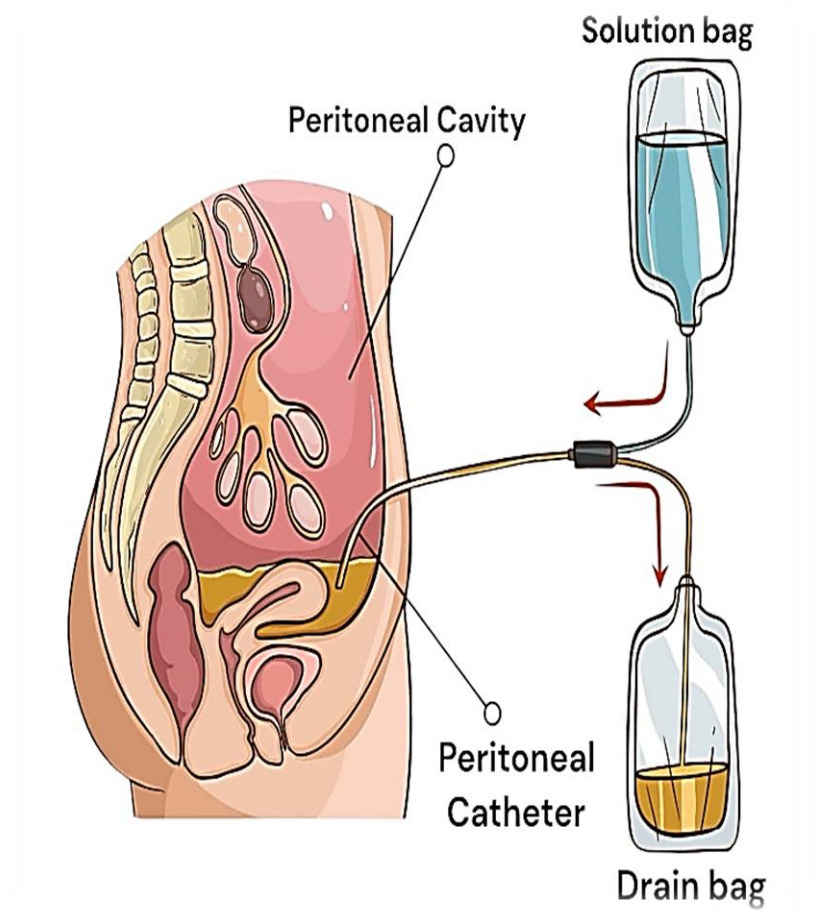
# Guideline on Running the Peritoneal Dialysis Service

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**Acronyms:**

| | |
|---|---|
| ACEIs | Angiotensin Converting Enzyme Inhibitors |
| ARBs | Angiotensin Receptor Blockers |
| APD | Automated Peritoneal Dialysis |
| CAPD | Continuous Ambulatory Peritoneal Dialysis |
| BMI | Body Mass Index |
| BP | Blood Pressure |
| CCPD | Continuous Cycling Peritoneal Dialysis |
| CrCl | Creatinine Clearance |
| CKD | Chronic Kidney Disease |
| CQI | Continuous Quality Improvement |
| DGMS | Directorate General of Medical Stores |
| DVD | Digital Video Disc |
| ECG | Electrocardiogram |
| ECHO | Echocardiography |
| eGFR | estimated Glomerular Filtration Rate |
| EPS | Encapsulating peritoneal sclerosis |
| ESI | Exit-Site Infection |
| ESKD | End Stage Kidney Disease |
| GDPs | Glucose Degradation Products |
| GFR | Glomerular Filtration Rate |
| GI | Gastrointestinal |
| HD | Hemodialysis |
| HIT | Heparin Induced Thrombocytopenia |
| HOD | Head of Department |

| | |
|---|---|
| IP | Intra Peritoneal |
| IV | Intravenous |
| IPD | Intermittent Peritoneal Dialysis |
| ISPD | International Society of Peritoneal Dialysis |
| KPI | Key Performance Indicator |
| KRT | Kidney Replacement Therapy |
| Kt/v | K= dialysis clearness, T= Time of dialysis, V= volume of distribution of urea |
| NCD | Non Communicable Diseases |
| PD | Peritoneal Dialysis |
| PDC | Peritoneal Dialysis Catheter |
| PET | The Peritoneal Equilibration Test |
| Ph | Potential of Hydrogen |
| RKF | Residual Kidney Function |
| SOP | Standing Operating Procedures |
| T | Time |
| TI | Tunnel Infection |
| TPD | Tidal Peritoneal Dialysis |
| UF | Ultrafiltration |
| UFF | Ultrafiltration failure |
| V | Volume |
| WBC | White Blood Cells |

**Definitions**

- **Automated Peritoneal Dialysis (APD):** It is a type of PD dialysis that uses a machine called a cycler to perform the PD exchanges according to the prescription.
- **Caregiver:** a person who takes care of the needs or concerns of a person with short or long-term limitations due to disability, injury, or illness.
- **Catheter Adapter (Titanium Adapter):** It is a connector made from titanium that is used to connect the PD catheter to the transfer set.
- **Continuous Ambulatory Peritoneal Dialysis (CAPD):** where dialysis solution is always present in the peritoneal cavity. A new solution is exchanged typically 3-5 times per day and performed manually by using gravity to move fluid in and out of the peritoneal cavity.
- **Continuous Cycling Peritoneal Dialysis (CCPD):** It is a form of APD in which the patient performs the PD exchanges overnight and one exchange during the day.
- **Continuous Quality Improvement (CQI):** It is a concept of planning and system management that enhances quality through the collection and quality assessment of data, which targets a specific problem such as peritonitis.
- **Dialysate/ Dialysis Solution:** A sterile solution containing a specific concentration of an osmotic agent, electrolytes, and lactate or bicarbonate- based buffer in order to facilitate diffusion and osmosis across the peritoneal membrane.
- **Effluent:** dialysis fluid (fill volume) plus ultrafiltrate fluids and wastes emptied from the peritoneal cavity after a period of time (dwell time).
- **Empirical Antibiotic:** an initial antibiotic that is given for an infection before we have peritoneal fluid or blood culture result. The choice of antibiotics is based on local antimicrobial sensitivity patterns. It is prescribed immediately when an infection occurs by an unknown organism, while the results of bacterial culture and other tests are awaited.
- **Encapsulating Peritoneal Sclerosis (EPS):** It is a rare complication of peritoneal dialysis that is characterized by intraperitoneal fibrosis and inflammation which results in the encasement of bowel loops. EPS causes bowel obstruction and ultrafiltration failure.
- **Exit Site:** is a point at which the PD catheter exits the body. The location of the exit site should be selected carefully, ensuring that it can be conveniently cleaned and the chance of accidental trauma is minimized.

- **Exit-Site Infection (ESI)**: It is the presence of purulent discharge with or without skin erythema at the catheter-epidermal interface.
- **Euvolemia:** It is a state of adequate fluid/ blood volume in the body. The fluid status is a vital adequacy parameter and a predictor of outcome in peritoneal dialysis compared to solute clearness.
- **Fill Volume:** The amount of dialysate prescribed to fill the peritoneal cavity per each cycle which depends on the body surface area.
- **Fluid leaks:** This may occur early after catheter insertion where the fluid leaks through the exit site if it is not yet fully healed. Sometimes, it may occur late after the exit site has healed and the fluid leak from the peritoneum, but as there is no passage through the skin, fluid will collect in subcutaneous tissues. In this case, the patient may notice poor fluid drainage.
- **Flushing PD Catheter with Heparin:** The instillation of heparinized PD fluid into the PD catheter followed by immediate drainage of the same in order to maintain the patency of the peritoneal catheter. This procedure should be done for new catheters post-surgery, catheters not in use, during peritonitis and if necessary.
- **Healed Exit Site:** An exit site is considered healed when the skin around the exit site looks intact with no skin gaping or crusting and no erythema, discharge, or tenderness.
- **Hemoperitoneum:** Defined as blood loss into the peritoneal cavity that results in cloudy/bloody effluent.
- **Hydrothorax:** It is an uncommon, but well- recognized complication of PD. It occurs due to the leak of dialysate across the diaphragm into plural space which results from increased intra-abdominal pressure.
- **Intermittent Peritoneal Dialysis (IPD):** it is a PD model with frequent and short cycles performed over 8 -10 hours per session, 2- 3 times weekly. It can be done manually or via the PD machine.
- **KT/V:** It is a formula for measuring dialysis adequacy. K is a clearance of urea in mL/min; t= time and V= volume of urea distribution.
- **Peritoneal Catheter:** It is a permanent soft and flexible tube, made of silicon and is used to allow the solution to flow in and out of the peritoneal cavity. There are different types of PD catheters: single-cuff catheter versus double cuffs catheter and straight catheter versus coiled catheter.
- **Peritoneal Dialysis (PD):** It is a treatment that uses a natural membrane (Peritoneal membrane) in the body for fluid and solute exchange. This treatment involves the removal of waste products, excess fluid and the adjustment of acid-base and electrolyte imbalances. A dialyzing solution

(dialysate) is instilled into the peritoneal cavity for a period known as a dwell period. Following the dwell period, the fluid (Effluent) containing waste products such as urea, creatinine, electrolytes, and amino acids is drained and replaced by fresh dialysate. For this treatment to work, the patient requires a PD catheter to be inserted into the peritoneal cavity.

- **PD Exchange or Cycles:** PD has repeated fluid exchange or cycles that involve:
  1) **Fill phase:** Dialysis solution is infused into the peritoneal cavity through the peritoneal catheter.
  2) **Dwell phase:** Dialysate remains in the peritoneal cavity which allows ultrafiltration and diffusion to occur.
  3) **Drain Phase:** The dialysate, the ultrafiltrate fluid, electrolytes and wastes are drained from the peritoneal cavity through the peritoneal catheter.
- **Peritoneal Equilibrium Test (PET):** A standardized method for assessing the peritoneal membrane function and it is used for tailoring an appropriate, individualized PD prescription.
- **Peritonitis:** An inflammation of the peritoneum (the tissue that lines the inner wall of the abdomen and covers the abdominal organs). Peritonitis is usually caused by infection from bacteria or fungi.
- **Recurrent Peritonitis:** An episode that occurs within **four** weeks of therapy completion of a prior episode but **with a different organism**. It should be counted as another episode when calculating the peritonitis rate.
- **Refractory Peritonitis:** Failure of the effluent to clear up after five days of appropriate antibiotics.
- **Relapsing Peritonitis:** An episode that occurs within four weeks of therapy completion of a prior episode but **with the same organism**. It should not be counted as another episode when calculating the peritonitis rate.
- **Tidal PD (TPD):** An automated process that fills and drains the dialysis fluid, but keeps a designated amount of fluid at the drain time so that the peritoneum cavity never completely empties. It is a good choice for patients with severe abdominal pain during the draining phase.
- **Transfer Set:** It is an extension tubing that connects the PD catheter to the bag of dialysis solution. It is attached to the main peritoneal catheter that approaches the peritoneum. All procedures associated with peritoneal dialysis take place at the transfer set and it protects the main catheter from contamination and infection.
- **Tunnel:** The part of the catheter that is tunneled through the subcutaneous tissue and the rectus muscle.

- **Tunnel Infection (TI):** Presents as erythema, edema or tenderness over the catheter's subcutaneous pathway, but is often clinically invisible and can be detected only by ultrasound studies. TI usually occurs with exit site infection (ESI) but rarely occurs alone.
- **Ultrafiltration:** Excess fluid and substances that have passed through the semipermeable membrane during dialysis. Calculated by (ultrafiltration = fill volume – effluent volume).

# CHAPTER ONE:

## 1. Introduction

Kidney disease in Oman and other parts of the world is one of the most challenging diseases because of its serious impact on survival and patient's quality of life. Peritoneal dialysis (PD) is one of the options for treating end stage kidney disease (ESKD). There is a great deal of misinformation and lack of expertise concerning the type of dialysis. A team approach is very much emphasized on peritoneal dialysis program, with the peritoneal dialysis nurses being the key to a successful program. Furthermore, without an educational program, most patients simply default from their treatment.

This document has been developed in an effort to improve the practice of peritoneal dialysis service in the Ministry of Health (MOH) facilities and it is expected to be a roadmap for running a successful PD program in Oman.

## 2. Purpose

The purpose of this document is to provide a national standing operating procedures for the care of patients on peritoneal dialysis therapy. The objective is to standardize PD practice among the MOH's renal dialysis facilities which is supported by evidence-based practice.

## 3. Scope

This SOP applies to all the medical and nursing staff in the renal medicine units. All members of the multidisciplinary team are responsible for the care they deliver. They should base their practice on the best available evidence to provide effective and safe patient care.

## 4. Structure

Chapter (2) Methods and Procedure Used in Peritoneal Dialysis

Chapter (3) Requirements for the PD program

Chapter (4) Annexes, Resources and References

# CHAPTER TWO

## Methods and Procedures Used in peritoneal Dialysis

1. **Setting up Peritoneal dialysis (PD) Service**
2. **Procedure for Initiation of PD Service**
3. **Peritoneal Dialysis for Children**
4. **Volume Management in Peritoneal Dialysis**
5. **Maintenance of Euvolemia**
6. **Warming of PD Solutions**
7. **Changing a Transfer Set**
8. **Applying PD Catheter Adapter (Titanium Adapter)**
9. **Adding Medications to the PD solution**
10. **Flushing PD catheter with Heparin**
11. **Specimen Collection: PD Effluent**
12. **Immediate Post- operative care of Peritoneal Dialysis Exit Site (Un-Healed)**
13. **Exit Site Care- For Chronic Healed Wound**
14. **Prevention, Diagnosis and Treatment of PD- related infections**
15. **Peritonitis Rate**
16. **PD Catheter Removal and Replacement**
17. **Noninfectious Peritoneal Dialysis Complications**
18. **Training in Peritoneal Dialysis**
19. **Home Visit**
20. **Patient follow-up in the PD clinic**
21. **Peritoneal Dialysis Adequacy**
22. **Disposal of Used PD supplies and PD fluids Waste**
23. **Continuous Quality Improvement**

1. **Setting up Peritoneal Dialysis Service**

The main requirements needed to establish a successful PD service are:

1.1 The establishment of a PD clinic can be in any health facility that has a dialysis unit and it should include:

1.1.1 Well-equipped and furnished Section (clean bed, washbasins with tap water handle and trolleys carrying necessary items to perform PD procedures).

1.1.2 Education and Training Section (educational materials, a demonstrative dummy, APD machine, samples of PD catheters and samples of PD solutions).

1.1.3 Nursing Office including desk, chairs, a telephone/fax, and a computer with a printer.

1.1.4 Store/ small area in the unit consisting of suitable supplies that may be needed in emergencies such as PD catheters, Titanium Adapters, PD solutions of different types with different concentrations and volumes, separate drainage bags, surgical items as well as PD's accessories such as mini-cap, cassette and etc.

1.1.5 Dirty Utility room (preferred to be available to use for waste contaminated with body fluids such as dialysis drainage). Health care providers must comply with the infection control practices in their health care settings.

1.1.6 The clinic should be run by nephrologists and PD nurses **(who must have experience and training in PD)**.

1.2 Availability of a motivated and a dedicated PD team which includes nephrologists, PD nurses and focal points from the following specialties: a surgeon, a pharmacist, a psychologist, a pediatrician, a social worker and a dietitian.

1.3 Continuous education and training of medical and nursing staff.

1.4 Patient education program.

1.5 Continuous monitoring and evaluation program.

1.6 Home visit program.

1.7 Home delivery for PD supply.

1.8 Surgical and Medical items indent.

2. **Procedure for Initiation of PD Service**

There are 9 key steps that have been highlighted if the hospital plans to start a patient on PD successfully:

### 2.1 Identify all potential PD candidates:

The selection criteria for national PD inclusion at present include the following:

2.1.1 New ESKD patients who are fit to be on PD (refer to section 2.2).

2.1.2 Patients who are not tolerating HD.

2.1.3 Pediatric patients with ESKD.

2.1.4 Young Adults aged (13-16) years with ESKD

2.1.5 Patients with multi-vascular access failure.

2.1.6 Patients with heparin-induced allergy.

2.1.7 Patients who have difficulty reaching the HD centers.

2.1.8 Patients who are at high risk for HD because of any other medical conditions such as heart disease.

### 2.2 Assess for PD eligibility

This step requires an assessment of any contraindications or barriers to initiation of PD:

#### 2.2.1 Contraindications

This may disqualify the patient from being on PD; however, each case should be individually assessed:

2.2.1.1 Morbid obesity with a BMI of more than 40 kg/m2.

2.2.1.2 Previous multiple abdominal surgeries and extensive abdominal surgery such as laparotomy that may disrupt the peritoneum and cause adhesions.

2.2.1.3 Abdominal malignancy or Bowel ischemia.

2.2.1.4 Severe diverticular disease of the colon.

2.2.1.5 Recurrent chronic backache with preexisting disc disease.

2.2.1.6 Large abdominal hernias that cannot be repaired.

2.2.1.7 Chronic constipation dependent on laxatives.

2.2.1.8 Severe chronic obstructive pulmonary disease

2.2.1.9 Previous unresolved peritonitis because of other reasons.

2.2.1.10 History of poor adherence

#### 2.2.2 Barriers

Factors that make the therapy a challenge, but that do not contraindicate it and can be overcome if solved or sufficient support is available to the patient**:**

2.2.2.1 Psychiatric diseases such as Schizophrenia or a behavioral disorder.

2.2.2.2 Poor general hygiene.

2.2.2.3 General weakness (Bedridden).

2.2.2.4 Impaired vision.

2.2.2.5 Cognitive impairment

2.2.2.6 Addiction/ substance abuse

2.2.2.7 Lack of a proper place for dialysis at home.

2.2.2.8 Elderly patients with no caregivers.

**2.3 Offer PD if Eligible**

PD should be offered as a treatment modality to all patients who are eligible and have no contraindications.

**2.4 Notification to add the patient to the contract list (approval process)**

2.4.1 Before catheter insertion, an official letter should be sent by the governorate's hospital to the Department of Non-Communicable Disease (Department of NCD) in the Ministry of Health. The department of NCD in turn will send the notification to the Directorate General of Medical Supplies (DGMS) to add the patient to the contract list.

2.4.2 For patients who need to start the PD treatment immediately as a lifesaving measure, initiate the PD procedure immediately and send the notification letter with the date of catheter insertion mentioned in the letter.

**2.5 Pre- Catheter insertion**

Prior to catheter insertion, the PD team should give the patient an appointment to visit the nephrology clinic or pre-dialysis clinic for:

2.5.1 Scheduling an appointment for the surgery.

2.5.2 Blood workup.

2.5.3 Physical assessment.

2.5.4 ECG (If required).

2.5.5 ECHO (If required).

2.5.6 Chest X-ray (If required).

2.5.7 Abdomen X-ray.

2.5.8 Review by a surgeon and an anesthetist (Not required in case of percutaneous insertion).

2.5.9 Environmental assessment for the possibility of PD

2.5.10 Psychosocial assessment for the possibility of PD.

2.5.11 Pediatric case (Refer to Child Psychologist or Adolescent Pediatrician if available).

2.5.12 Consent.

**Despite the above preparation process, for emergency cases, catheter insertion procedures may be done at the bedside (For adults only).**

## 2.6 Patient Admission

On the day of admission, which may be the day before surgery, the PD team must ensure the following:

2.6.1 Identify a suitable length of the catheter.

2.6.2 Abdominal site marking (Marking of the entry and exit sites for the catheter).

2.6.3 Pre-operative antibiotic prophylaxis.

2.6.4 Bowel preparation with laxatives.

2.6.5 Ensuring bladder emptying.

2.6.6 Body hygiene and surgical site preparation.

## 2.7 PD catheter Insertion

Different factors should be considered when inserting PD catheters:

2.7.1 It is highly recommended that an experienced PD team performs the catheter insertion.

2.7.2 Currently, PD catheters must be inserted by an Expert Surgeon, Interventional Nephrologists, or Interventional Radiologists depending on the service availability and experience.

2.7.3 Avoid the midline location of the PD catheter. The location of the exit sites should be para-median or lateral abdominal as this location permits better tissue ingrowth around the cuff due to the richer vascularization of the muscle tissue, which will minimize the risk of peritoneal leak.

2.7.4 To reduce the incidence of early-onset peritonitis, pre-operative antibiotic prophylaxis is recommended within 60 minutes before the incision for PD catheter placement.

2.7.5 Implantation technique involves open surgical technique, percutaneous technique, or laparoscopy.

2.7.6 The choice of the technique depends on the operator's expertise, availability of the operator and the urgency of the situation.

2.7.7 Post-operative care of the catheter includes the following: flushing the catheter, covering the exit site with a suitable non-occlusive dressing and avoiding usage of the catheter for 5 – 10 days.

2.7.8 Catheter insertion should be performed at least two weeks before initiating PD.

2.7.9 Earlier needs or temporal needs for dialysis: use small dialysate volumes in the supine position or frequent exchanges with cycler and short dwell time.

**2.8 Selection of PD Solution & Dialysis Prescription**

Successful peritoneal dialysis therapy depends on long-term preservation of the peritoneal membrane, which can be achieved through the following considerations:

2.8.1 Euvolemia is critical to improving patient outcomes.

2.8.2 Adequate Ultrafiltration (UF) is a central goal when writing a PD prescription.

2.8.3 The initial prescription for peritoneal dialysis depends on body volume status, residual Kidney function (RKF) and time of initiating PD.

2.8.4 According to the Peritoneal Equilibration Test (PET), peritoneal membranes are classified as high, high average, low average, and low transporter. This test can be done by using 2.27 % dextrose (or equivalent) with fill volume depending on the body surface area. Then at 0, 2 and 4 hours evaluate the drain volume & the creatinine clearance (Dialysate/Plasma=D/P). (Appendix 6).

2.8.5 Patients with high or high average membrane transport tend to have poor UF. As they attain equilibrium, the dialysate solution is reabsorbed very fast. Therefore, these patients should be on short dwelling time, higher glucose dialysate or Icodextrin use and diuretics to preserve residual kidney function.

2.8.6 Patients with low and low average membrane transport tend to have appropriate UF with poor solute clearance; therefore, improving clearance should include long dwell time.

2.8.7 Icodextrin is favorable for both adults and children. It is effective in enhancing ultrafiltration and in improving clearances.

2.8.8 The use of Icodextrin, which is the glucose polymer PD solution is recommended for: patients with high and high-average peritoneal transport, patients who have ultrafiltration problems and CAPD patients as last exchange.

2.8.9 Icodextrin should only be used once daily to avoid excessive plasma maltose and high molecular weight polymer concentrations.

2.8.10 The use of Icodextrin may give **false high glucose readings** due to its products such as maltose. Therefore, the PD nurse must adjust the glucose monitor with Icodextrin or ensure that the patient is using a glucose monitor device that is glucose- specific.

2.8.11 If Icodextrin is not available, hypertonic (3.86% or 2.27% dextrose solutions) can be used but not as a chronic therapy to avoid excessive glucose exposure and to preserve the membrane for a longer period.

2.8.12 Anuric patients who consistently achieve daily ultrafiltration of less than 750 ml should be closely monitored and changing the modality can be considered.

**2.9 Start PD therapy**

After receiving the acceptance of adding the patient to the contract list, the PD team (PD nurse focal point or one of the PD nurses) at the hospital should ensure the following:

2.9.1 The patient completed all the steps of initiating PD therapy.

2.9.2 The patient and caregivers completed the training process (Page 35) and they are competent to perform the treatment procedures at home after discharge (Train at least 2 caregivers).

2.9.3 Contact the company that supplies the PD solutions to confirm that the patient has all the PD consumables at home including the PD machine for APD before discharging him from the hospital.

2.9.4 Include patient's details such as full name, patient's hospital number, civil number, date of catheter insertion & type of PD therapy in the PD monthly report (do not include the patient in the list until the patient has already started PD successfully with no complaints).

## 3. Peritoneal Dialysis for Children

### 3.1 Initiating Peritoneal Dialysis for Children

3.1.1 PD helps children with ESKD to attend schools regularly and perform activities. Furthermore, PD avoids complications associated with vascular access which can be problematic.

3.1.2 PD is the modality of choice in children undergoing kidney Replacement Therapy (KRT) until the ultimate goal of kidney transplant is reached.

3.1.3 There are specific aspects of the pediatric population that have to be considered in order to accomplish adequate peritoneal dialysis treatment. These include the following:

3.1.3.1 It must be initiated by a qualified and trained pediatric team for catheter insertion, PD management and continuous PD care.

3.1.3.2 It should be initiated when the estimated Glomerular Filtration Rate (eGFR) is less than 15 ml/min/1.73 m2, or when there are symptoms and signs of uremia or growth failure.

3.1.3.3 The use of PD solutions with low glucose content.

3.1.3.4 The rapid growth must be accompanied by a positive calcium balance.

3.1.3.5 Tissue fragility with the rapid increase in the intra-abdominal fat mass.

### 3.2 Catheter Insertion for Children

3.2.1 The use of a double-cuff Tenckhoff catheter with a downward or lateral subcutaneous tunnel design is appropriate for children.

3.2.2 Pre-operative antibiotic prophylaxis is recommended within 60 minutes before the incision for PD catheter placement.

3.2.3 Post-operative exit site care: After catheter insertion, if no leaking, bleeding or discharges, dressing change and catheter mobilization should be avoided during the first two postoperative weeks.

3.2.4 After 2 weeks, once-weekly sterile dressing to the exit site is recommended until the exit site is well healed, then it can be done on alternate days.

3.2.5 If leaking or bleeding is observed, then the dressing must be changed immediately.

### 3.3 Optimal Fill Volume for Children

3.3.1 Fill volume should be prescribed initially to be well tolerated by the patient, but thereafter fill volume should be modified according to the individual patient's needs.

3.3.2 In children older than 2 years, the assumed optimal fill volume should be increased step-wise close to the upper limit of 1,200–1,400ml/m2 for a nocturnal exchange in the prone position.

3.3.3 In infants younger than 2 years, the fill volume is based more on tolerance than on an optimal dialytic exchange volume. The fill volume should not exceed 800 ml/m2 or 30–50 ml/kg body weight.

### 3.4 Optimal Dwell time for children

3.4.1 Since the body size changes rapidly in children, frequent adjustment of dwell volume and dwell time is required.

3.4.2 One-hour dwell time is a typical choice for the initial APD prescription in children. Then, re-evaluated and modified based on the individual patient's needs taking into consideration:

3.4.2.1 Patient's growth

3.4.2.2 Residual kidney function

3.4.2.3 Peritoneal membrane function

3.4.2.4 The desired clinical goals which are ultrafiltration or phosphate purification:

3.4.2.4.1 Short dwell time results in adequate ultrafiltration and urea purification.

3.4.2.4.2 Long dwell time results in high creatinine and phosphate clearness but with the risk of impaired ultrafiltration.

### 3.5 Appropriate solution for children

3.5.1 Peritoneal dialysis (PD) fluids contain electrolytes such as sodium, chloride, calcium and magnesium which are required to maintain blood composition.

3.5.2 In children, the usage of pH-neutral solutions with a low concentration of glucose degradation products (GDPs) and bicarbonate or a bicarbonate/lactate mixture as a

buffer has been associated with better membrane preservation and improved cell function.

3.5.3 Icodextrin is favorable for both adults and children and it is an effective method to enhance ultrafiltration and improve clearance.

3.5.4 Icodextrin containing lactate as a buffer, improves long-term preservation of the peritoneal membrane and improves cardiovascular health as well as long-term survival.

**3.6 PD Training in Children**

3.6.1 PD training for caregivers should be performed by an experienced PD nurse who specializes in the pediatric field.

3.6.2 Re-training should be provided to all caregivers 3-4 weeks after initial training and routinely thereafter (once yearly at minimum).

3.6.3 Re-evaluation of the PD technique should be conducted after the development of a peritonitis episode.

3.6.4 Specific issues such as growth, nutrition, gastrostomies and behavioral changes should be managed promptly.

**4. Volume Management in Peritoneal Dialysis**

4.1 volume overload is common in PD and it can result from inadequate peritoneal ultrafiltration, reduced residual kidney function or increased dietary salt and fluid intake.

4.2 volume overload can be managed by:

4.2.1 Fluid and salt restriction.

4.2.2 Ensure proper adherence to prescription.

4.2.3 Rule out constipation.

4.2.4 Rule out hernias or leaks.

4.2.5 Rule out catheter flow dysfunction.

4.2.6 Optimize glycemic control.

4.2.7 Maximize loop diuretics for patients with residual kidney function > 100 mL/day or thiazide-like diuretics to enhance fluid removal in this population.

4.2.8 Hypertonic 3.86% dextrose solution may be required to achieve euvolemia; however, long term use of such solution is not desirable.

4.2.9 Icodextrin solution is preferred for long-duration (>8-hour) dwells.

4.2.10 Patients with high or high average solute transport are at the greatest risk of fluid reabsorption and should be considered for APD and icodextrin.

4.3 Fluid depletion (hypovolemia) is less common which may result from vigorous removal of fluid during dialysis or by recurrent diarrhea or vomiting. Patients usually present with symptomatic postural hypotension, nausea and weakness. It can be managed by:

4.3.1 Ruling out underlying causes.

4.3.2 Holding antihypertensives and diuretics.

4.3.3 Considering IV fluids.

4.3.4 Discontinuing the use of any hypertonic PD solutions.

**5. Maintenance of Euvolemia in PD**

5.1 All PD patients should have established dry weight within the first 30 days of PD initiation and should be monitored regularly for consistent achievement of this dry weight and volume status every 1-3 months or more frequently according to clinical stability.

5.2 Net daily peritoneal UF volume of <750 mL in anuric patients or <250 ml with RRF and should be an indication for careful evaluation of volume status.

5.3 Focusing on salt and water intake, blood glucose control in diabetic patients, cardiac status, changes in RRF, adherence to the PD prescription, mechanical complications and changes in peritoneal membrane function.

5.4 If membrane failure is suspected, assessment with a modified (3.86% dextrose) PET is required. A peritoneal UF volume of less than 400 mL over 4 hours with a 3.86% dextrose PET is a good indicator of UF failure, after excluding other causes such as Leak or Catheter Dysfunctions.

**6. Warming of PD Solutions**

6.1 PD solutions should be warmed prior to inflow and should be used as soon as possible following heating.

6.2 The following dry heating methods can be used to warm PD solutions prior to infusion: heating pads, heating/warming cupboards, or manufacturer-supplied warming devices.

6.3 The measured solution's temperature prior to inflow should be approximately 37 degrees C (+/- 0.5 degrees C).

6.4 The solution's temperature can be checked by folding the bag over an electronic thermometer probe.

6.5 Water baths should not be used for heating solutions due to the potential of water borne organism contamination to the system.

6.6 The PD solution should appear clear in color prior to infusion and the bag should be discarded if the solution appears brown following exposure to the heat source.

6.7 All staff, patients and caregivers should receive specialized training that aims at mitigating potential risk factors associated with warming of PD solutions such as hot spots and glucose degradation products (GDP) formation.

**7. Changing a Transfer Set**

To ensure patient safety and reduce the risk of infection, the transfer set should be replaced in the following conditions:

7.1 Every 6 months as part of the routine PD care.

7.2 Immediately after a Peritoneal Dialysis catheter (PDC) contamination.

7.3 Whenever a PDC or extension set is damaged or faulty.

**8. Applying PD Catheter Adapter (Titanium Adapter)**

This adapter needs to be replaced in the following conditions:

8.1 When the titanium adapter is damaged or faulty.

8.2 If a PDC titanium adapter is pulled or cut off.

8.3 Whenever a PDC has a split or hole.

**9. Adding Medications to the PD solution**

PD patients sometimes need to add medications to their dialysis fluid. The medications added are mainly heparin, calcium & potassium supplements or antibiotics. Therefore, to add medications safely and minimize the complications, the following issues should be considered:

9.1 The addition of a medication to the dialysis solution requires a physician's order, which must be patient-specific and should include the drug name, dosage, route of administration and frequency.

9.2 Staff nurses are responsible for adding the prescribed medication to the PD dialysate and should explain to the patient the methods of how to using and storing it.

9.3 Dialysis solution bags with added medications should be used according to the stability of the medication (Appendix 7).

## 10. Flushing PD catheter with Heparin

**10.1** Flushing of a catheter with heparin should be done at the hospital by a physician or a PD nurse and it is recommended in the following situations:

10.1.1 Weekly to maintain patency of a newly inserted PD catheter.

10.1.2 Weekly to maintain the patency of an old PD catheter that is not in use.

10.1.3 To resolve a blocked or poorly flowing PD catheter.

10.1.4 Heparin lock after flushing a new PDC is also recommended to prevent blockages.

10.1.5 Frequent Flushing is required for patients with severe hemorrhagic drain till it gets clear.

10.1.6 Heparin lock dose is 1000 Units (1ml) heparin mixed with 9 ml Normal Saline and instilled depending on catheter diameter.

**10.2** There are some cases where heparin should be avoided:

10.2.1 Patients with or at risk of heparin-induced thrombocytopenia (HIT) and thrombosis syndrome.

10.2.2 Patients with signs of acute bleeding from a non-compressible site including postoperative, cerebral, Gastrointestinal (GI), haemothorax and hemorrhagic pericarditis.

10.2.3 Patients who have an allergy or hypersensitivity to heparin.

## 11. Specimen Collection: PD Effluent

Consider the following whenever cloudy effluent is present:

11.1 Patients presumed to have peritonitis and should be treated after appropriate workup and specimen collection until the diagnosis is confirmed or excluded.

11.2 PD effluent should be tested for cell count, differential, Gram stain, and culture to confirm the diagnosis of peritonitis.

11.3 An empiric diagnosis of peritonitis is to be made if the effluent's WBC count is greater than 100/$mm^3$ and at least 50% of WBC are polymorph nuclear (International Society for Peritoneal Dialysis).

11.4 If the patient has abdominal pain and the effluent is clear, peritonitis must be excluded.

11.5 Some peritonitis episodes are associated with clear effluent. Therefore, repeated assessment of the effluent for cloudiness should be conducted with subsequent exchanges.

**12. Immediate Post- Operative Care of Peritoneal Dialysis Exit Site (Un-Healed)**

Patients with newly inserted peritoneal dialysis catheters (PDC) are predisposed to complications and PD-related infections post-surgery, therefore, it is crucial to protect the catheter and exit site through:

12.1 Cover all incisions and leave the dressing undisturbed for 5 to 7 days to allow epithelialization and wound healing.

12.2 Closely assessing and monitoring PDC exit-site and midline wounds for excessive bleeding or leaking.

12.3 Weekly change of exit site dressing for a minimum of 3 weeks from the time of PDC insertion.

12.4 No bathing or showering from the time of PDC insertion until wound healing.

12.5 Always secure and tape down the tip of PDC to the abdomen to prevent accidental trauma.

12.6 Changing the dressing immediately if it is displaced or wet.

12.7 PDC exit site dressing may need to be changed more frequently if the exit site wound is bleeding or leaking excessively.

**13. Exit Site Care- For Chronic Healed Wound**

Patients with healed PDC exit sites continue to remain at risk for catheter-related complications; therefore, it is crucial to protect the catheter and exit site to prevent complications, contamination or infection. The following measures are essential for routine care:

13.1 The nurse trainer should instruct the patients to wash their hands with antibacterial soap or rub with an alcohol-based antiseptic agent prior to touching the exit site.

13.2 Patients should be advised to change the exit site dressing daily and after every shower.

13.3 Instruct patients that wet dressings are to be replaced immediately to prevent fungal exit site infections.

13.4 Daily application of mupirocin ointment or cream to the skin around the exit site is effective in reducing *S. aureus* exit-site infection and possibly peritonitis (ISPD 2016).

13.5 Instruct the patient on PD catheter immobilization and avoidance of mechanical stress on the exit site.

13.6 Secure the PDC by taping it down to the abdomen to prevent dangling, pulling or twisting which could result in exit site trauma.

13.7 Aggressive treatment of exit- site infections with prompt catheter replacement if necessary as the exit-site infections may lead to peritonitis.

## 14. Prevention, Diagnosis and Treatment of PD-Related infections

### 14.1 Prevention of PD- Related Infections

PD- related infections are exit site infections, tunnel infections and peritonitis. Exit site infections and tunnel infections are called catheter- related infections and are major predisposing factors for peritonitis. **There are many strategies to prevent PD-related infections:**

14.1.1 Prophylactic antibiotics must be administered prior to catheter insertion.

14.1.2 Adherence to aseptic procedures to reduce the incidence of catheter-related infections.

14.1.3 The use of nasal antibiotic prophylaxis is recommended if the patient is identified as being nasal S. aureus carries on screening prior to PD catheter insertion.

14.1.4 The exit-site location should be chosen carefully so that it can be conveniently cleaned and accidental trauma can be prevented.

14.1.5 Whenever possible, catheter insertion should be performed at least two weeks before starting PD to allow for adequate healing of the operation site, which in turn will decrease the risk of dialysate leakage and prevent further infections.

14.1.6 PD training to be conducted by qualified and experienced nursing staff.

14.1.7 Identification of appropriate caregiver or helper for the patient to perform the procedure at home (at least 2 caregivers).

14.1.8 A home visit by the PD team is highly recommended to detect problems with exchange techniques, adherence to protocols and other environmental and behavioral issues that increase the risk of infections.

14.1.9 Routine evaluation of the needs for re-training at 6 months and yearly thereafter.

14.1.10 Follow the measures of exit site care (5.9) and (5.10).

14.1.11 The use of a double-bag system with the Y-connection when flushing PD system tubing is effective in preventing peritonitis.

14.1.12 Avoid penetration of PD fluid bags.

14.1.13 Antibiotic prophylaxis **must** be given before any invasive procedure such as dental, colonoscopy, polypectomy, hysteroscopy and cholecystectomy.

14.1.14 Treat constipation.

14.1.15 Every PD unit should monitor its infection rate at least yearly as part of Continuous Quality Improvement (Key Performance Index KPI).

## 14.2 Diagnosis of PD-Related Infections (Exit Site Infection, Tunnel Infection and Peritonitis)

### 14.2.1 Exit Site & Tunnel Infection

14.2.1.1 Exit site infection is characterized by the presence of purulent discharge with or without erythema of the skin at the catheter epidermal interface.

14.2.1.2 Tunnel Infection is characterized by the presence of clinical inflammation (erythema, swelling, tenderness or induration) with or without ultra-sonographic evidence of a fluid collection anywhere along the catheter tunnel.

### 14.2.2 Peritonitis

14.2.2.1 Peritonitis should be diagnosed when at least two of the following are present:

14.2.2.1.1 Clinical features consistent with peritonitis (abdominal pain and/or cloudy dialysis effluent).

14.2.2.1.2 Dialysis effluent white cell count > 100/mL or > 0.1 x $10^9$/L (after a dwell time of at least 2 h) with > 50% polymorph nuclear leukocytes (PMN).

14.2.2.1.3 Positive dialysis effluent culture.

14.2.2.2 The diagnosis of peritonitis in patients on automated PD with night dwell (dry day-time) is slightly more difficult than in those on CAPD.

14.2.2.3 The International Society for Peritoneal Dialysis (ISPD) recommends using the proportion of polymorphonuclear cells rather than the absolute numbers (> 50% is diagnostic even if the cell count is < 100/μL).

14.2.2.4 The PD nurse is advised to collect the Specimen:

14.2.2.4.1 If the patient brings the drainage bag or has the PD fluid remaining in the abdomen with a minimum dwell time of 2 hours,

A. Use an aseptic technique to drain 0.5- 1L from the drainage bag.

B. Collect fluid samples and send for fluid cell count, gram stain, culture and sensitivities (use blood C/S bottle).

14.2.2.4.2 If the patient did not bring the drainage bag or has no PD fluid remaining in the abdomen with a minimum dwell time of 2 hours,

A. Instill 1-2 L of low CAPD dialysate.

B. Dwell for 2 hrs.

C. Drain and use an aseptic technique to collect fluid samples for fluid cell count, gram stain, culture and sensitivities.

14.2.2.5 Sometimes a second exchange with a dwell time of at least 2 h can confirm the diagnosis.

14.2.2.6 Pseudomonas aeruginosa and Staphylococcus aureus are the organisms that most often result in catheter infections and subsequent peritonitis.

**14.3 Management of PD-Related Infections (Exit Site Infection, Tunnel Infection and Peritonitis)**

14.3.1 An empirical antibiotic therapy should be initiated immediately after microbiological specimen collection.

14.3.2 The empirical antibiotic plan should cover both gram-positive and gram-negative organisms.

14.3.3 Once culture and sensitivity results are known, the appropriate antibiotic adjustment should be made.

14.3.4 For catheter-related infections (Exit- Site Infection & Tunnel Infection):

14.3.4.1 Erythema but no pus discharge, Topical Mupirocin or Chlorhexidine can be applied (For exit Site Infection).

14.3.4.2 Exit site inspection and cleansing daily till no discharge.

14.3.4.3 For Gram-positive organisms: Cephalosporin, Flucloxacillin, Vancomycin or Rifampicin can be given.

14.3.4.4 For Gram-negative organisms: Ciprofloxacin or Gentamicin can be prescribed.

14.3.4.5 For Pseudomonas species, Ciprofloxacin can be used.

14.3.4.6 Oral Antibiotic therapy must be continued for a minimum of 2 weeks until the exit site appears entirely normal (Appendix 1& 2).

14.3.4.7 Treatment for 3 weeks is probably necessary for ESI caused by *P. aeruginosa*.

14.3.4.8 For catheter tunnel Infection, antibiotics can be administered orally, intra-peritoneal (IP) or intravenous (IV) after the culture result is obtained unless signs of severe infection are present, in which case antibiotics may be started empirically.

14.3.4.9 In the case of fungal infection, the action is to remove the catheter and start on systemic antifungal.

14.3.4.10 For patients with **unresponsive exit site and tunnel infection without peritonitis**, catheter removal and reinsertion of a new PD catheter under antibiotic coverage are recommended.

14.3.4.11 For patients with **exit-site or tunnel infections with peritonitis (or refractory peritonitis),** PD catheter removal should be followed by temporary hemodialysis with no attempted reinsertion of the PD catheter until at least 2 weeks after catheter removal and complete resolution of peritoneal symptoms.

14.3.4.12 Catheters should be **removed** when there is a recurrent infection due to the same organism, exit site infection unresponsive to medical therapy, presence of tunnel tract abscess or associated peritonitis.

14.3.5 For Peritonitis, ISPD (2022) recommends that gram-positive organisms be covered by vancomycin or a first-generation cephalosporin and gram-negative organisms by a third-generation cephalosporin or an aminoglycoside. (Appendix 3& 4).

14.3.6 The length of antibiotic therapy for the treatment of peritonitis should be at least 2 weeks and at least 3 weeks in case of severe infections.

14.3.7 For fungal PD peritonitis, it is recommended to remove the PD catheter immediately with the addition of antifungal treatment for a minimum of 2 weeks after catheter removal.

14.3.8 Consider catheter removal for: relapsing peritonitis, refractory peritonitis, recurrent peritonitis, fungal peritonitis and unresponsive exit-site and tunnel infection.

14.3.9 Intraperitoneal (IP) antibiotics are the preferred route of administration via PD solutions unless the patient has systemic sepsis features.

14.3.10 For APD patients with peritonitis, antibiotics could be administered IP into the bag of day-time long dwell PD solution. The patient could be temporarily converted to CAPD depending on the antibiotic and the type of the organism.

14.3.11 Intraperitoneal heparin is recommended to prevent fibrin formation in the PD fluid.

14.3.12 Daily visual inspection of dialysis effluent to monitor the clinical improvement and repeat cell count (WBC) and culture after 48 hours.

14.3.13 Prophylaxis of secondary fungal peritonitis by Nystatin or Fluconazole to prevent secondary candida peritonitis in patients receiving antibiotic therapy.

14.3.14 Antibiotic stability in PD solutions should be considered (Appendix 7).

## 15. Peritonitis Rate

The International Society for Peritoneal Dialysis, 2022 (ISPD) recommends that the **incidence and outcomes of peritonitis** in each PD unit should be monitored at least yearly. The monitoring parameters should include:

- The PD-related peritonitis rate.
- Peritonitis rates of specific organisms.
- The percentage of patients per year who are peritonitis-free.
- The antimicrobial sensitivity of the infecting organisms.

### 15.1 Calculate peritonitis rate

#### 15.1.1 Method (1) Episode per patient-months

A. Calculate how long each patient was on PD treatment in months.

B. Calculate the total number of all patient months.

C. Calculate the total number of peritonitis episodes.

D. Divide the total patient months by the number of peritonitis episodes.

**Example**

A. Patient “1” started PD in May 2022 = 20 months until the end of 2023, patient “2” started in March 2023 = 10 months until the end of 2023), do the same with all patients in the program.

B. Let us say, there are 82 patients in the program by end of 2023 and the total number of months was 1870 months. There are 7 peritonitis episodes.

C. 1870/7= 267.

D. Peritonitis rate is 1 per 267 patients' months.

** (ISPD recommends 1 episode per 18 patient month or above)

**15.1.2 Method (2) Episode per patient – year**

A. Total number of peritonitis episodes.

B. Total patients' months

C. Divide the number of episodes by the total months on PD, multiply by 12

**Example**

A. There are **7** peritonitis episodes in the program in 2023. The total patient-months was 1870 months.

B. 7/1870= 0.0037 x 12 = 0.04 episode/year

**ISPD (2022) recommended that the overall peritonitis rate Should be no more than 0.4 episodes per year at risk.

** The initial episode and all relapsing episodes (whatever number) should be calculated as a single episode.

## 16. PD Catheter Removal and Replacement

16.1 Consider catheter removal in:

16.1.1 Peritonitis due to surgical cause: emergency surgical intervention with PD catheter removal and empirical broad-spectrum antibiotics.

16.1.2 Relapsing peritonitis

16.1.3 Refractory peritonitis

16.1.4 Recurrent peritonitis

16.1.5 Fungal peritonitis

16.1.6 Unresponsive exit-site/ tunnel infection.

16.2 For relapsing and recurrent peritonitis, simultaneous catheter removal and reinsertion should be considered after the culture of PD fluid has become negative and the PD fluid cell count is > 100/ml with the absence of a concomitant exit site or tunnel infection.

## 17. Noninfectious Peritoneal Dialysis Complications

Although peritonitis is always considered to be the main complication of PD, there are many other noninfectious complications:

- **Hernia**
- **Fluid Leak**
- **Pain**
- **Catheter malfunction**
- **Ultrafiltration Failure (UFF)**
- **Encapsulating peritoneal sclerosis (EPS)**
- **Hydrothorax**
- **Hemoperitoneum**

### 17.1 Hernia

17.1.1 Incisional, inguinal and umbilical hernias are the most common hernias reported in PD patients.

17.1.2 They are caused by increased intra-abdominal pressure and are more common with higher volume exchanges, especially when the dialysate volume is increased to achieve adequacy.

17.1.3 An incisional hernia can occur due to the weakening of abdominal muscles secondary to multiple previous abdominal surgeries.

17.1.4 Any hernia detected before the initiation of PD should be repaired surgically prior to PD catheter insertion.

17.1.5 If the hernia occurs later, the following should be done:

A. Surgical repair of the hernia.

B. Reduction of the exchange volume.

C. Conversion to APD overnight therapy (lower intra-abdominal pressure when the patient is supine).

D. HD for 2-3 weeks after surgery depending on the size and the location of the hernia. (maybe required)

E. To reduce the risk of recurrence, delay the use of full exchange volume for the first 2 weeks of CAPD or APD.

## 17.2 Fluid Leaks

17.2.1 Early fluid leaks can be managed by discontinuing dialysis until the exit site is fully healed and lower volume exchanges should be used.

17.2.1 Consider the following steps for the late fluid leaks:

A. Discontinue PD for 2-3 weeks and the patient may shift to APD or HD, but if the patient has residual kidney function, then no other dialysis is needed till recovery.

B. Lower the volume of the daytime exchanges in the first 2 weeks of recommencing PD.

C. If leaking reoccurs, the patient may be changed to night-time APD.

## 17.3 Pain

One of the less common causes for patients dropping out from peritoneal dialysis is the presence of pain during drainage (drain pain) or during infusion (inflow pain) of PD solution (Peritoneal Dialysis International 2014).

### 17.3.1 Inflow Pain

17.3.1.1 Inflow pain (infusion pain) is common in PD.

17.3.1.2 The patient may experience abdominal pain or discomfort.

17.3.1.3 The patient may report inflow pain, which can occur in the first 2 weeks of PD and usually resolves spontaneously. If it does not resolve, it should be treated by:

A. Checking the line position, dialysate temperature and if the patient has constipation.

B. Opening the valves partially to reduce the rate of dialysate inflow.

C. Adjusting the height of the IV stand to a lower level, to slow down the instillation rate.

D. Biocompatible PD solutions (normal pH, low concentrations of glucose degradation products) should be used in patients experiencing infusion pain.

### 17.3.2 Drain Pain

17.3.2.1 It may occur as a consequence of negative pressure at the end of the drain cycle, especially with the APD machine.

17.3.2.2 It may occur if the intraperitoneal portion of the catheter in the abdomen is too low and lies against the parietal peritoneum.

17.3.2.3 The use of Tidal Peritoneal Dialysis (TPD) can resolve the pain.

17.3.2.4 Switch to CAPD as it is a gravitational drain.

## 17.4 Catheter Malfunction

It is a mechanical failure in dialysate inflow or outflow. The most common causes of catheter malfunction include catheter migration, fibrin clots, omental or bowel wrapping.

17.4.1 Catheter migration can be corrected by:

17.4.1.1 Inducing peristalsis.

17.4.1.2 Having the patient assume a knee-chest position.

17.4.1.3 Encouraging ambulation and activity.

17.4.1.4 Performing a surgical procedure (laparoscopy, fluoroscopic guide wire).

17.4.2 Fibrin clots. It can be managed by the following measures:

17.4.2.1 Catheter irrigation may be required. A large syringe can be used to flush the catheter with heparinized saline or dialysis solution.

17.4.2.2 If the catheter does not drain, attempts can be made to gently aspirate using a push/pull technique. If pressure is felt, the attempt should be stopped, so that adjacent tissue is not pulled into the catheter.

17.4.2.3 Heparin 500 u/L-1000u/L may be added to the peritoneal exchanges whenever fibrin plugs or strands of fibrin or blood are visible in the drained effluent.

17.4.2.4 Fibrinolytic therapy with tissue plasminogen (TPA) may be attempted to clear intraluminal fibrin or blood clots in a dose of 1 mg /ml based on the calculated volume of the catheter assembly.

17.4.3 Omental/bowel wrapping

17.4.3.1 The diagnosis should be confirmed by radiography

17.4.3.2 It can be corrected by laparoscopic omentectomy.

## 17.5 Ultrafiltration Failure (UFF)

It is defined as a failure to achieve at least 400 ml of net ultrafiltration during a 4 h dwell using 3.86% dextrose with the absence of catheter malfunction, fluid leaks or extensive intraperitoneal adhesions. It is a common problem in peritoneal dialysis (PD) and its

occurrence is related to changes in peritoneum functions and structure. There are four types of UFF that are related to different causes:

17.5.1 High effective peritoneal surface area.

Most common form of UFF that occurs due to changes in the peritoneal membrane over time causing a transition to a very rapid transport status.

17.5.2 Low effective peritoneal surface area.

Hypo-permeability of the peritoneal membrane that results in impairment of ultrafiltration and solute transport.

17.5.3 Low osmotic conductance to glucose.

UFF due to aquaporins deficiency where the aquaporins are decreased in the peritoneal membrane which results in inadequate water removal via the aquaporin. The clinical indicator of this type of ultrafiltration failure is the reduction in sodium filtration.

17.5.4 High total peritoneal fluid loss rate.

An increase in the rate of bulk fluid absorption from the peritoneal cavity into lymphatics and into the peritoneal tissues interstitium.

Glucose, glucose degradation products and advanced glycation end-products (AGEs) through different pathways induce inflammation, fibrosis and angiogenesis. The avoidance of glucose and natural pH fluids with fewer glucose degradation products may help to preserve the peritoneal membrane in the long term.

**17.6 Encapsulating peritoneal sclerosis (EPS)**

It is a rare but severe complication associated with long-term PD. It is characterized by intraperitoneal fibrosis and inflammation which results in the encasement of bowel loops. EPS causes bowel obstruction and ultrafiltration failure.

17.6.1 PD should be discontinued after the diagnosis of EPS.

17.6.2 Treat the underlying conditions

17.6.3 Therapeutic approaches include:

17.6.3.1 Steroid therapy and immunosuppression.

17.6.3.2 Nutritional support and assessment.

17.6.3.3 Parenteral or enteral nutrition.

17.6.3.4 Surgical enterolysis should be considered if conservative medical therapy fails.

**17.7 Hydrothorax**

It is an uncommon, but a well-recognized complication of PD. It occurs due to the leak of dialysate across the diaphragm into the plural space which results from an increased intra-abdominal pressure.

17.7.1 Characterized by breathlessness and pleuritic chest pain.

17.7.2 Examination of the pleural fluid will identify a transudate with an elevated glucose concentration. The glucose concentration in dialysate and peritoneal fluid is higher than the serum glucose concentration.

17.7.3 It may develop rapidly after PD initiation, showing a pre-existing pleuro-peritoneal communication (congenital diaphragmatic defect).

17.7.4 It also develops on long-term PD, due to a weakened tissue being repeatedly exposed to raised intra-abdominal pressure and development of pleuro-peritoneal communication (acquired diaphragmatic defect).

17.7.5 The mechanisms for hydrothorax development include:

17.7.5.1 Increased pleuro-peritoneal pressure gradients.

17.7.5.2 Congenital or acquired diaphragmatic defects.

17.7.5.3 Lymphatic drainage disorders.

17.7.6 Patients may require thoracentesis for initial relief of symptoms.

17.7.7 Temporary (2-4 weeks) PD cessation may permit spontaneous resolution of the hydrothorax and the diaphragmatic connection.

17.7.8 PD may then be reintroduced gradually with low volume in a semi-upright position.

17.7.9 A visible diaphragmatic defect should be referred for surgical repair of the diaphragmatic hernia.

17.7.10 Permanently convert to hemodialysis, if the conservative approaches fail.

**17.8 Hemoperitoneum**

It is blood loss into the peritoneal cavity that results in cloudy/ bloody effluent. As little as few drops of blood will produce obviously bloody dialysate.

17.8.1 Ovulation, retrograde menstruation, and endometriosis are common benign causes of hemoperitoneum among menstruating women.

17.8.2 Other causes: catheter-related problems, such as lacerations or contusions; sclerosing peritonitis; or retroperitoneal pathology such as cyst rupture or kidney tumors.

17.8.3 For the first occurrence of mild, self-limited bleeding in a non-menstruating patient: obtaining peritoneal fluid erythrocyte count, white blood cell count, amylase, culture, and peripheral white blood cell count is indicated.

17.8.4 Heavy or recurrent bleeding or bleeding that is associated with pain and fever requires urgent evaluation. Physical findings such as rebound tenderness or guarding should be treated as a surgical emergency.

17.8.5 Imaging studies, such as an abdominal computed tomography (CT) scan, ultrasound, or magnetic resonance imaging (MRI), may be indicated. Angiography is a last resort that may be required for a more definitive diagnosis.

17.8.6 Surgical consultation should be obtained with consideration of early laparoscopy or laparotomy.

17.8.7 It can be managed by the following measures:

17.8.7.1 Manage the underlying cause.

17.8.7.2 Instillation of heparin (500 units/L) in the dialysate to prevent clotting in the peritoneal catheter.

17.8.7.3 Frequent exchanges till the draining is clear.

17.8.7.4 Use of room-temperature dialysis exchanges.

17.8.7.5 Oral contraceptives to prevent ovulation and control bleeding among menstruating women.

17.8.7.6 Stopping aspirin or other anticoagulants should be balanced against the therapeutic indications in the individual patient.

## 18. Training in Peritoneal Dialysis

Training is an essential aspect of a successful PD program, which includes continuous education and training of medical staff (nurses and nephrologists) and patient education programs.

### 18.1 Education and training of medical staff

It is one of the most critical factors for achieving optimal PD clinical outcomes including avoidance of peritonitis and prolonging the life span of PD catheter and therapy. The following are important aspects of the education and training of the medical staff:

18.1.1 Nephrologists should undergo theoretical and practical re-training courses (two weeks- one month) and receive encouragement and support to consider PD treatment as an important modality option for the management of ESKD patients.

18.1.2 PD nurses should receive a training course at any training center available. This training should include anatomy and physiology, modalities, applications, procedures, indications, troubleshooting, advantages and disadvantages of peritoneal dialysis.

18.1.3 PD nurses should receive adequate practical exposure in other well-established PD units under the supervision of experienced staff.

18.1.4 All new nephrology nurses should receive a minimum of 2 weeks of training (can be divided into theory and practical).

18.1.5 Hospital PD nurse focal point or the senior PD nurses are responsible for training and monitoring of new PD nurses.

18.1.6 New PD trainers are to be supervised by experienced PD staff for at least two patient training courses before they can serve as independent trainers.

18.1.7 Continuous medical education is essential to ensure proper skills and knowledge updates.

18.1.8 Education and training should also be supported by providing educational materials including internet PD websites, brochures, booklets, video/DVD programs and PD scientific journals.

18.1.9 For pediatric patients, it is advisable to train two family members or caregivers to ensure that support is available at home to help meet the daily burden of PD care.

## 18.2 Patient Education/ Training

As PD is a home-based therapy, patients and their caregivers generally need to perform all exchange procedures without the assistance of clinical staff and complications.

18.2.1 Training may take place in the PD clinic, in the ward if the patient is admitted or in any suitable area equipped for PD teaching.

18.2.2 Testing the patients' practical skills at the end of training is essential.

18.2.3 Training, retraining and home visits are three necessary steps to ensure training effectiveness.

18.2.4 Maintaining and encouraging flexibility to meet individual patient needs is a key factor in improving training outcomes.

18.2.5 Any PD unit should have a well-planned PD training program that includes the following domains:

**18.2.5.1 Theory**

A. Functions of the kidney.
B. Overview of CKD, causes and stages.
C. Overview of PD mechanisms involving osmosis and diffusion.
D. Fluid balance concept related to weight and blood pressure.
E. Use of different strengths and types of dialysis fluid.
F. Prevention of infection.
G. Complications of PD.

**18.2.5.2 Practical**

A. Hand washing.
B. Aseptic technique.
C. Dialysis therapy—machine or manual exchanges (step-by-step procedure guide).
D. Emergency measures for catheter contamination.
E. Troubleshooting alarms on the cycler.
F. Blood pressure monitoring and recording.
G. Weight monitoring and recording.
H. Exit-site care.

**18.2.5.3 Complications**

A. Signs, symptoms, and treatment of PD-related infection involving exit-site, tunnel infection and peritonitis.
B. Drain problems due to constipation and fibrin.
C. Fluid balance including symptoms of hypertension and hypotension.
D. Hernias.
E. Leaks.
F. Pain.

#### 18.2.5.4 Others

A. Treatment record-keeping by using a daily therapy manual or records saved in an APD machine.
B. Administration of medications.
C. Dietary management.
D. Ordering and managing supplies at home.
E. Managing life with PD (school, sports and holidays).
F. Contact the hospital or PD's team for any issue through the numbers given.
G. Clinic visits.
H. Having home visits.

### 18.3 PD re-training

In addition to the initial training, regular re-training should reduce errors in performing practical procedures and prevent future infections as well as complications.

18.3.1 ISPD (2011) suggests that routine re-training should be performed 3 months after initial training and consistently thereafter i.e. once yearly at a minimum. However, there are other indications for re-training:

18.3.1.1 Following prolonged interruption in PD.

18.3.1.2 Following peritonitis and/or catheter infection.

18.3.1.3 Following a change in skill, vision, or mental acuity.

18.3.1.4 Following a change to another type of PD therapy or solutions.

18.3.2 Re-training should include:

18.3.2.1 Observation of dialysis exchange procedures & hand washing techniques.

18.3.2.2 Recognition of signs and symptoms of peritonitis.

18.3.2.3 Recognition of contamination and the appropriate response to it.

18.3.2.4 Exit site care.

## 19. Home Visit

Home visit is an ideal method to evaluate the actual implementation of the technique by PD patients that cannot be detected during regular outpatient clinic visits.

19.1 The visiting team should include a PD physician, a PD nurse and a community nurse.

19.2 The PD physician focal point and the nurse focal point are responsible for scheduling home visit dates.

19.3 Home visits should be done at regular intervals:

19.3.1 At the initiation of PD.

19.3.2 At least once per year for stable and compliant patients, however, non-compliant patients may need more visits.

19.3.3 Following PD-related infections.

19.3.4 Post long-lasting hospitalizations.

19.4 A home visit must include the following:

19.4.1 Assessment of the home environment.

19.4.2 Evaluation of patient's compliance with the exchange procedures.

19.4.3 Review of dialysis equipment, supplies usage and storage.

19.4.4 Check of solutions expiry dates and usage according to the latest prescription.

19.4.5 Medication usage, storage and expiry dates.

19.4.6 Monitoring of potential hazards.

19.4.7 Ongoing education and instructions on preventing PD infection and complications.

19.4.8 Psychosocial assessment and to provide support accordingly.

## 20. Patient Follow-up in the PD clinic

Continuous monitoring and provision of support to the patients receiving PD should be done monthly or every two months in the PD clinic visits. It should include:

20.1 Clinical assessment of laboratory results.

20.2 Checking the peritoneal and kidney clearances.

20.3 Assessment of the hydration status.

20.4 Assessment of the nutritional status.

20.5 Evaluating the patient's quality of life.

20.6 Hemoglobin concentration.

20.7 Responsiveness to erythropoietin therapy.

20.8 Electrolytes and acid–base balance.

20.9 Calcium phosphate homeostasis.

20.10 Blood pressure control.

20.11 Special procedures such as changing the catheter transfer set, may also be done during the visit.

20.12 During the visit, patients should be informed to bring the following:

20.12.1 Their medications.

20.12.2 Daily dialysis records.

20.12.3 Effluent or urine collected for 24 hours (if required) for the clearance tests or for measuring residual kidney function.

## 21. Peritoneal Dialysis Adequacy

Adequate dialysis needs special attention to nutrition and volume status as well as to clearances. Consider the following tests to determine whether the patient is receiving adequate dialysis:

### 21.1 (PET) Peritoneal Equilibrium Test

21.1.1 The transport rate varies from patient to patient.

21.1.2 Patients who have a high transport rate absorb dextrose from the dialysis solution quickly; therefore, they should be on short dwell time.

21.1.3 It is recommended to obtain the peritoneal equilibrium test after the first **4 to 8** weeks of starting dialysis.

21.1.4 Then, peritoneal membrane transport testing should be repeated when clinically indicated like impaired ultrafiltration or after an episode of peritonitis.

### 21.2 Clearance test (Kt/V urea & Creatinine clearance)

21.2.1 The samples of drained solution and urine are collected over 24-hour period and a blood sample is also obtained.

21.2.1 The amount of urea in the blood is compared with the amount of urea in the collected solution to see the effectiveness of the current PD prescription in clearing the urea from the blood.

21.2.1 Both urea and creatinine clearances can be used to monitor dialysis adequacy.

21.2.1 Creatinine clearance should be with a target of 50 L/week/1.73 m2.

### 21.3 KT/V

21.3.1 It is recommended that a combined urinary and peritoneal Kt/v of 1.7-2/week for adults and 1.8/week for children.

21.3.1 It is recommended that the total Kt/V be measured using 24-hour dialysate and urine collections soon after the patient has been stabilized on PD after 4 – 6 weeks.

21.4 **RKF (Residual Kidney Function)**

21.4.1 For patients with residual kidney function, it should be monitored regularly and every 1 to 2 months if possible, otherwise not less than every 4 – 6 months so that the PD prescription can be adjusted promptly.

21.4.2 To preserve RKF, BP should be controlled.

21.4.3 Oral furosemide (up to 250 mg daily) and oral metolazone (up to 5 mg daily), as well as Angiotensin converting-enzyme inhibitors (ACEIs) or angiotensin receptor blockers (ARBs) can be considered in all PD patients with urine output more than 100ml daily unless it is contraindicated and taking attention that there are no signs or symptoms of postural hypotension or volume depletion.

**21.5 Dialysis not effective**

If the adequacy tests above showed that the dialysis is not effective, the physician should change the prescription by:

21.5.1 Increasing the number of exchanges per day for patients treated with CAPD or per night for patients treated with APD.

21.5.2 Increasing the total volume (the amount of solution in the bag) in each exchange for CAPD/APD.

21.5.3 Adding an extra exchange in the middle of the night for CAPD patients.

21.5.4 Adding an extra exchange in the middle of the day for APD patients.

21.5.5 Using a solution with a higher dextrose concentration.

**22. Disposal of Used PD Supplies and PD Fluids Waste**

At the end of a PD procedure, the drained fluid waste that a peritoneal dialysis (PD) patient takes out after their dwell time should be treated like other body fluids.

22.1 At Hospital:

Follow the hospital protocol for disposing of body fluids.

22.2 At home:

22.2.1 The patient should be educated to empty all fluids into the toilet and dispose of the empty bags and tubes in a household trash bag.

22.2.2 Syringes and needles should be placed in puncture resistant containers. Then the full containers should be disposed in a household trash bag.

## 23. Continuous Quality Improvement (CQI)

23.1 The PD CQI team should include hospital administrators, nephrologists, surgeons, PD nurses, pharmacists, pediatricians, social workers and dietitians.

23.2 This team should meet to identify problems, develop solutions, monitor clinical outcomes and clearly evaluate results to improve patient care.

23.3 Quality improvement programs with continuous monitoring of exit-site infections, tunnel infections and peritonitis rates are essential to decrease PD-related infections in PD programs.

23.4 Continuous review of every episode of infection to identify the main cause of the episode should be a crucial element in any PD program.

23.5 CQI should include gathering and analyzing data for the following indicators and processes:

23.5.1 All PD-related infections: identifying the causes and planning interventions accordingly to prevent infection. These interventions include retraining, equipment changes and management of contamination.

23.5.2 Death cases and causes of death.

23.5.3 Quality of life, patient satisfaction and clinical indicators including anemia, mineral bone disease, dialysis adequacy and residual kidney function (RKF).

23.5.4 Catheter-related problems and survival (surgical placement failure incidence and the outcome).

23.5.5 Home visit's findings.

23.5.6 Number of hospitalizations.

# CHAPTER THREE:

## 1. Prerequisites to Implement the Guideline

The following requirements are needed to establish a successful PD service and before implementing this guideline:

A. Availability of PD clinic.
B. Availability of a motivated and dedicated PD team.
C. Continuous education and training of the medical and nursing staff.
D. Availability of patient education program.
E. Availability of home visit program.
F. Knowing the mechanism for delivering peritoneal dialysis supplies to the patient's home.
G. Familiarity with the mechanism of adding new patients to peritoneal dialysis service.
H. Familiarity with the Surgical and Medical items indent.

## 2. Human resources

It is believed that a dedicated and experienced PD team is the key factor underlying a successful PD program. The PD multidisciplinary health care team should include:

A. A nephrologist.
B. An access surgeon.
C. A PD nurse.
D. Registered nurses with experience in peritoneal dialysis (other PD nurses).
E. A pharmacist.
F. A dietitian.
G. Community nurse.
H. A social worker.

## 3. Responsibilities

The most essential point for developing any PD program is the dedication and commitment of the PD team, where each member is responsible for the success.

### 3.1 Responsibilities of the National PD Coordinator (At the Central Level)

3.1.1 Should have experience and qualification in nephrology.

3.1.2 Coordinates the national PD program with hospitals that provide PD service.

3.1.3 Collaborate with the other MOH departments involved in PD service to ensure the smooth and efficient running of the service.

3.1.4 Responsible for the complete operation of the service. All processes from patient initiation on PD till the patients receive the supplies.

3.1.5 Provides administrative support to ensure that the day-to-day operation of the PD program is smooth and efficient.

3.1.6 Measures the service outcomes.

3.1.7 Works to maximize educational opportunities and facilitates good communication among all those involved in the PD program.

3.1.8 Collects all statistical PD data from the governorate PD focal points (surveillance + complications).

3.1.9 Provides statistical information to relevant departments.

3.1.10 Revises Peritoneal Dialysis (Standing Operating Procedure) periodically based on the best evidence available.

3.1.11 Collaborates with the supplier companies to have planned educational programs for the hospitals.

**3.2 Responsibilities of the Administration (director and head of nursing) at the Regional Hospitals**

3.2.1 Ensures that the need for an adequate infrastructure for training and care of patients is met.

3.2.2 Selection of PD team members which includes nephrologists, PD nurses and focal points from each of the following specialties: a surgeon, a pharmacist, a psychologist, a pediatrician, a social worker and a dietitian.

3.2.3 Ensures adequate training of the staff and patients.

3.2.4 Ensures that the skills and knowledge of PD staff are maintained and renewed.

3.2.5 Continuous monitoring and continuous quality improvement of the PD service by constant auditing.

**3.3 Responsibilities of the PD focal point physician:**

The hospital's administration is responsible for ensuring the availability of PD team members including a trained nephrologist or physician. She/he is responsible to:

3.3.1 Identify patients who need dialysis.

3.3.2 Clinically determine the appropriate modality of kidney replacement therapy.

3.3.3 Refer the End-Stage Kidney Disease patients to education sessions with the PD nurse.

3.3.4 Monthly patient follow-up.

3.3.5 Monitor the patients every 3- 6 months for the adequacy of dialysis & after changing the prescription.

3.3.6 Arrange for the PD catheter insertion if it has been approved by MOH that catheter insertion can be done by a nephrologist.

3.3.7 Collaborate actively in quality improvement with the nurse and other PD team members.

3.3.8 Work with the renal unit HOD and the hospital's administration to ensure the provision of infrastructure for the training and care of patients, as well as the provision of adequate training to the staff.

**3.4 Responsibilities of PD focal point Surgeon:**

The hospital administration is responsible for ensuring the availability of PD team members including a trained surgeon. He/she is responsible to:

3.4.1 Communicate with the PD team with regard to catheter placement issues.

3.4.2 Peritoneal dialysis catheter placement and removal.

3.4.3 Select the possible catheter placement sites

3.4.4 Consulted in the management of surgical complications such as hernia repair.

3.4.5 Train the other surgeons in the hospital.

3.4.6 Improve his expertise in PD catheter placement through continuous self-development training to maintain his skills and knowledge.

3.4.7 Collaborate actively in quality improvement activities with the other PD team members.

**3.5 Responsibilities of the PD focal point Nurse:**

3.5.1 A nephrology nurse who has training and experience in PD.

3.5.2 Collaborate with the national PD coordinator and the other team members to ensure continuous care and coordination.

3.5.3 Report all the issues that are related to PD supplies or any issues related to the supplying company immediately to the National PD Coordinator.

3.5.4 Ensure continuity and implementation of the patient training program, including the initial training and retraining.

3.5.5 Monitor the patient's clinic visits in collaboration with the PD physician and other PD team members.

3.5.6 Responsible for maintaining an accurate amount of PD supplement without shortage or extra accumulation at the patient's home.

3.5.7 Manage and maintain the home visit schedule.

3.5.8 Follow up with the patients who have failed to come to the clinic by telephone.

3.5.9 Educate the patients on PD modality options and should work closely with the PD educators.

3.5.10 The PD nurse focal point should communicate with the patients, physicians, dialysis facilities and hospital administration when needed to initiate PD.

3.5.11 Collaborates actively in quality improvement with the physician and the other PD team.

3.5.12 Answers patient queries and ensures patients understand instructions.

3.5.13 Maintains a good relationship with the dialysis facilities.

3.5.14 Builds long-term therapeutic relationships with PD patients.

3.5.15 Supervises the new nurse trainees.

3.5.16 Keeps PD statistics, including PD complications and sends them to the relevant department at the MOH headquarters.

Note: Well-trained, competent, committed, independent nurses are the key to a successful PD program.

**3.6 Responsibilities of the other PD nurses:**

3.6.1 They should be nephrology nurses or general nurses with training and experience in PD.

3.6.2 Enrolled in the PD program after successfully completing a training on peritoneal dialysis.

3.6.3 Collaborate with the nurse focal point to perform procedures for PD patients.

3.6.4 Improve the confidence of patients with PD and relieve any worries or concerns through assuring the patient & the family, and confirming their ability to perform these procedure steps at home.

3.6.5 Train patients and caregivers/relatives on PD therapy.

3.6.6 Assess possible complications of PD.

3.6.7 Work actively with the nurse and physician focal points to resolve patient issues.

3.6.8 Coordinate lab workup for the patients with the PD team members.

3.6.9 Build a long-term relationship with the PD patients.

**3.7 Responsibilities of Focal Point Dietitian:**

3.7.1 Provides clinical guidance to assess patients' nutritional needs.

3.7.2 Develops individual nutritional programs and education.

3.7.3 Evaluate and monitor the patient's response.

3.7.4 Collaborates actively in quality improvement with other PD team members.

**3.8 Responsibilities of the company that supplies PD solutions and consumables:**

3.8.1 The selected company should be under evaluation by the Directorate General of Medical Supplies and the department that is responsible for the PD program at the Ministry of Health.

3.8.2 The supplying company will be responsible for the products integration, supplies and PD service according to the negotiated contract. These services include:

3.8.2.1 Supplying and delivering all the PD solutions and disposables to the patient's home, which will minimize the need to store large quantities of PD solutions in the unit and the hospital.

3.8.2.2 Delivering the supplies in a timely manner in accordance with the patient schedule and notifying the patient or the focal point in the governorate of any delays in delivering the items.

3.8.2.3 Providing products that are clearly labeled, new and have not been used or reconditioned.

3.8.2.4 Maintaining a continuous supply of APD machines to the patients as well as the PD unit.

3.8.2.5 Avoiding retention of expired PD solutions through delivering supplies within a shelf life ranging from 12-24 months and rotating the stock in the patient's storage area.

3.8.2.6 Maintaining a record of the patient's prescription and consumption.

3.8.2.7 Assessing the monthly and the yearly PD consumptions for all patients.

3.8.2.8 Communicating with the national PD coordinator and the PD focal points in the PD unit for any issues in the supply.

3.8.2.9 Collaborating with the PD focal points to train the staff (nurses, physicians) on the PD techniques and the use of the machines as needed.

3.8.2.10 Providing PD training supplies and all training requirements.

3.8.2.11 Providing and arranging the annual planned education program in collaboration with the responsible department at the MOH headquarters, which should include: PD fundamentals and advanced training courses for both the adult and pediatric nephrology units.

**3.9 Responsibility of PD Patients/ patient's caregiver:**

3.9.1 Engage in the dialysis decision-making process.

3.9.2 Comply with diet, medications and lifestyle requirements.

3.9.3 Follow the home PD-prescribed regimen and use products according to the prescription.

3.9.4 Sort supplies and note expiry dates.

3.9.5 Ensure the availability of someone at home at the time of supplies delivery.

3.9.6 For travel, the patient should discuss the travel plan with the PD nurse focal point or physician. The focal point should send a letter to DGMS in MOH with the patient's details and name of the country to be visited as well as the prescription details to enable the supplier to decide whether service can be provided in that country. The letter should be sent at least 3 months earlier before travel.

**3.10 Responsibilities of the Medical Store Department at the Directorate General of Medical Supplies (DGMS) in MOH**

3.10.1 Contract monitoring.

3.10.2 Responsible for purchasing PD supplies and requirements.

3.10.3 Evaluate and supervise the companies that supply PD solutions and consumables.

3.10.4 Stock control, monitoring and procurement of dialysis consumables.

3.10.5 Supplies arrangement for patients who are traveling abroad in collaboration with the governorate nurse focal point and the supplier company.

3.10.6 Reporting the financial information to the relevant department.

### 3.11 Responsibilities of the Medical Store Department in the Governorates/ Hospitals

3.11.1 PD supplies indent and monitoring of Hospital stocks.

3.11.2 Bills monitoring in collaboration with the PD nurse focal Point.

3.11.3 Acts as a link between PD teams in the governorate/hospital and DGMS (MOH).

3.11.4 Acts as a link between the PD teams and the Supplier Company.

# Chapter Four:

## 1. Document History and Version Control

| Version | Description | Review Date |
|---|---|---|
| 1 | Initial Release | July 2020 |
| 2 | 2nd edition | April 2028 |
| | | |

## 2. References


| Title of book/ journal/ articles/ Website | Author | Year of publication | Page |
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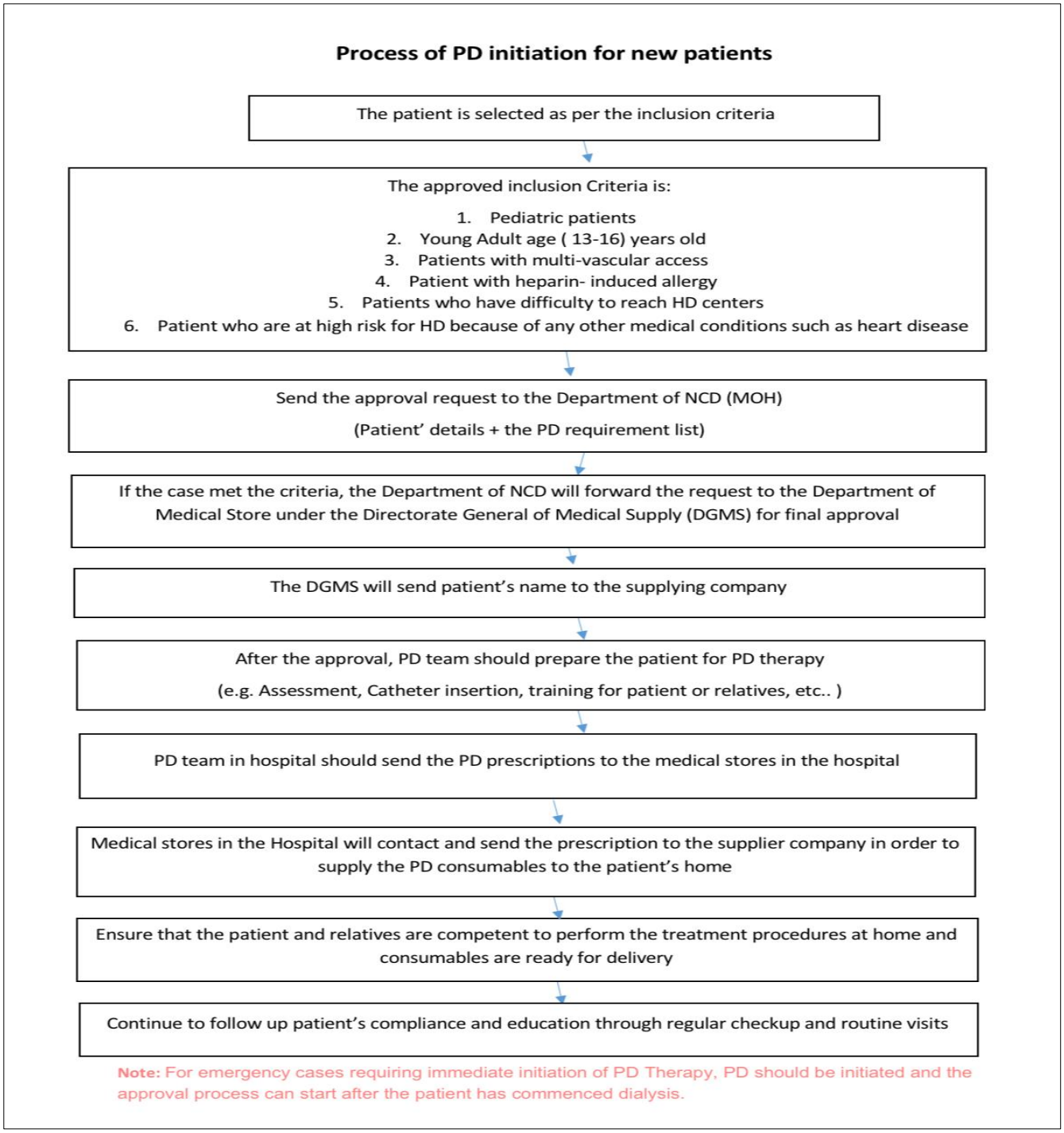
# 3. Appendixes

## 3.1 Appendix (1) Process of Peritoneal Dialysis Initiation for New Patients



## 3.2 Appendix (2) Oral Antibiotics Used in Catheter- Related Infections (Adult)

| Adult | |
|---|---|
| Amoxicillin/Clavulanate | 500 mg/125 mg or 250 mg/125 mg BD ( first line empirical oral antibiotic) |
| Cephalexin | 250- 500 mg BD ( first line empirical oral antibiotic) |
| Cloxacillin or dicloxacillin | 500 mg QID ( first line empirical oral antibiotic) |
| Ciprofloxacin | 500- 750 mg daily |
| Clarithromycin | 500 mg loading, then 250 mg BD |
| Clindamycin | 300-450mg TID to QID |
| Levofloxacin | 300mg daily |
| Linezolid | 600 mg BD for 48 h, then 300 mg BD |
| Moxifloxacin | 400 mg daily |
| Rifampicin | 450 mg daily for BW < 50 kg, 600 mg daily for BW ≥ 50 kg |
| Trimethoprim/ Sulfamethoxazole | 80 mg / 400 mg daily to 160 mg/ 800 mg daily |
| **BD**: two times per day, **TID**: three times per day, **QID**: four times per day, **BW**: body weight<br>* Rifampicin is used for treating Staphylococcus. aureus synergistically with other antibiotics and should not be given as a single-agent therapy. | |
| Chow K et al. (2023) ISPD Catheter- Related Infection Recommendations: 2023 Update. *Peritoneal Dialysis International*. [Online] 43 (3), 201-219. Available from https://doi.org/10.1177/08968608231172740 [ accessed 3rd August 2024]. | |

### 3.3 Appendix (3) Oral Antibiotics Used in Catheter- Related Infections (Pediatric)

| **Pediatric** | | | | |
|---|---|---|---|---|
| **Antibiotic** | | **Recommended Dose** | **Dose Frequency** | **Per Dose Maximum** |
| Amoxicillin | | 10-20 mg/ kg/ day | Daily | 1000 mg |
| Cephalexin | | 10-20 mg/ kg/ day | Daily or 2 times daily | 1000 mg |
| Ciprofloxacin | | 10- 15 mg/ Kg/ day | Daily | 500 mg |
| Clarithromycin | | 7.5 mg/ Kg/ day | Daily or 2 times daily | 500 mg |
| Clindamycin | | 30 mg/ kg/ day | 3 times | 600 mg |
| Dicloxacillin | < 40 kg | 20-50mg/kg/ day | 4 times daily | 500 mg |
| | > 40 Kg | 125- 500 mg/kg/day | 4 times daily | 500 mg |
| Erythromycin | | 30- 50 mg/kg/day | 3 or 4 times daily | 500 mg |
| Fluconazole | | 6 mg/ kg/ day | Every 24- 48 hours | 400 mg |
| Levofloxacin | | 10 mg/ kg | Every 48 hours | Day 1 (500 mg), then 250 mg |
| Linezolid | < 5 years | 10 mg/ kg/ dose | 3 times daily | 600 mg |
| | 5- 11 years | 10 mg/kg/ dose | 2 times daily | 600 mg |
| | ≥ 12 years | 600 mg/ dose | 2 times daily | 600 mg |
| Metronidazole | | 30 mg/ kg/ day | 3 times daily | 500 mg |
| Rifampicin | | 10- 20 mg/ kg/ day | 2 times daily | 600 mg |
| Trimethoprim/ Sulfamethoxazole | | 5- 10 mg/ kg/day | Daily | 81 g |

### 3.4 Appendix (4) Intraperitoneal (IP) Antibiotic Dosing Recommendations for Treatment of Peritonitis (Adult)

| Adult | | | |
|---|---|---|---|
| **Intraperitoneal Antibiotic** | | **Intermittent(1exchange daily), APD** | **Continuous (all exchanges)** |
| Aminoglycosides | Amikacin | 2mg/kg daily | Not advised |
| | Gentamicin | 0.6 mg/kg daily | Not Advised |
| | Netilmycin | 0.6 mg/kg daily | Not Advised |
| | Tobramycin | 0.6 mg/kg daily | Not advised |
| Cephalosporins | Cefazolin | 15 mg/kg daily (for long dwell)<br>20 mg/kg daily ( for short dwell) | LD 500 mg/L, MD 125 mg/L<br>*LD: loading dose, MD maintenance dose |
| | Cefepime | 1000 mg daily | LD 500 mg/L, MD 125 mg/L |
| | Cefoperazone | No data | LD 500 mg/L, MD 62.5-125 mg/L |
| | Cefotaxime | 500-1000 mg daily | No data |
| | Ceftazidime | 1000-1500 mg daily (for long dwell)<br>20 mg/kg daily (for short dwell) | LD 500 mg/L, MD 125 mg/L |
| | Ceftriaxone | 1000 mg daily | No data |
| Penicillins | Penicillin G | No data | LD 50,000 unit/L, MD 25,000 unit/L |
| | Amoxicillin | No data | MD 150 mg/L |
| | Ampicillin | 4 gm daily | MD 125 mg/L |
| | Ampicillin/ Sulbactam | - | LD 1000 mg/500mg, MD 133.3 mg/66.7 mg |
| | Piperacillin/Tazobactam | No data | LD 4gm/0.5gm, MD 1gm/0.125 gm |
| | Ticarcillin/clavulanic | No data | LD 3gm/0.2gm, MD 300 mg/20 mg/L |
| Others | Aztreonam | 2gm daily | LD 500 mg/L, MD 250 mg/L |
| | Ciprofloxacin | No data | MD 50 mg/L |
| | Clindamycin | No data | MD 600 mg/bag |
| | Daptomycin (NA) | 300 mg daily | LD 100 mg/L, MD 20 mg/L |

| | | | |
|---|---|---|---|
| | Imipenem/Cilastatin | 500 mg in alternate exchange | LD 250 mg, MD 50 mg/L |
| | Ofloxacin | No data | LD 200 mg, MD 25 mg/L |
| | Polymyxin B | No data | MD 300,000 unit (30mg)/bag |
| | Quinupristin/Dalfopristin | 25 mg/L in alternate exchange | No data |
| | Meropenem | 500 mg daily ( for long dwell in APD)<br>1000 mg daily ( for short dwell in CAPD) | MD 125 mg/L |
| | Teicoplanin | 15 mg/kg every 5 days | LD 400 mg/bag, MD 20 mg/L |
| | Vancomycin | 15-30 mg/kg every 5-7 days (CAPD)<br>15 mg/kg every 4 days for APD | LD 20-25 mg/kg, MD 25mg/L |
| Antifungals | Fluconazole | IP 150-200 mg every 24 to 48 hours | No data |
| | Voriconazole | IP 2.5mg/kg daily | No data |

***(LD= loading Dose, MD= Maintenance Dose)**

## 3.5 Appendix (5) Antibiotic Dosing Recommendations for Treatment of Peritonitis in Pediatric

| Pediatric | | | |
|---|---|---|---|
| **Intraperitoneal Antibiotic** | | **Intermittent(1exchange daily), APD** | **Continuous (all exchanges)** |
| Aminoglycosides | Amikacin (IP) | | *LD 25 mg/L, *MD 12 mg/L |
| | Gentamicin (IP) | Anuric: 0.6 mg/kg | LD 8 mg/L, MD 4 mg/L |
| | Netilmycin (IP) | Non-anuric: 0.75 mg/kg | LD 8 mg/L, MD 4 mg/L |
| | Tobramycin (IP) | | LD 8 mg/L, MD 4 mg/L |
| Cephalosporins | Cefazolin (IP) | 20 mg/Kg | LD 500 mg/L, MD 125 mg/L |
| | Cefepime (IP) | 15 mg/Kg | LD 500 mg/L, MD 125 mg/L |
| | Cefotaxime (IP) | 30 mg/Kg | LD 500 mg/L, MD 250 mg/L |
| | Ceftazidime (IP) | 20 mg/Kg | LD 500 mg/L, MD 125 mg/L |
| Penicillins | Ampicillin (IP) | No data | MD 125 mg/L |
| Quinolones | Ciprofloxacin (IP) | No data | LD 50mg/L, MD 25 mg/L |
| Glycopeptides | Vancomycin | 30 mg/ Kg, repeat dosing: 15mg/Kg every 3-5 days. | LD 1000 mg/L, MD 25 mg/L |
| | Teicoplanin | 15 mg/Kg every 5-7 days | LD 400 mg/L, MD 20 mg/L |
| Others | Aztreonam (IP) | No data | LD 1,000 mg/L, MD 250 mg/L |
| | Clindamycin (IP) | No data | MD 300 mg/L, 150 mg/L |
| | Imipenem-/Cilastatin (IP) | No data | LD 250 mg/L, MD 50 mg/L |
| | Linezolid (PO) | No data | < 5 years: 30 mg/ Kg daily, divided into 3 doses.<br>5- 11 years: 20mg/ Kg daily, divided into 2 doses.<br>≥ 12 years: 600 mg/dose, twice daily. |
| | Metronidazole (PO) | No data | 30 mg/Kg daily, divided into 3 doses (Max: 1.2 g daily). |

| | | | |
|---|---|---|---|
| | Rifampin (PO) | No data | 10- 20mg/Kg daily, divided into 2 doses (Max 600 mg daily). |
| Antifungals | Fluconazole (IV, IP or PO)<br><br>Caspofungin (IV only) | No data<br><br>No data | 6-12 mg/Kg every 24-48 h (Maximum 400 mg Daily).<br><br>LD 70 mg/m2 on day 1, MD 50/m2 daily. |

*** (LD= loading Dose, MD= Maintenance Dose)**

### 3.6 Appendix (6) Calculate the Peritonitis Rate

**Method (1) Episode per patient-months**

A. Calculate how long each patient was treated with PD in months (Including patients out of PD within the year of calculation)
B. Calculate the total number of all patient months.
C. Calculate the total number of peritonitis episodes.
D. Divide the total patient months by the number of peritonitis episodes.

**Example**

A. Patient "1" started PD on May 2022 = 20 months until end of 2023, patient "2" started on March 2023 = 10 months until end of 2023), do the same with all patients in the program. (Including patients out of PD within 2023)
B. Let us say, there are 82 patients in the program by end of 2023 and the total number of months was 1870 months. There are 7 peritonitis episodes.
C. 1870/7= 267.
D. Peritonitis rate is 1 per 267 patients' months.

** (ISPD recommend 1 episode per 18 patient month or above)

**Method (2) Episode per patient – year**

A. Total number of peritonitis episodes.
B. Total patients' months
C. Divide number of episode by total months on PD, multiply by 12

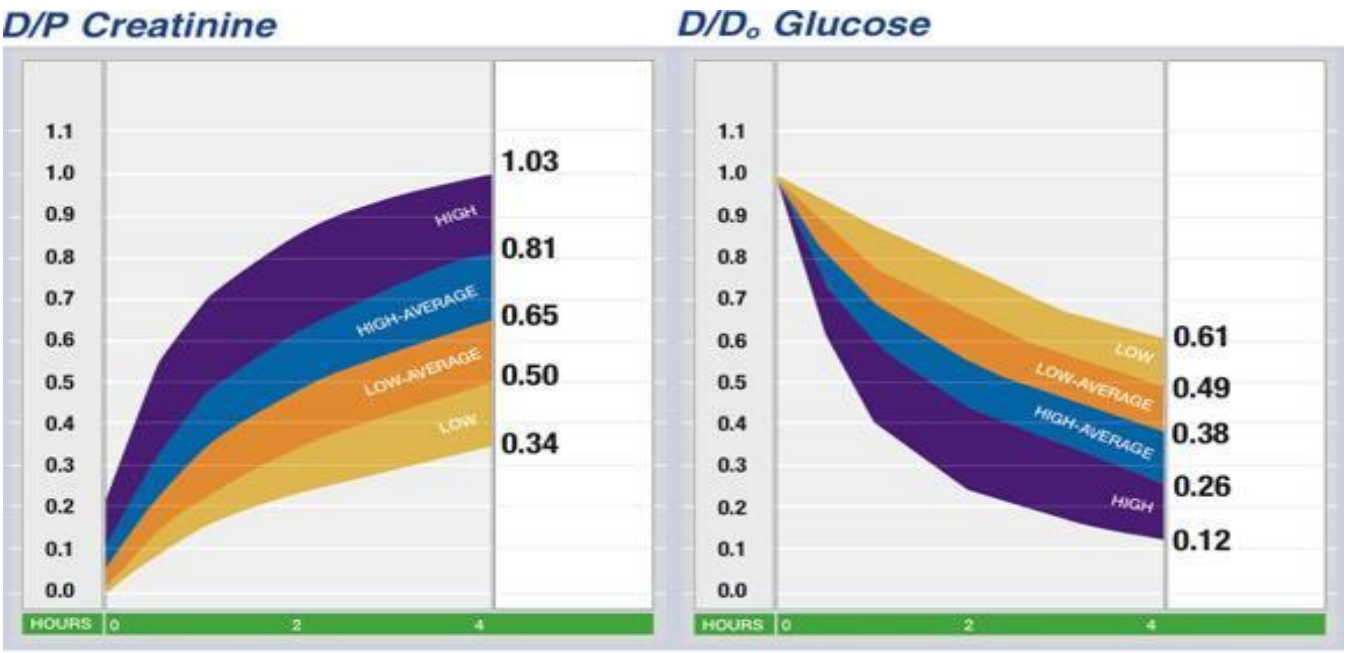
**Example**

A. There are **7** peritonitis episodes in the program in 2023. The total patient-months was 1870 months.
B. 7/1870= 0.0037 x 12 = 0.04 episode/year

**(Should no more than 0.4 episodes, ISPD 2022).

** Initial episode and all relapsing episodes (whatever number) should be calculated as single episode.

### 3.7 Appendix (7) Classifications of Peritoneal Membranes Based on Peritoneal Equilibration Test (PET) result




| Membrane Transport Type | 4-hour D/P Creatinine |
|---|---|
| HIGH | .82 – 1.03 |
| HIGH-AVERAGE | .65 – .81 |
| LOW-AVERAGE | .50 – .64 |
| LOW | .34 – .49 |

**(Dialysate/Plasma=D/P)**

## 3.8 Appendix (8) list of Antibiotics Stability in Peritoneal Dialysis Solutions

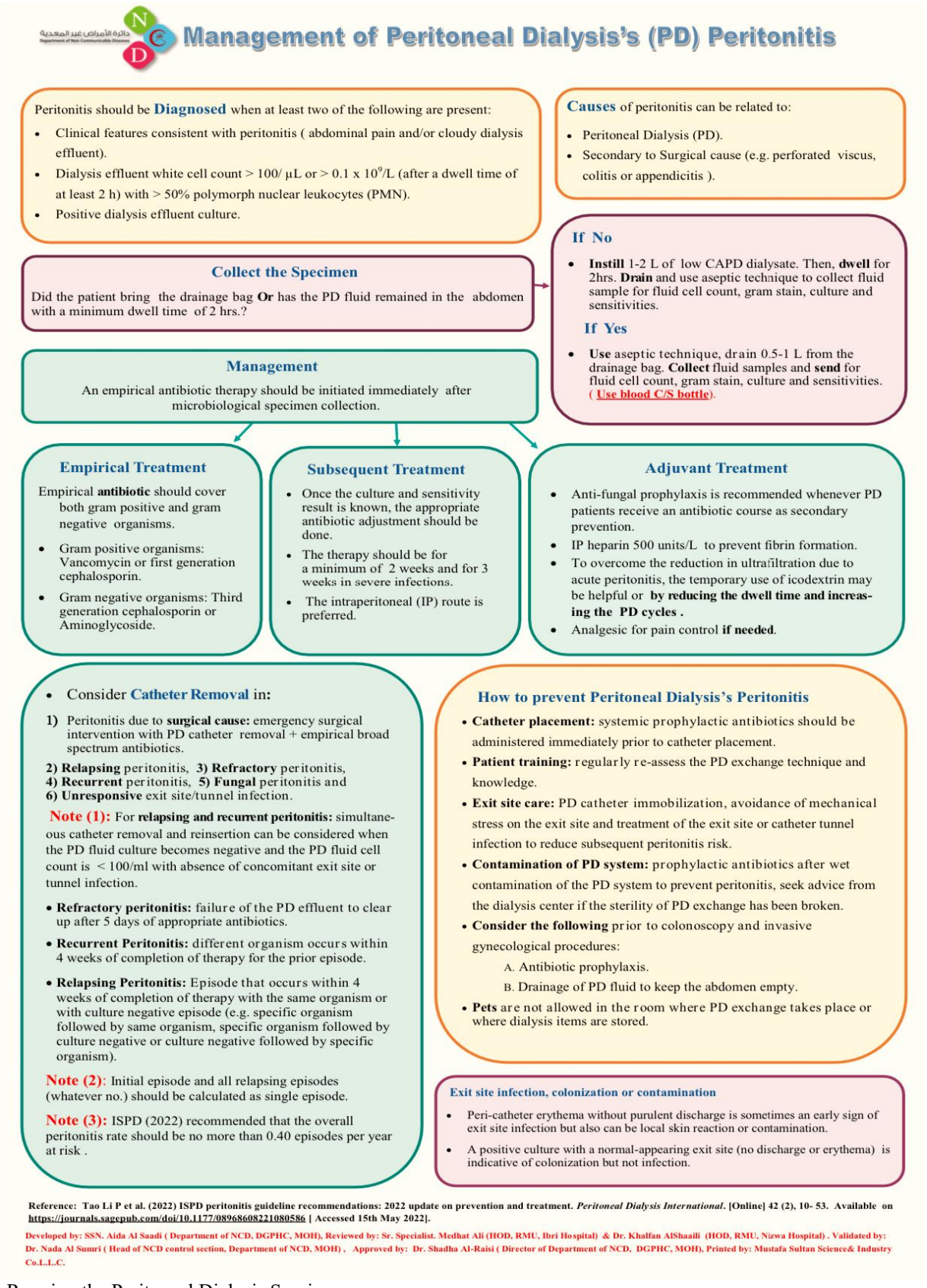
| Drug Name | Concentration (mg/L) | Types of PD solutions and drug stability in Hours/ Days | | | | Compatibility |
|---|---|---|---|---|---|---|
| | | Dianeal 1.36 % | Dianeal 2.27 % | Dianeal 3.86 % | Extraneal 7.5 % | |
| Gentamicin | 4 mg/L | 14 days @ 37 °C<br>14 days @ 25 °C<br>14 days @ 4 °C | 14 days @ 37 °C<br>14 days @ 25 °C<br>14 days @ 4 °C | 14 days @ 37 °C<br>14 days @ 25 °C<br>14 days @ 4 °C | 14 days @ 37 °C<br>14 days @ 25 °C<br>14 days @ 4 °C | Compatible |
| Tobramycin | 4mg/L | 8 hours @ 37°C<br>2 days @ 25°C<br>2 days @ 4°C | 8 hours @ 37°C<br>2 days @ 25°C<br>2 days @ 4°C | 8 hours @ 37°C<br>2 days @ 25°C<br>2 days @ 4°C | 7 days @ 37 °C<br>7 days @ 25°C<br>14 days @ 4 °C | Compatible |
| Cefazolin | 125 mg/L | 8 hours @ 37°C<br>7 days @ 25 °C<br>14 days @ 4 °C | 8 hours @ 37°C<br>7 days @ 25 °C<br>14 days @ 4 °C | 8 hours @ 37°C<br>7 days @ 25 °C<br>14 days @ 4 °C | 1 day @ 37 °C<br>7 days @ 25 °C<br>14 days @ 4 °C | Compatible |
| Cefepime | 100-125 | 14 days @ 4 °C | 14 days @ 4 °C | 14 days @ 4 °C | 14 days @ 4 °C | Compatible |
| Cefotaxime | 250 mg/L | 1 day @ 4 °C<br>1 day @ 25 °C<br>6 hours @ 37°C | 1 day @ 4 °C<br>1 day @ 25 °C<br>6 hours @ 37°C | 1 day @ 4 °C<br>1 day @ 25 °C<br>6 hours @ 37°C | Not reported | Compatible |
| Ceftazidime | 125 mg/L | 12 hours @ 37°C<br>4 days @ 25°C<br>6 days @ 4 °C | 12 hours @ 37°C<br>4 days @ 25°C<br>6 days @ 4 °C | 12 hours @ 37°C<br>4 days @ 25°C<br>6 days @ 4 °C | 16 Hours @ 37 °C<br>2 days @ 25 °C<br>7 days @ 4 °C | Compatible |
| Ampicillin | 125 mg/L | 2 days @ 25 °C | 2 days @ 25 °C | 2 days @ 25 °C | 2 days @ 25 °C | Avoid mix with other antibiotics due to chemical incompatibility |
| Ciprofloxacin | 25mg/L or 50 mg/L | 2 days @ 37 °C<br>7 days @ 25°C<br>14 days @ 4 °C | 2 days @ 37 °C<br>7 days @ 25°C<br>14 days @ 4 °C | 2 days @ 37 °C<br>7 days @ 25°C<br>14 days @ 4 °C | 7 days @ 25 °C<br>14 days @ 4 °C | Compatible |
| Vancomycin | 25mg/ L | 5 days @ 37 °C<br>14 days @ 25 °C<br>14 days @ 4 °C | 5 days @ 37 °C<br>14 days @ 25 °C<br>14 days @ 4 °C | 5 days @ 37 °C<br>14 days @ 25 °C<br>14 days @ 4 °C | 4 days @ 37 °C<br>14 days @ 25 °C<br>14 days @ 4 °C | Compatible |
| Teicoplanin | 20 mg/L | 8 hours @ 37 °C<br>24 hours @ 25°C | 8 hours @ 37 °C<br>24 hours @ 25°C | 8 hours @ 37 °C<br>24 hours @ 25°C | Not reported | Compatible |
| Clindamycin | 150 mg/L | 2 days @ 25 °C | 2 days @ 25 °C | 2 days @ 25 °C | Not reported | Compatible |

** Concentration is the (MD) Maintenance Dose.

** PD bags mixed with antibiotics can be safely warmed to body temperature before instillation.

** Any drug not in the above list is not investigated for stability.

## 3.9 Appendix (9) Management of Peritoneal Dialysis's (PD) Peritonitis flow chart





**Reference:** Tao Li P et al. (2022) ISPD peritonitis guideline recommendations: 2022 update on prevention and treatment. *Peritoneal Dialysis International*. [Online] 42 (2), 10- 53. Available on https://journals.sagepub.com/doi/10.1177/08968608221080586 [ Accessed 15th May 2022].



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### 3.10 Appendix (10) Flow of operation from patient entry to the hospital to exit