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Ministry of Health

# Infection Control Guidelines in Hemodialysis Units

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**Definition:**

Dialysis or renal replacement therapy is a procedure that replaces the normal kidney functions in removing metabolic waste products by diffusion through artificial (hemodialyzer) or a natural (peritoneum) semipermeable membrane.

**Key Concepts:**

To provide the guidelines needed for the prevention of infection transmission at dialysis settings being a high-risk area for infection transmissions in health care facilities.

**These Guidelines Include:**

1. Infection Control Practices for Hemodialysis Units.
2. Serological tests & vaccination in hemodialysis units.
3. Selection and maintenance of vascular lines.
4. Water treatment at dialysis units.

**Key Terms:**

**Infection Risk at Dialysis Setting:**

Transmission of infection in hemodialysis unit occurs mainly through contact transmission by either:

- Direct from patient to patient.
- Indirect via contaminated devices, equipment, and supplies, environmental surfaces, or hands of healthcare personnel.

**Patient Risk Factors:**

- Most patients undergoing dialysis are already at risk for certain types of infections resulting from underlying diseases or conditions (e.g., diabetes, hypertension, cardiovascular disease, immunosuppressive therapy, and critical illnesses).
- Dialysis also increases the patient's risk of infection because of direct access into normally sterile areas, the circulatory system or peritoneal cavity.

### 1-Infection Control Practices for Hemodialysis Units:

**Infection Control Precautions for All Patients:** transmission by contact can be prevented by effective hand hygiene, glove use, and disinfection of environmental surfaces.

#### A) Hand Hygiene:

- Adequate number of easy accessible hand washing sinks should be available (one for every 2-4 chair/beds).
- At least, an alcohol hand rub device (wall-mounted dispenser or desk top pump bottle) should be available for every patient's chair/bed.

Hand hygiene opportunity	Specific examples
1-Before touching a patient.	1-Before entering the station to provide care to a patient. 2-Before contact with vascular access site. 3-Before adjusting or removing cannulas.
2-Before aseptic procedures.	1-Before cannulation or accessing catheter. 2-Before performing catheter site care. 3-Before parenteral medication preparation. 4-Before administering infusions or IV medications.
3- Following body fluid exposure risk.	1-Following exposure to any blood or body fluids. 2-Following contact with other contaminated fluids (e.g., spent dialysate). 3-After handling used dialyzers, blood tubing, or priming buckets. 4-After performing wound care or dressing changes.
4-After touching a patient.	1-When leaving the station after performing patient care. 2-After removing gloves.
5- After touching patient Surrounding.	1-When leaving the station after touching dialysis machine or other items within the dialysis station. 2-After removing gloves. 3-After using chair side computers for charting.

**Table 1:** Opportunities of hand hygiene in the dialysis unit.

#### B) Personal Protective Equipment:

- During the process of hemodialysis, exposure to blood and potentially contaminated items are routinely anticipated gloves are needed whenever caring for a patient or touching the patient's equipment.

- Staff members should wear fluid resistant gowns, face shields, or protective eyewear, and surgical masks to protect themselves and prevent soiling of clothing when doing procedures which may lead to spurting or spattering of blood e.g., during initiation and termination of dialysis session, insertion of dialysis catheter, manipulation of patient's access at any time and cleaning of the dialysis station.
- During the process of hemodialysis healthcare worker can deal with patient and machine wearing gloves only and there is no need for wearing gown and mask all the time.
- Gloves and gown are likely to become contaminated with blood or body substances. Change these coverings when they are visibly soiled, when they become damaged, and on a routine basis (e.g., between patients).

### **C) Aseptic Technique:**

- Restrict the use of common supplies, medications, instruments, and common medication trays and avoid the use of a common medication cart.
- Unused supplies or medications (e.g., syringes, alcohol swabs, adhesive tape, infusion bottles) taken to the patient's station should not be used on for other patients or returned back to a common clean area as they could become contaminated with blood and other body fluids and serve as a vehicle of transmission to other patients either directly or by contamination of the hands of personnel.
- Prepare medications in an area or a room separated from the patient treatment area and designated only for medications.

#### **❖ Single-dose medication:**

Should be used whenever available. When multi-dose vial is used, dedicate it to a single patient whenever possible.

#### **❖ Multi-dose medication:**

- If needed for more than one patient (e.g. multi-dose vaccines, heparin), they should be prepared in a medication preparation area.
- Multi-dose vial should not enter the immediate patient treatment area.
- Access to multi-dose vial should be under complete aseptic technique as the self-seal rubber cap should be alcohol swabbed every time before access of the vial, use of new syringe every time, consider the use in proper life span of the vial.
- If the multi-dose medication is brought to patient treatment area, it should be discarded and should not be returned back or used for another patient.
- The vial should be discarded if sterility is compromised or questionable.

- Intravenous medication vials labeled for the single use must not be punctured more than once only. Once a needle has entered a single use vial, the sterility of the product can no longer be guaranteed.
- Staff members should not eat, drink, or smoke in the dialysis treatment area.

#### **D) Cleaning and Disinfection:**

- Establish written rules for cleaning and disinfecting surfaces and equipment in the dialysis unit.
- Use an approved MOH-disinfectant for cleaning and disinfection (one-step process) all non-critical surfaces in dialysis station and other environmental surfaces.

After each patient treatment session, all surfaces at the dialysis station should be cleaned with bleach (1:100 dilution of household bleach) (300--600 mg/L free chlorine) or comparable intermediate-level disinfectant include the following:

- Outside of the machine.
- Bed (or chair) and over-bed table.
- Computer /Counters.
- BP cuff and tubing.
- TV control/ call light.
- Pay special attention to control panels on the dialysis machine and other surfaces that are frequently touched and potentially contaminated with the patient's blood.
- Units should confirm with the manufacturer whether the use of chlorine-based disinfectant is compatible with their machines; if not, units should follow the manufacturer's recommendations regarding disinfection of surfaces between patients.
- Process of internal cleaning and disinfection of dialysis machines in-between patients should be performed according to manufacturer's instructions.
- Unused Back-up (Standby) HD Machines should be disinfected according to manufacturer's instructions.
- Any reusable medical equipment must be cleaned and disinfected before being returned to a common area or being used for another patient.

#### **❖ Cleaning of blood spills:**

Trained staff should deal with spills of blood or body fluids using the standard protocol.

#### **E) Waste and Sharps Disposal:**

- Waste generated by the hemodialysis unit might be contaminated with blood and should be considered infectious and handled accordingly.

- All disposable items (e.g., dialyzers and tubing) should be placed in yellow waste bags thick enough to prevent leakage.
- Needles and sharps should be discarded immediately after use into a leak proof puncture resistant biohazardous yellow sharp container.
- Infectious waste containers and sharp containers should be available in each dialysis station with proper sizes compatible with the size and length of the produced waste and sharps.

#### **F) Isolation precautions:**

##### **Contact precautions:**

For patients at increased risk for transmission of pathogenic bacteria, including antimicrobial-resistant strains (e.g., those infected or colonized with MRSA or VRE), additional precautions (i.e., contact precautions) are also required during the whole dialysis session.

##### **Contact precautions include:**

- a) Placing the patient in a single room or with another patient infected or colonized with the same organism (in consultation with the ICPs).
- b) Using gloves whenever entering the patient's room.
- c) Using a gown when accessing the patient's room for potential contact with the patient, environmental surfaces, or items in the patient's room.

#### **Management of Patients with Acute Respiratory Illness (ARI):**

To prevent the transmission of respiratory infections among hemodialysis patients, including MERS-CoV, COVID-19, the following infection control measures should be implemented:

##### **A) Respiratory triage for patients with Acute Respiratory Illness (ARI):**

- All patients attending hemodialysis units must be triaged at the entrance using predefined scoring derived from the approved updated guidelines.
- Identified patients with ARI should be asked to perform hand hygiene and wear a surgical mask.
- ARI patients should be segregated, examined and evaluated immediately in a single room separate between any patients.
- Dedicate a waiting area(s) for ARI patients linked to examination room with spatial separation of at least 1.2 meter between patient.

- Post visual alerts in appropriate languages (e.g., respiratory & cough etiquette signs) at the entrance of the facility and waiting areas. Messages in the visual alerts include the following:
  - a. Cover your mouth and nose with a tissue when coughing or sneezing.
  - b. Dispose of the tissue in the nearest waste receptacle immediately after use.
  - c. Perform hand hygiene (e.g., hand washing with non-antimicrobial soap and water, alcohol-based hand sanitizer) after having contact with respiratory secretions and contaminated objects or materials.

**B) Prevention of overcrowding in hemodialysis patients care area:**

Space requirements for patients` treatment area:

- Area: Individual patient area should have a minimum floor area of 80 feet (7.43 m<sup>2</sup>).
- Clearance: The distance between patients` beds/ chairs in hemodialysis units should be  $\geq 4$  feet (1.2 meters) to reduce the risk of transmission between patients and to staff.

**C) Isolation of hemodialysis patient with suspected, or confirmed MERS-CoV or COVID-19 infection:**

**Non critically ill (stable) Patients** should be placed in single patient rooms in an area that is clearly segregated from other patient-care areas, droplet contact isolation precautions should be applied. A portable HEPA filter could be used (if available).

**Critically ill** patients should be placed in Airborne Infection Isolation Rooms (Negative Pressure Rooms), if available. When negative pressure rooms are not available, the patients should be placed in adequately ventilated private rooms with a portable HEPA filter.

**D) Prevention and Management of HBV Infection:**

*Dialysis patients may become infected through the following means:*

- Internally through contaminated dialysis equipment (e.g., venous pressure gauges, isolators or filters).
- Externally through contaminated dialysis machines, including their surfaces, control knobs or intravenous poles.
- Improperly prepared or contaminated injection site.
- Through breaks in the skin or mucous membranes.
- Contaminated items and surfaces such as clamps, scissors, telephones or walls.
- Improper handling of multiple-dose medication vials and intravenous solutions.
- The dialysis staff (contaminated hands, gloves and other objects).

Preventing Hepatitis B virus (HBV) transmission among chronic hemodialysis patients requires:

- Infection control precautions recommended for all hemodialysis patients.
- Routine serologic testing for markers of Hepatitis B virus (HBV) infection and prompt review of results.
- Isolation of HBsAg-positive patients with dedicated room, machine, other equipment, supplies, and staff members;
- Vaccination.

#### Management of HBV-Infected Patients:

- Specify separate room(s) for treatment of HBV-infected patients (HBsAg-positive patient must be strictly isolated in distinct room).
- Designate machines, equipment, instruments, medications, and supplies exclusively for HBV-infected patients (i.e., will not be used by HBV-susceptible patients).
- Most importantly, staff members who are caring for HBsAg-positive patients should not care for HBV-susceptible patients at the same time, including during the period when dialysis is terminated on one patient and initiated on another (during the whole work shift).

#### **E) Training and Education:**

- All hemodialysis patients and their family caregivers should be educated about signs and symptoms of infection related to the hemodialysis device (central venous catheter or AVF/AVG) and the importance of reporting these signs to the treating physician.
- All hemodialysis patients and their family caregivers should be educated about the recommended ways to prevent infections of vascular access, hand hygiene, cough etiquette and methods of transmission of respiratory viruses.
- Training and education for all employees at risk for occupational exposure to blood should be provided at least annually, given to new employees before they begin working in the unit, and documented. At a minimum, they should include information on the following topics:
  - Proper hand hygiene technique.
  - Proper use of protective equipment.
  - Modes of transmission for blood-borne viruses, pathogenic bacteria, and other microorganisms as appropriate.



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- Infection control practices recommended for hemodialysis units and how they differ from Standard Precautions recommended for other health-care settings.
- Proper handling and delivery of patient medications.
- Rationale for segregating HBs Ag-positive patients with a separate room, machine, instruments, supplies, medications, and staff members.
- Proper infection control techniques for initiation, care, and maintenance of access sites.
- Housekeeping to minimize transmission of microorganisms, including proper methods to clean and disinfect equipment and environmental surfaces.
- Recording and monitoring of all dialysis parameters including routine serologic testing results for HBV and HCV, hepatitis B vaccine status, episodes of bacteremia and loss of access caused by infection, and other adverse events. Records of surveillance for water and dialysate quality should also be maintained.
- Periodically assessment of knowledge and competency for caring of AVF and central venous hemodialysis catheter, catheter insertion and medication preparation and delivery in hemodialysis

## 2-SEROLOGICAL TESTS & VACCINATIONS IN DIALYSIS UNIT:

### Routine Serologic Testing of dialysis patients:

Serologic testing for hepatitis B surface antigen (HBsAg), antibody to the core antigen (anti-HBc), antibody to hepatitis B surface antigen (anti-HBs), in addition to antibody to hepatitis C virus (anti-HCV), and alanine aminotransferase (ALT) should be performed on admission to a hemodialysis unit according to the following schedule:

Patient Status	On Admission	Monthly	Semi-annual	Annual
All patients	HBsAg, anti-HBc, anti-HBs, anti-HCV, ALT			
Unvaccinated individuals and Non responders to vaccine		HBsAg		
Anti-HBs positive (> 10 mIU/mL), anti-HBc negative				Anti-HBs
Anti-HBs and anti-HBc positive		No additional HBV testing needed		
Anti-HCV negative		ALT	anti-HCV	

**Table2:** tests for a hemodialysis patient.

Results of hepatitis B testing should be known before the patient begins dialysis. If results are not known, the patient should receive dialysis on unknown viral status machine until the results appear.

- Patients who are anti-HBc and anti-HBs positive do not require further hepatitis B virus-related testing.
- Patients who are only anti-HBs positive require annual anti-HBs testing and a booster if anti-HBs declines to less than 10 mIU/mL.



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- Patients susceptible to hepatitis B virus, including those with no response to the vaccine, should be tested monthly for HBsAg.
- When testing for HBsAg, care should be taken as recent vaccination with hepatitis B vaccine may result in positive HBsAg results for 7 to 30 days after vaccination.
- All anti-HCV negative patients should be tested for increased ALT at least monthly and anti-HCV semiannually.

**Note: Routine testing of patients for HDV or HIV infection for purposes of infection control is not recommended.**

### Routine Serologic Testing of dialysis staff:

Routine testing of staff for HBV is no longer considered necessary as their risk is not greater than that of other healthcare personnel.

Routine testing of staff members for other blood-borne pathogens (HCV, HDV and HIV) is also not recommended.

### **Hepatitis B Vaccination:**

- Hepatitis B vaccine is recommended for all susceptible hemodialysis patients and staff.
- After 1 to 2 months of the last dose test for anti-HBs.
- If anti-HBs levels are below 10 m IU/ml additional three doses are required and test for anti-HBs
- If anti-HBs levels are equal or above 10 m IU/ml consider the patient immune and retest annually.
- Because antibody response is poorer in hemodialysis patients than in healthy control subjects, an increased number of vaccine doses or larger vaccine doses are required.
- If antibody levels decline below 10 m IU/ml., booster doses are required

### **Staff Vaccination:**

- For staff personnel who respond to hepatitis B vaccine, booster doses of vaccine are not necessary, and periodic serologic testing is not recommended to monitor antibody concentrations.
- Primary non-responders to vaccination who are HBs Ag negative should be labeled susceptible to HBV infection and counseled concerning recommended precautions to prevent HBV infection and the need to obtain post-exposure prophylaxis with hepatitis B immune globulin for any known or likely percutaneous or mucosal exposure to HBs Ag-positive blood.
- Estimate staff members who do not respond to revaccination to determine if they are HBs Ag positive.
- HBsAg-positive Seroconversion:  
Report HBsAg-positive seroconversion in a chronic hemodialysis patient to local health directorate as required by law or regulations.
- Verify that the patient has not received Hepatitis B vaccine within the preceding 30 days (vaccine-related antigen may be detected).
- Isolate the patient until the case is ruled out or the patient is HBsAg negative.
- Perform additional testing as indicated. It is recommended that the patient's physician verify infection and determine clinical outcome by sending Hepatitis B viral load, anti-HBs, and anti-HBc.

- Review records of all other hemodialysis patients' routine laboratory results to identify other possible additional cases.
- Investigate potential sources to decide if transmission might have happened within the dialysis unit, including review the patient's medical record for recent medical interventions that could have resulted in infection (e.g., blood transfusions, invasive procedures or hospitalization) and for high-risk behaviors (e.g., injecting drug abuse, sexual activity or tattoos, and review hemodialysis unit practices and procedures for possible breaks in routine procedures (e.g., medication distribution, routine cleaning and disinfection of dialysis machines and surfaces, or sharing of common use items) that could have led to transmission from an unrecognized case.
- Perform counseling and medical evaluation of newly Hepatitis B infected patients with vaccination of contacts.

### **Prevention and Management of HCV Infection:**

#### Screening:

Screening of patients for HCV should be performed upon admission to determine the prevalence of the virus in the hemodialysis unit.

Screening for ALT and anti-HCV should be carried out upon admission, with anti-HCV- negative patients screened monthly for ALT and semi-annually for anti-HCV.

#### Management of HCV infection:

There is no consensus regarding the need to isolate HCV infected patients and dialyze them on dedicated machines to prevent transmission.

HCV transmission within the dialysis environment can be prevented by strict adherence to the infection control precautions recommended for all hemodialysis patients.

Although the isolation of HCV-infected patients is not recommended, routine testing for ALT and anti-HCV is important for monitoring transmission within centers and ensuring that appropriate precautions are being properly and consistently used.

HCV-positive patients should receive information concerning how they can prevent further harm to their liver and prevent transmitting HCV to others.

### **HCV-negative patients:**

- Monthly ALT testing will facilitate the timely detection of new infections and provide pattern from which to determine when exposure or infection may have occurred.

- In the absence of unexplained ALT elevation, testing for anti-HCV (ELISA) every 6 months should be sufficient to monitor the occurrence of new HCV infections
- If unexplained ALT elevation is observed in patients who are anti-HCV negative, repeated anti-HCV testing (ELISA) is necessary. If unexplained ALT elevation persists in patients who repeatedly test anti-HCV negative, testing for HCV RNA (PCR) should be considered.
- *Previously HCV-positive patients who were treated with DAAs (Direct Antiviral Agents) and achieved SVR (Sustained Virologic Response):*  
Testing for HCV RNA (PCR) could be repeated semiannually to detect relapse.

#### **Anti-HCV Seroconversion:**

- Report HCV seroconversion in a chronic hemodialysis patient to the local health directorate as required by law or regulations.
- Perform additional testing as indicated. It is recommended that the patient's physician verify infection and determine clinical outcome.
- Review records of all other hemodialysis patients' routine laboratory results to identify other possible additional cases.
- Investigate potential sources to decide if transmission might have happened within the dialysis unit, including review the patient's medical record for recent medical interventions that could have resulted in infection (e.g., blood transfusions, invasive procedures or hospitalization) and for high-risk behaviors (e.g., injecting drug abuse, sexual activity or tattoos, and review hemodialysis unit practices and procedures for possible breaks in routine procedures (e.g., medication distribution, routine cleaning and disinfection of dialysis machines and surfaces, or sharing of common use items) that could have led to transmission in the hemodialysis unit from an unrecognized case.
- Perform more frequent monitoring (every 1 - 3 months) for a limited time to detect additional infections. If no additional cases are identified, routine semi-annual testing can be resumed.
- If additional cases are identified, possible control measures should be identified. Implementation of control measures should be carefully monitored for consistent application.
- Perform counseling and medical evaluation of newly HCV infected patients.

### **prevention and Management of HDV Infection:**

#### Screening:

Routine testing for HDV infection for the purpose of infection control is not recommended.

*Hepatitis B Vaccination* of HBV- susceptible patients for prevention of HBV transmission will reduce the risk of HDV infection.

#### Management of HDV infection:

Patients known to be infected with HDV should be isolated from all other dialysis patients, including HBV-positive patients, and should receive dialysis on dedicated machines.

Routine screening for HDV is only indicated if there is a patient who is known to be infected with HDV or evidence of transmission within the dialysis unit.

### **Prevention and Management of HIV Infection:**

#### Screening:

Routine testing for HIV infection for the purpose of infection control is not recommended.

Patients with risk factors for HIV infection should be tested. If found to be positive, they should receive proper medical care and counseling regarding preventing the transmission of the virus.

#### Management of HIV infection:

There is no need to isolate patients who are HIV-antibody +ve or have acquired immunodeficiency syndrome (AIDS) from other patients or receive dialysis on separate machines to prevent transmission.

HIV transmission between patients within the dialysis environment can be prevented by strict adherence to the infection control precautions (i.e., standard precautions) recommended for all hemodialysis patients.

### 3-Selection and Maintenance of Vascular Access for Hemodialysis:

Three Types of Vascular access in order of preference: Fistula, Graft, Central Venous Catheter (CVC).

**AV Fistula:** a surgical anastomosis between an artery and a vein that allows arterial blood to flow through the vein, causing the vein to distend and the vessel to thicken

***This type of access is the preferred access for chronic hemodialysis.***

There is a sevenfold greater risk for bacteremia in patients with a dialysis catheter than in those with a primary AV fistula.

- To reduce the number of central venous hemodialysis catheter and their complications, CKD patients should be ideally referred for assessment and creation of AVF when they reach stage 4.
- Infection may result from breaches in infection prevention practices, including aseptic technique, bacterial seeding from another part of the body, or poor hygiene and care of the access arm.
- Because of infection risk, creation of the AV fistula in the upper arm is preferred over the thigh, and maturation of the surgical anastomosis for 1 to 4 months is necessary before use.
- Sterile preparation of the skin over the fistula site (creation of sterile field, use of sterile barriers and sterile gloves) is not more effective in preventing infection than clean technique (clean barriers and clean gloves with strict attention to aseptic technique).

**AV Graft:** If an AV fistula cannot be established in a patient requiring chronic access, an AV graft is the next preferred: a biologic, semi-biologic, or prosthetic graft is implanted subcutaneously to form an anastomosis between an artery and a vein.

- Causes of infection are the same as those of an internal AV fistula. However, complications resulting from infection may be more severe because of the risk of disintegration of graft materials and subsequent hemorrhage.
- All patients should be taught to wash their access site with soap and water daily and before hemodialysis session.
- Patients should also be instructed to ensure that all staff accessing the access site are preparing the skin appropriately and in the proper way prior to cannulation plus wearing a mask for all access connections.
- 2% chlorhexidine gluconate (CHG) is the antiseptic of choice. If povidone-iodine solution is used (apply for 2-3 minutes) and/or 70 percent alcohol

- (apply in rubbing motion for one minute in an outward circular motion to insertion site and allow it to dry before cannulation). The insertion site should not be palpated once the site has been prepared.
- Patients should be taught to recognize symptoms and signs of infection either at the access site or remote site (e.g., fever, chills, and pain, redness, or drainage around the access site).
- To prevent seeding of the access site by microorganisms, remote sites of infection also should be identified and effectively treated as quickly as possible.

### **Central Venous Catheter (CVC) / Temporary vascular access devices:**

#### ❖ **Non-tunneled central line:**

A central venous catheter that goes directly from the skin entry site to a vein and terminates close to the heart or one of the great vessels typically intended for short term use.

#### ❖ **Tunneled central line:**

- A central venous catheter that travels a distance under the skin from the insertion point before terminating at or close to the heart or one of the great vessels.
- For acute hemodialysis, where access for less than 3 weeks' duration is anticipated, vascular access may be obtained using a non-cuffed or cuffed catheter.
- If a catheter must be used for access for longer than 3 weeks, a tunneled, cuffed central venous catheter should be used (if possible, it should not be placed on the same side as a maturing AV access).
- The preferred insertion site is the right internal jugular.
- Subclavian access should be only used when jugular options are not available and in patients who are not anticipated to need permanent vascular access (with subclavian CVC, there is a greater incidence of central venous thrombosis and stenosis).
- Because of associated infection rates of femoral catheters, they should be only placed in bed-bound patients with good exit site care and left in place for no more than five days.
- Percutaneously inserted, non-cuffed central venous catheters have been associated with the highest rates of bacteremia in the hemodialysis setting.

The following recommendations are for the prevention of catheter associated infections:

Catheters should be inserted using maximal sterile Barrier Precautions:

- Special room for insertion equipped with hand washing facility
- PPE (mask, sterile gloves, and long-sleeve sterile gown)
- large sterile sheet or drape.
- Emphasis should be placed on the principles of asepsis when accessing or caring for temporary vascular accesses.
- Use of hemodialysis catheters for other purposes (e.g., administration of fluids, blood /blood products, or parenteral nutrition) should be restricted to circumstances where no alternative vascular access is feasible.
- All personnel involved in the maintenance of intravascular catheters should receive education in appropriate infection control measures and be periodically assessed in knowledge of and adherence to the guidelines.

***It is recommended for the patient and staff members to wear masks for all access connections.***

- Transparent dressing is preferred unless the insertion site is oozing, in which case gauze should be used.
- The dressing should be replaced when it becomes damp, loosened, or soiled or when inspection of the site is necessary.
- Gauze dressings should be replaced every 2 days and transparent dressings at least every 7 days on short-term central venous catheters placed in adults and no more than once a week on tunneled or implanted central venous catheter sites until the insertion site has healed.
- Because of its broad spectrum of activity, a (> 0.5%) chlorhexidine gluconate (CHG) preparation with alcohol is the antiseptic of choice. However, CHG products currently available are not compatible with all dialysis catheters; therefore, the catheter manufacturer should be consulted regarding compatibility.
- If chlorhexidine cannot be used, povidone-iodine is used. It is recommended to use povidone-iodine ointment at the catheter exit site of hemodialysis patients if the ointment does not interact with the material of the hemodialysis catheter.
- Patients should be instructed to keep central venous catheter dressing clean and dry and not to submerge their catheter or catheter site in water. They, or

their caregivers, should also be instructed in the proper way to care for the site and replace the dressing if it became compromised.

- Emphasis should be placed on early recognition of possible signs of infection (tenderness, redness, or drainage around the insertion site) and the principles of asepsis when accessing or caring for temporary vascular accesses.

### **Catheter Connection and Disconnection Protocol:**

#### **Connection Steps:**

1. Perform hand hygiene and don new clean gloves.
2. Clamp the catheter (*Note: Always clamp the catheter before removing the cap. Never leave an uncapped catheter unattended.*)
3. Disinfect the hub with caps removed using an appropriate antiseptic.
  - a. Prior to cap removal, disinfect the caps and the part of the hub that is accessible and discard the antiseptic pad (i.e., use a separate antiseptic pad for the next step).
  - b. Remove the caps and disinfect the hub with a new antiseptic pad for each hub. Scrub the sides (threads) and end of the hub thoroughly with friction, making sure to remove any residue (e.g., blood).
  - c. Using the same antiseptic pad, apply antiseptics with friction to the catheter, moving from the hub at least several centimeters towards the body. Hold the limb while allowing the antiseptic to dry.
  - d. Use a separate antiseptic pad for each hub/ catheter limb. Leave hubs “open” (i.e., uncapped and disconnected) for the shortest time possible.
4. Always handle the catheter hubs aseptically. Once disinfected, do not allow the catheter hubs to touch nonsterile surfaces.
5. Attach sterile syringe, unclamp the catheter, withdraw blood, and flush per facility protocol.
6. Repeat for other limb (this might occur in parallel).
7. Connect the ends of the blood lines to the catheter aseptically.
8. Remove gloves and perform hand hygiene.

#### **Disconnection Steps:**

1. Perform hand hygiene and don new clean gloves.
2. Clamp the catheter (*Note: Always clamp the catheter before disconnecting. Never leave an uncapped catheter unattended.*)
3. Disinfect the catheter hub before applying the new cap using an appropriate antiseptic (see notes).
  - a. (*Optional*) Disinfect the connection prior to disconnection. If this is done, use a separate antiseptic pad for the subsequent disinfection of the hub.

- b. Disconnect the blood line from the catheter and disinfect the hub with a new antiseptic pad. Scrub the sides (threads) and end of the hub thoroughly with friction, making sure to remove any residue (e.g., blood).
- c. Use a separate antiseptic pad for each hub. Leave hubs “open” (i.e., uncapped and disconnected) for the shortest time possible.
4. Always handle the catheter hubs aseptically. Once disinfected, do not allow the catheter hubs to touch nonsterile surfaces. Hold the catheter until the antiseptic has dried.
5. Attach the new sterile caps to the catheter aseptically. Use caution if tape is used to secure caps to the catheter.
6. Ensure that catheter is still clamped.
7. Remove gloves and perform hand hygiene.

#### 4- Water treatment in dialysis unit:

The purity of water used for hemodialysis, reuse, or concentrate preparation is critical. Most hemodialysis centers have water treatment systems that consist of a water softener, carbon filters, particulate filters, reverse osmosis and/or deionizers, and filters and ultrafilters, with or without ultraviolet (UV) light.

Systems should be designed to eliminate the anticipated chemical and biologic impurities found in the potable water in the location where they are installed.

##### **Particulate filters Multimedia (depth filter) (sediment filters):**

Remove sediment (coarse particulate materials) from incoming water that could damage or clog the water treatment system.

##### **Carbon filters:**

Carbon filters remove chlorine, chloramine, and organic material from the municipal water supply.

##### **Water Softener:**

Removes calcium and magnesium from the incoming city water by “ionic exchange” (i.e., the calcium and magnesium ions in water are exchanged for sodium ions).

##### **Micron Filters:**

These are used to remove any particles coming through the tank filtration system before entering the RO.

**Reverse Osmosis (RO):**

Reverse osmosis (RO) uses osmotic and hydrostatic pressures over semipermeable membranes to remove dissolved solutes, bacteria, viruses, endotoxin and pyrogens (in theory RO is capable of removing 90% to 99% of electrolytes and all bacteria, viruses and endotoxins).

**Deionizers (DI):**

Deionizers contain resin beds, which remove cations and anions by binding them to the resin and releasing hydrogen and hydroxyl ions. Deionizers do not remove bacteria and endotoxin and resin beds may contribute to bacterial growth significantly. For these reasons, if the deionizing system is the last process in the water treatment system, it must be followed by an ultrafilter or other bacteria and endotoxin-reducing device.

**Ultraviolet Light:**

Some dialysis centers may use UV lights to reduce microbial contamination. However, care must be taken as UV irradiation does not remove endotoxin and it may be ineffective in killing some microbes if the radiant energy decreases below effective levels or the light cannot reach microorganisms.

**Ultrafilters (Bacterial and endotoxin retentive filters):**

Dialysis centers use ultrafilters, with or without UV lights, to remove bacteria and endotoxins. The ultrafilter should be the last component of the water processing system before the distribution loop.

Because no system should be considered 100% effective at removing bacteria or endotoxin, the use of ultrafilters does not eliminate the need for monitoring of bacterial and/or endotoxin contamination.

**Water distribution and storage:**

- Water distribution systems should be constructed of plastic pipes because metal pipes could contaminate the treated water with chemicals such as copper, lead, or zinc.

- The system should be configured as a continuous loop, with no dead ends or unused branches and minimal number of elbows and T joints because stagnant areas may serve as a source of bacterial contamination for the rest of the water system.
- The outlets of water distribution system should be at the highest point to allow adequate contact of all parts of the system with germicide during disinfection.
- When possible, storage tanks should not be used because they increase the amount of water and surface area available for bacterial contamination. If a storage tank is used, it should be:
  - The smallest tank possible.
  - Designed to have a constant flow with no stagnant areas.
  - With an airtight lid, and vented through a hydrophobic 0.2-micron air filter.
  - Able to be cleaned, disinfected, and rinsed.
  - With a conical or bowl shaped base, and drain from the bottom.
- All piping (including water lines from the processed water outlet to the dialysis machines) and storage tanks must be disinfected at intervals adequate to prevent bacterial growth. The interval will depend on the quality of water entering the system and on the system's design.
- Total viable bacteria should not exceed 100 colony-forming units per milliliter (cfu/ml), with a need for action if results are in excess of 50 cfu/ml.
- Endotoxin limits should be less than 0.25 ELISA units per milliliter (EU/ml) in processed water ( $\leq 0.5$  in dialysate). With Endotoxin levels  $\geq 0.125$  EU/ml in processed water (0.25 EU/ml in dialysate) action is required.

#### **Disinfection of the Dialysis System:**

- The routine disinfection of isolated components of a dialysis system is usually inadequate (i.e., the complete dialysis system: water treatment system, distribution system and dialysis machine should be considered during the disinfection procedure).
- Disinfection procedures used for the machine to control bacterial infection are considered sufficient to reduce blood contamination below

infectious levels (i.e., it is not only to prevent the multiplication of waterborne bacteria to a significant level but also to eliminate blood-borne viruses.)

- Recirculating or recirculating single-pass dialysis machines should be disinfected immediately prior to first use of the day and after each use.
- For single-pass machines, the disinfection process should be performed immediately prior to first use and after each patient use.
- For the purpose of disinfecting dialysis systems, the manufacturer's instructions should be followed for both the machines and the disinfectants.

### **Monitoring of water that is used for hemodialysis:**

#### **Microbiological testing:**

##### **Frequency of Testing**

- Microbiologic monitoring of treated water and dialysate (Bacterial counts and endotoxin levels) should be performed at least monthly and more frequently if problems are identified (i.e., weekly if not up to the standards).
  - Weekly testing for one month should be done when a water distribution system or dialysate system is new or a change has been made in the existing system.
  - Samples should always be taken before disinfection or sanitization of the water system or dialysis machines.
- Minimum sites of sampling for testing:
    - a. Post RO membrane.
    - b. First point of the water distribution loop (first outlet or first machine port) .
    - c. End point of the water distribution loop (last outlet or last machine port).

If a problem with the water system is suspected, additional test sites may include before the RO membrane, after the storage tank, before and after deionization tanks, and other locations in the water distribution loop.

#### **Dialysate Samples for Bacterial Testing:**

- Test at least 2 machines a month
- Rotate so that each machine is tested at least once per year
- Obtain sample from the dialysate port of the dialyzer or a sampling port
- Process immediately or refrigerate to retard growth

#### **Limits and Action Level:**

##### Maximum Allowed:

CFU level < 100 CFU/ml

Endotoxin level < 0.25 EU/ml

**Action Level:**

The action level is the concentration at which corrective measures are to be immediately conducted to reduce the bacteria and/or endotoxin levels, which are typically 50% of the maximum allowable level.

CFU level  $\geq$  50 CFU/ml

Endotoxin Level  $\geq$  0.125EU/ml (Ref: AAMI/ISO 23500: 2011)

**Note:** If Action Levels are observed, disinfection and retesting shall be done immediately to restore the quality to an acceptable level.

**Laboratory:**

All samples shall be sent to a designated laboratory recognized by the General directorates of laboratories and blood bank of the MOH.

**Record:**

All the results shall be properly documented and made available for inspection.

**Note: Routine testing of water and action done by public health (Environment health). Infection control monitoring the result of water monthly only and all the results shall be properly documented and made available for inspection.**

### Implications of Inadequate Treatment or Distribution of Water:

Hazard/hygiene indicator	Timing/frequency of testing	Result	INTERPRETATION	Action	References
Bacterial Colony Counts (CFU)	Monthly (or more frequently if necessary)	0 - < 50 / ml	Satisfactory	No action; system under control	UK renal association, 2009
		≥ 50 - <100/ ml	Borderline	Investigate cause and put corrective action in place	
		≥ 100 / ml	Unsatisfactory	Take out of use until corrective action implemented	
Endotoxin Levels(EU/ml)		0 - < 0.125 EU/ml	Satisfactory	No action;system under control	
		≥ 0.125 - < 0.25 EU/ml	Borderline	Investigate cause and put corrective action in place	
		≥ 0.25 EU/ml	Unsatisfactory	Take out of use until corrective action implemented	

**Table 1:** Testing requirements and interpretation of renal dialysis fluid and water used for the preparation of dialysis fluid

**Source:** - ANSI/AAMI/ISO. Guidance for the preparation and quality management of fluids for hemodialysis and related therapies 23500:2011. Association for the Advancement of Medical Instrumentation; Arlington, VA: 2011.

Bacterial contamination of water used for dialysis has been associated with severe illness and/or death.

#### **Gram-negative bacteria:**

Gram-negative bacteria have been associated with pyrogenic reactions and bacteremia. Symptoms include shaking chills, fever, hypotension, headaches, myalgia, nausea, and vomiting.

### **Endotoxin:**

Endotoxin can acutely activate both humoral and cellular immune response, leading to fever, shaking chills, hypotension, multisystem organ failure, and even death. Long-term exposure may lead to a chronic inflammatory response.

### **Non-tuberculous mycobacteria:**

Non-tuberculous mycobacteria have been associated with disseminated disease, bacteremia, localized abscess, and localized graft infection. Symptoms include fever, malaise, and anorexia.

### **Responsibility:**

**Public health personnel (in coordination with hemodialysis unit staff)** are responsible for conducting initial and routine monthly sampling of treated water for hemodialysis after installation of a water treatment and distribution systems; reporting the results to hemodialysis responsible staff for proper documentation and identifying trends in these results; and, taking corrective measures when abnormal results are reported.

*Public health personnel serve as the reference point for training and consultations related to water quality standards. If doesn't meet standards, weekly testing until resolved.*

**Maintenance personnel:** will conduct disinfection of water treatment and distribution systems; do water sampling and testing; report the results; and, take corrective actions accordingly and as per their related standard operating procedures (SOPs) and guidelines.

**Laboratory personnel** will receive the samples; analyze them; and, report results in a timely manner and as per related SOPs.

**IP&C personnel** are responsible of reviewing and supervise regularity of routine monitoring of treated water for hemodialysis as per MOH guidelines (i.e., double-checking for frequency of testing; testing methods; and corrective measures with abnormal results).

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