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Guidelines for Infection Prevention and Control in Dialysis Settings

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Section 1: General Overview

Background

Infection prevention and control (IPC) in dialysis settings is a critical component of patient safety and quality of care. Patients receiving hemodialysis or peritoneal dialysis are inherently vulnerable to infection due to repeated vascular access, frequent exposure to blood and invasive procedures, and reliance on complex equipment and water treatment systems. Dialysis-associated infections—including vascular access site infections, bloodstream infections, peritonitis, and transmission of bloodborne pathogens—are associated with increased morbidity, prolonged hospitalization, higher healthcare costs, and preventable mortality.

National surveillance data highlights the substantial burden of infection risk within dialysis populations. A dialysis event rate of 0.97 per 100 patient-months reflects ongoing exposure to infectious complications. These findings underscore the persistent risk of bloodstream and vascular access–related infections in dialysis units and emphasize the importance of comprehensive infection prevention and control strategies.

Importantly, infection rates varied markedly by type of vascular access, reflecting differences in inherent risk. Temporary central venous catheters demonstrated the highest dialysis event rate (4.36 per 100 patient-months), followed by permanent central venous catheters (1.87), arteriovenous grafts (0.35), and arteriovenous fistulas (0.17). This gradient reinforces well-established evidence that catheter-based access significantly increases infection risk and emphasizes the need for stringent IPC practices, optimal access selection, and continuous monitoring.

In this context, the implementation of standardized, evidence-based IPC guidelines is essential to reducing preventable infections in dialysis facilities. Accordingly, this guideline has been developed to consolidate infection prevention and control measures specific to dialysis practice, ensuring that healthcare workers are equipped with clear, practical, and evidence-informed standards to protect both patients and staff. By aligning with national surveillance findings and international best practices, this guideline aims to strengthen infection control programs, promote safer vascular access management, and enhance the overall quality and safety of dialysis care.

Purpose of the Guideline

This guideline is intended to establish evidence-based infection prevention and control (IPC) practices within dialysis settings. Its purpose is to prevent healthcare-associated infections (HAIs), enhance patient safety and outcomes, and ensure the consistent application of safe practices among healthcare workers.

Target Audience

This guideline is developed for all healthcare personnel engaged in dialysis services, including but not limited to:

- Nephrologists and other physicians
- Dialysis nurses or technicians
- Infection prevention and control (IPC) professionals
- Environmental services and housekeeping staff
- Other healthcare professionals

Section 2: Dialysis Fundamentals: Modalities, Vascular Access, and Machine Components

Dialysis Modalities

There are several approaches to dialysis, each tailored to meet the individual needs and clinical conditions of patients, ensuring effective blood purification and overall patient safety.

Hemodialysis

Hemodialysis (HD) is a process that removes toxins, excess fluids, and electrolytes from the blood using a dialysis machine and an artificial membrane housed within a dialyzer. The cleansing solution used in this process is called dialysate, which is composed of three main elements: purified water, acetate, and bicarbonate. Inside the machine, the dialysate is prepared and circulated through the dialyzer in the opposite direction of the patient's blood flow.

Although blood and dialysate never come into direct contact, waste products and excess substances move across the membrane through diffusion and hydraulic pressure. Once the dialysate absorbs these wastes, it becomes effluent and is discarded through a drainage system, usually connected to a wall box at the dialysis station.

Continuous Renal Replacement Therapy

Continuous renal replacement therapy (CRRT) is often preferred over intermittent hemodialysis (HD) in acute care settings for patients with conditions such as hemodynamic instability, significant fluid overload, or brain injury. CRRT is delivered through a central venous catheter (CVC) and is typically performed in intensive or critical care units.

Peritoneal Dialysis

Peritoneal dialysis (PD) is a renal replacement therapy that uses the patient's peritoneal membrane as a natural filter to remove waste products and excess fluids. A sterile dialysate solution is instilled into the peritoneal cavity through a permanently placed catheter. After a dwell time, the solution is drained and replaced with fresh fluid. The International Society for Peritoneal Dialysis (ISPD) advocates use of a double-cuff catheter because of fewer exit site complications and longer survival times than are seen with single cuff catheters.

Peritoneal dialysis (PD) can be delivered using different schedules and systems, which are selected based on patient needs, lifestyle, and clinical considerations.

- **Intermittent Peritoneal Dialysis (IPD):**
  - Treatments are typically performed several times per week, often overnight, with a duration of 8–14 hours.
  - IPD generally requires the use of an automated cycler to heat the dialysate and perform exchanges.
  - The cycler utilizes disposable tubing and pre-prepared dialysate, which must be set up and connected to the patient's peritoneal access following standardized procedures.
  - At the conclusion of treatment, all dialysate is drained from the peritoneal cavity.
- **Continuous Ambulatory Peritoneal Dialysis (CAPD):**
  - Exchanges are performed manually every 4–6 hours during the day, using either self-administered or assisted techniques.
  - Patients retain a prescribed volume of dialysate (dwell), typically up to 2 L in adults, within the peritoneal cavity between exchanges.
- **Continuous Cycling Peritoneal Dialysis (CCPD):**
  - Exchanges are generally performed every 2–3 hours overnight using an automated cycler.
  - The cycler heats the dialysate and performs automatic exchanges.
  - Patients retain a prescribed dwell volume during the day.

Bedside or Portable Hemodialysis

In acute care settings, dialysis can be performed at the patient's bedside using a portable reverse osmosis (RO) water system. The water and dialysate used in this setup must adhere to the same quality standards as those used in dialysis centers.

Home Hemodialysis

Home hemodialysis (HHD) causes less disruption to a patient's family life and work schedule, as it eliminates the need for frequent travel to dialysis centers. Patients undergoing HHD must be willing and able to perform treatments independently or with the assistance of a caregiver, without direct supervision from dialysis center staff.

Vascular Access

Table 1: Vascular Access Types

Type	Method	Permanent/ Temporary	Pros	Cons
Arteriovenous fistula	A surgical anastomosis is created between an artery and a vein to create a large vessel for cannulation and flow	Permanent	- Preferred access type - Lowest risk of infection and complications	Requires 6 weeks to 4 months of maturation before AVF can be used
Arteriovenous graft	A synthetic graft is used to create the anastomosis between an artery and vein	Permanent	Risk of infection comparable to AVF	- Requires 3-6 weeks of maturation before AVG can be used - Higher rate of complication compared to AVF - Life span of graft is shorter than that of AVF
Tunneled CVC	Cuffed catheters are inserted into large veins through a tunnel under the skin	Temporary	Immediate access to bloodstream for HD	Much higher rate of infection than AVF or AVG
Non tunneled CVC	Catheter is percutaneously placed through the skin directly into a large vein	Temporary	Immediate access to bloodstream	Highest risk of infection

***AVF**= Arteriovenous fistula- **AVG**= Arteriovenous graft - **CVC**= Central venous catheter*

Central Venous Catheters

When urgent dialysis is required, a central venous catheter (CVC) may be inserted to provide immediate vascular access. Both cuffed and non-cuffed catheters can be used; however, if the device is expected to remain in place for longer than three weeks, a tunneled, cuffed catheter is recommended. To reduce complications and preserve future vascular access sites, the right internal jugular vein is preferred.

Arteriovenous Grafts

Arteriovenous grafts (AVGs) are constructed from synthetic materials that white blood cells cannot infiltrate, making them moderately susceptible to infection. Various materials—including autologous, homologous, and heterologous options—can be used for graft creation, though expanded polytetrafluoroethylene (ePTFE) is currently the most utilized. Since ePTFE grafts are considered prosthetic devices, patients require careful monitoring for potential stenosis and thrombotic complications.

Arteriovenous Fistulas

Native arteriovenous fistulas (AVFs) present the lowest risk of infection among vascular access options. They are regarded as the preferred access type, as numerous observational studies have demonstrated that AVFs are associated with fewer complications compared to arteriovenous grafts (AVGs) or central venous catheters (CVCs).

Dialysis Machine Structure and Components

Dialyzer

The type of dialyzer used may differ across centers; however, all contain a semi-permeable membrane. These membranes differ in characteristics such as material, pore size, and susceptibility to blood leakage. In every hemodialyzer design, the semi-permeable membrane fully separates the blood compartment from the dialysate compartment.

Dialysate

Is the specially prepared fluid used in dialysis that facilitates the removal of waste products, excess electrolytes, and fluid from the blood.

Dialysis Machines

Hemodialysis machines employ three types of fluid pathways: recirculating, single-pass recirculating, and single-pass systems.

Table 2: Dialysis Machine Fluid Pathways

Recirculating System	Circulates dialysate repeatedly through the hemodialyzer during dialysis
Recirculating Single-Pass System	Contains a reservoir partially replaced by a constant flow of fresh dialysate
Single-Pass System	Discard all dialysate through the drain

Section 3: Infection Prevention & Control Core Measures

Standard Precautions

Hand Hygiene

Hand hygiene (HH) is the single most effective measure to prevent infection transmission. In dialysis units, opportunities for hand hygiene occur before and after touching patients, before aseptic procedures, after contact with body fluids, and after touching patient surroundings. Handwashing sinks and alcohol-based hand rubs must be available at all points of care:

- An adequate number of easily accessible handwashing sinks should be provided, with a minimum of one sink for every 2 to 4 dialysis chairs or beds.
- At a minimum, an alcohol-based hand rub dispenser (either wall-mounted or tabletop) should be available at each dialysis chair or bed.

Table 3: Opportunities for Hand Hygiene in the Dialysis Unit

Hand Hygiene Opportunity
1. Before touching a patient.
2. Before aseptic procedures.
3. Following body fluid exposure risk.
4. After touching a patient.
5. After touching patient surrounding.

Personal Protective Equipment

Personal protective equipment (PPE)—including gloves, gowns, and protection for the mouth, nose, and eyes—must be used whenever there is a likelihood of contact with blood or body fluids. Since multiple opportunities for exposure arise throughout dialysis procedures, ensuring the availability of PPE at the point of care is essential to promote staff adherence to safety practices.

Respiratory Hygiene

A comprehensive respiratory protection program must be implemented with all its required components to ensure effectiveness, compliance, and the prevention of respiratory infection transmission among dialysis patients. Patients with respiratory symptoms must wear surgical masks and be placed in designated areas. Visual alerts about cough etiquette and hand hygiene must be posted.

Injection Safety

Single-Dose Medication

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

Multi-Dose Medication

- A dedicated medication preparation room must be available.
- Multi-dose vials should not enter the immediate patient treatment area.
- Access to multi-dose vials must follow strict aseptic technique: the rubber self-seal cap should be disinfected with alcohol before each entry, a new syringe must be used for each access, and the vial should only be used within its recommended lifespan.
- Any multi-dose medication brought into the patient treatment area must be discarded and not reused for another patient.
- Vials should be discarded if sterility is compromised or uncertain.
- Single-use intravenous medication vials must only be punctured once; once accessed, sterility cannot be guaranteed.
- Prohibition of re-entering multidose vials with the same needle.
- Staff must not eat or drink in the dialysis treatment area.

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.
- Aseptic technique must be strictly implemented during the connection and disconnection of dialysis access.

Environmental Cleaning & Disinfection

Dialysis Station

Develop written protocols for cleaning and disinfecting all surfaces and equipment in the dialysis unit. Cleaning with a germicidal detergent before disinfection is essential to remove organic material (e.g., blood, mucous, or feces), dirt, or debris. The presence of such material protects microorganisms from the disinfection process by physically blocking or inactivating the disinfectant.

- Use approved cleaning and disinfecting agents on all non-critical surfaces within the dialysis station and other environmental areas.
- After each patient session, clean and disinfect all surfaces at the dialysis station with an approved intermediate-level disinfectant, including:
  - Exterior of the dialysis machine
  - Bed or chair and over-bed table
  - Computers and counters
  - Blood pressure cuffs and tubing
  - TV controls and call lights
- Pay special attention to frequently touched areas, such as dialysis machine control panels, which are at higher risk for contamination.
- All reusable medical equipment must be cleaned and disinfected before returning to shared areas or being used for another patient.
- Blood or body fluid spills must be managed by trained staff following standard infection control procedures.

Dialysis Machine

The dialysis machine is considered dirty or potentially contaminated once a patient is connected to the circuit. Precautions should be taken when cleaning to avoid employee exposure to bloodborne pathogens. All surfaces of the machine need to be cleaned, this includes the front, sides, base and back of the machine along with connection ports and valves that are easy to overlook. If the machine was used to perform bedside dialysis, it must be cleaned prior to removing from the patient room and transporting back to dialysis storage. Confirm with the manufacturer that the disinfectant is compatible with the dialysis machine; if not, follow the manufacturer's instructions for surface disinfection.

Wall Box

Dialysis wall boxes are recessed units located at each hemodialysis station, providing connections for the machine to receive acid and base concentrates, access treated water, and discharge waste. These boxes pose specific infection prevention and control concerns, as they can become readily contaminated with microorganisms that may be transmitted to dialysis patients, who are highly susceptible to infection. Regular cleaning, disinfection, and proper maintenance of wall boxes are therefore essential to minimize the risk of patient infections.

Medical Waste Management

- Waste generated by the dialysis unit might be contaminated with blood and should be considered infectious and handled accordingly.
- All disposable items, including dialyzers and tubing, should be managed in accordance with national medical waste regulations.
- Needles and other sharps must be disposed of immediately after use in leak-proof, puncture-resistant yellow biohazard containers.
- Appropriate infectious waste and sharps containers of suitable size should be available at each dialysis station.

Linen Handling

Soiled linens in dialysis units should be handled carefully to minimize the spread of microorganisms. Key principles include:

- Place used linens directly into designated leak-proof containers at the point of use.
- Do not sort or rinse linens in patient care areas.
- Prevent contact between clean and contaminated linens.
- Store clean linens in a dry, clean area, separate from soiled materials.

Occupational Health

Occupational health aims to prevent the transmission of infections between healthcare workers (HCWs) and patients. Key strategies include pre-employment (pre-placement) medical examinations and immunization programs. All dialysis settings staff must undergo a pre-employment assessment to ensure medical fitness, identify any health conditions requiring support, and establish baseline health data for ongoing monitoring. This evaluation typically includes a review of medical, family, occupational, and social history, a physical examination, and relevant laboratory or radiological investigations. Immunization status is assessed and updated as needed to protect HCWs and patients from vaccine-preventable diseases.

Recommended Vaccines for Healthcare Workers

Vaccine	Category	Recommendations
MMR	All HCW/ pre-employment	Proof of receiving at least two doses of MMR vaccine or Proof of immunity by lab test (IgG)
Chickenpox (Varicella)	All HCW/ pre-employment	Proof of receiving at least two doses of Varicella vaccine or Proof of immunity by lab test (IgG) or clinically documented previous infection

Hepatitis B virus (HBV)	All HCW/ pre-employment	Proof of receiving at least three doses of HBV vaccine or Proof of immunity by lab test (HBsAb =/> 10U)
Tdap	All HCW/ pre-employment	One-time dose of Tdap Td boosters every 10 years thereafter Pregnant HCWs need to get a dose of Tdap during each pregnancy
Meningococcal	All HCW/ pre-employment	Proof of receiving at least one doses of a quadrivalent Meningococcal meningitis vaccine
Influenza	All HCW annually	Proof of vaccination is required during the influenza season
COVID-19	All HCW/ pre-employment	Based on the national recommendations

Best Practices for Reducing Site-Related Infections in Dialysis

A. HD Access Best Practices

- The risk of infection associated with hemodialysis vascular access depends on the type of access used. Arteriovenous fistulas (AVFs) and grafts (AVGs) carry a lower risk of bloodstream infection compared to central venous catheters (CVCs).
- To further reduce infection, creating a fistula in the upper arm is preferred over the thigh.
- If complications with an AVF or AVG occur and CVC use is expected to extend beyond three weeks, a tunnelled, cuffed CVC is recommended.
- In urgent situations, a non-tunnelled CVC may be used; however, it should either be removed or replaced with a tunnelled catheter as soon as possible, and in no case left in place for more than two weeks.
- Evidence-based recommendations support the use of the right internal jugular vein as the preferred site for vascular access, with the subclavian vein considered only if no jugular option is available. This is especially important for patients who may require permanent access in the future.
- In some chronic hemodialysis patients with multiple failed fistulas or grafts, or severely compromised upper body vasculature, femoral catheters may be required.
- Due to their higher risk of infection, femoral catheters should be limited to bedridden patients and managed with strict attention to site care and dressing protocols.

- Strategies to minimize risk during fistula or graft cannulation emphasize strict adherence to aseptic technique.
- Masks should be worn by the patient and healthcare worker when dressing is changed.
- Because of its broad antimicrobial activity, a chlorhexidine gluconate 2% in 70% alcohol is considered the antiseptic of choice. If chlorhexidine cannot be used, povidone-iodine is recommended as an alternative.
- When using a skin antiseptic (e.g., povidone-iodine, chlorhexidine, or alcohol-based solution), follow the manufacturer's instructions for contact time. Apply the antiseptic using a single, outward circular motion from the insertion site and allow it to dry completely before cannulation. Once the skin is prepared, the insertion site must not be touched.
- Strategies to reduce infection risk when using CVCs for vascular access emphasize proper site care and maintenance.
- The CDC notes that the choice of dressing is a matter of preference, but if the insertion site is oozing, gauze is preferred.
- Dressings should be changed if they become damp, loose, or soiled, or when site inspection is needed.
- All healthcare personnel responsible for intravascular catheter maintenance should be trained in proper infection control practices and regularly evaluated for both their knowledge and compliance with guidelines.
- In addition to strict aseptic measures, both staff and patients are advised to wear masks during any access connections.
- Patients should be instructed to avoid submerging their catheter or insertion site in water. Showering is permitted if the catheter and access site are securely protected with an impermeable dressing.

B. PD Access Best Practices

There are three types of infections related to peritoneal dialysis:

Exit-site infection:

- Erythema, tenderness, exuberant granulation tissue, or edema at the catheter exit site
- Presence of purulent or bloody drainage

Subcutaneous tunnel infection:

- Erythema, edema, or tenderness along the subcutaneous catheter pathway
- Purulent drainage or associated cellulitis

Peritonitis:

- Presence of at least two of the following:
  - Clinical signs or symptoms of peritonitis (e.g., abdominal pain or fever)
  - Cloudy dialysate
  - Dialysate white blood cell count > 100 cells/mm³ with ≥ 50% polymorphonuclear leukocytes
  - Positive dialysate culture or Gram stain

- It's suggested that the type of PD catheter used be left to shared decision-making between the individual clinician and patient.
- Double-cuff catheters are recommended due to lower exit-site complication rates and longer catheter survival compared with single-cuff devices.
- Patients should receive pre-procedure education on catheter placement, along with ongoing training on proper catheter and exit-site care.
- Prophylactic antibiotics should be administered immediately prior to catheter insertion to prevent peritonitis.
- Sterile dressings should be maintained until the exit site and subcutaneous tract are fully healed.
- For oozing or leakage, gauze dressings are preferred over occlusive transparent dressings until complete healing occurs.
- Routine antiseptics, such as 2% chlorhexidine gluconate (CHG) or povidone-iodine, should be used to reduce microbial colonization.
- Care must be taken to ensure compatibility between the catheter and all products used in its care.
- Catheter placement should be performed under sterile conditions, preferably in an operating room.
- Patients should promptly report any signs of infection, including redness, purulent discharge, swelling, soreness at the exit site, cloudy effluent, or fever.
- Positioning the catheter away from skin folds, belt lines, and diaper areas helps reduce infection risk and ensures accessibility for routine care and inspection.
- After healing, exit-site care should be performed daily and whenever the site becomes wet or soiled. Dressing is not required for adults but may help prevent infections in children.
- It is recommended that the initial exit-site dressing remains intact for seven days post-insertion, unless soiled, to stabilize the catheter and reduce infection risk.

- Prophylactic nasal antibiotics are suggested for patients identified as nasal carriers of *Staphylococcus aureus* prior to catheter insertion.
- Dialysate should be warmed before infusion to enhance patient comfort and safety.

Patient Catheter Connection & Disconnection

Catheter Connection Steps

- Perform hand hygiene and put on new clean gloves.
- Clamp the catheter. (Always clamp before removing the cap; never leave an uncapped catheter unattended).
- Disinfect the catheter hub:
  - Before removing caps, disinfect the accessible part of the hub and the caps using an antiseptic pad, then discard the pad.
  - Remove the caps and disinfect the hub again with a new antiseptic pad for each hub, scrubbing the sides (threads) and tip to remove any residue, such as blood.
  - Using the same pad, apply antiseptic with friction along the catheter from the hub several centimeters toward the body. Hold the limb and allow the antiseptic to dry.
  - Use a separate pad for each hub or catheter limb, and keep hubs “open” (uncapped and disconnected) for the shortest possible time.
- Handle catheter hubs aseptically; do not touch nonsterile surfaces after disinfection.
- Attach a sterile syringe, unclamp the catheter, withdraw blood, and flush according to facility protocol.
- Repeat steps for any additional catheter limb, which may be done in parallel.
- Connect the blood lines to the catheter aseptically.
- Remove gloves and perform hand hygiene.

Catheter Disconnection Steps

- Perform hand hygiene and put on clean gloves.
- Clamp the catheter. (Always clamp before disconnecting; never leave an uncapped catheter unattended).
- Disinfect the catheter hub before applying the new cap:
  - Optionally, disinfect the connection prior to disconnection using a separate pad for the subsequent hub disinfection.
  - Disconnect the blood line and scrub the hub thoroughly with a new antiseptic pad, ensuring all residue is removed.

- Use a separate pad for each hub and minimize the time the hub is left “open”.
- Handle hubs aseptically; avoid contact with nonsterile surfaces and allow antiseptic to dry.
- Attach new sterile caps to the catheter.
- Ensure the catheter remains clamped.
- Remove gloves and perform hand hygiene.

Transmission Based Precautions

Contact Precautions

For patients at increased risk for transmission of pathogenic microorganisms, 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. These precautions include:

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

Droplet Precautions

Applied for pathogens transmitted via large respiratory droplets (e.g., Influenza, Pertussis, Neisseria meningitidis). Measures include:

- Isolating patients in a single room.
- Healthcare workers wearing surgical masks whenever entering the patient's room.
- Practicing proper respiratory hygiene and cough etiquette.

Airborne Precautions

These precautions apply to infections transmitted via airborne particles (e.g., TB, Measles, Varicella) and include:

- Placing the patient in a negative-pressure airborne infection isolation room (AIIR) or a single room equipped with an approved portable HEPA filter.
- Healthcare personnel wearing fit-tested N95 respirators.
- Limiting patient movement outside the room.

Table 4: PPE Selection Based on the Isolation Precautions

Type of PPE	Standard Precautions	Transmission-Based Precautions		
		Contact Precautions	Droplet Precautions	Airborne Precautions
Gloves	As Needed	**At All Time**	As Needed	As Needed
Gown	As Needed	**At All Time**	As Needed	As Needed
Surgical Mask	As Needed	As Needed	**At All Time**	Never
Respirator	Never	Never	AGPs Only	**At All Time**
Eye Protection	As Needed	As Needed	As Needed	As Needed

AGPs= Aerosol-Generating Procedures

Transfer Patient Under Transmission-Based Precautions

- Restricted the transfer of patients under isolation precautions for medically necessary purposes.
- Notify the receiving unit/ward/department/ facility (diagnosis, type of isolation precaution).
- Isolation transportation cards must be used and should be consistent with the patient diagnosis, color-coded, posted in Arabic and English, and indicating the type of precautions required for staff and through less crowded traffic routes.

Management of Hepatitis B Virus (HBV) Infected Patient

Hemodialysis patients are considered immunocompromised and therefore more vulnerable to infections. Studies have shown that the most common mode of transmission among patients is the sharing of equipment between individuals. To minimize this risk, it is essential to designate a separate room for the treatment of patients infected with hepatitis B virus (HBV). This isolated room or area must have dedicated staff, equipment, medications, and supplies that are not shared with HBV-susceptible patients.

Management of Hepatitis C Virus (HCV) Infected Patients

Hepatitis C Virus (HCV) is less likely to be transmitted through occupational exposure compared to Hepatitis B Virus (HBV). As a result, patients with HCV do not require isolation from other patients.

Management of Hepatitis D Virus (HDV) Infected Patients

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.

Management of Human Immunodeficiency Virus (HIV) Infected Patients

There is no need to isolate patients who are HIV positive or have acquired immune deficiency syndrome (AIDS) from other patients or receive dialysis on separate machines to prevent transmission.

Section 4: Water Treatment and Dialysate Quality in Hemodialysis: System Components, Monitoring, and Standards

Components of a Hemodialysis Water Treatment System

Backflow Prevention	• Prevents contamination of the water system from ground water, storage tanks, and other sources during times of reduced water pressure. • Can be break tanks or reduced pressure zone valves.
Water Softener	• Exchange calcium and magnesium ions in incoming water for sodium ions. • Must be regenerated when no more sodium is available. • Permanent softeners are regenerated at point of use with a brine tank. • Portable softeners can be exchanged by vendors when depleted.
Carbon Filter	• Remove chlorine, chloramine, and organic material. • Prone to bacterial contamination. • Should have a primary carbon filter worker and second polisher tank. • Chloramine testing needs to be conducted at least every 4 hours while patients receive hemodialysis.
Particulate (Sediment) Filters	• Removes sediment that could damage or clog the water treatment system. • Bacteria growth can occur on the filter. • Need to be monitored for pressure drops across the filter. • Should be replaced or disinfected per manufacturer's instructions for use.
Reverse Osmosis	• Uses osmotic and hydrostatic pressures over semipermeable membranes to remove ions and organics. • Capable of removing 90 to 99 percent of electrolytes, bacteria, and endotoxin.
Deionizers	• Remove cations and anions. • Do not remove bacteria or endotoxins. • Cannot be used as main water treatment method, but it be used in conjunction with RO. • Required to have a temperature compensated resistivity monitor that audibly and visually alarms when resistivity of less than 1 megaohm-cm. • Must be followed by an ultrafilter or other bacteria and endotoxin reducing device.
Ultrafilters	• Used with or without UV lights to remove bacteria and endotoxins. • Should be the last component of the water processing system. • Can be placed before the RO system.

Storage Tanks	• Can be a source for bacterial growth/contamination. • When used, there should be smallest tank for the needs of the facility. • Must have a constant flow of water to prevent stagnation. • The tank should have a conical or bowl-shape, airtight lid and drain from the bottom. • Vented through a hydrophobic 0.2 micron air filter. • An ultrafilter should be installed distal to the storage tank.

Water Distribution Systems

Water distribution systems are typically made from plastic pipes, as metal pipes could contaminate the water treated with elements such as copper, lead, or zinc. The system should be designed as a continuous loop without dead ends or unused branches, since stagnant sections can become a source of bacterial contamination for the entire water network.

All piping (including water lines between the process's water outlet and the back of the dialysis machines) and storage tanks must be disinfected.

Disinfection schedules should be designed to prevent bacterial growth rather than eliminate it. Chemical disinfectants should be used according to the manufacturer's instructions for use and must be thoroughly rinsed from the system with treated water before the system is used.

Monitoring of Quality

Facilities must establish policies for regular testing to maintain these levels. Test results should be documented and reviewed by the medical director and dialysis staff, with prompt action taken if values reach or exceed established action limits. Infection prevention and control personnel should periodically evaluate water treatment procedures and test outcomes to identify trends and confirm that corrective measures are being implemented.

- 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:
  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.
- 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

Table 5: Microbiological and Endotoxin Test Results

Hazard/Hygiene Indicator	Frequency of Testing	Total Limit	Action Level
Total Viable Bacteria in Water	At least monthly, and if standard results are exceeded, testing is done weekly until meeting standard	< 200 cfu/mL	> 50 cfu/mL
Endotoxin Levels in Water		< 2 EU/mL	< 1 EU/mL
Endotoxin Levels in Dialysate		<0.5 EU/mL	>0.25 EU/mL

When a single machine has results at or above action limits, it is usually taken out of service for disinfection and retesting. Identification of organisms may be necessary to link high bacteria or endotoxin counts to cases of bacteremia or pyrogenic reactions but is not routinely performed.

Public Health Personnel (in Collaboration with Hemodialysis Unit Staff)

They oversee the initial and routine monthly sampling of treated water used for hemodialysis after installation of the treatment and distribution systems. Their duties include reporting results to the hemodialysis staff for documentation, monitoring trends in the data, and ensuring corrective actions are taken if abnormal results appear. They also act as the reference authority for training and consultation on water quality standards. If standards are not met, they ensure weekly testing continues until the issue is resolved.

Maintenance Personnel

They are responsible for disinfecting the water treatment and distribution systems, reporting outcomes, and carrying out corrective actions in line with their standard operating procedures (SOPs) and relevant national guidelines.

Laboratory Personnel

They receive the samples; analyze them; and report results in a timely manner and as per related SOPs.

IPC Practitioner

They review and supervise the consistency of routine water quality monitoring for hemodialysis, ensuring adherence to national guidelines. This includes checking the frequency of testing, verifying testing methods, and confirming that appropriate corrective actions are taken when abnormal results are identified.

Section 5: Screening and Immunizations

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:

Table 6: Baseline and Routine Serologic Testing Schedule for Hemodialysis Patients

Patient Status	Admission	Monthly	Semi-annual	Annual
All patients	HBsAg, anti-HBc, anti-HBs, anti-HCV, ALT			
HBV-susceptible, including 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	

- 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.
- 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 up to 30 days after vaccination.

- All anti-HCV negative patients should be tested for increased ALT at least monthly and anti-HCV semi-annually.

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

Routine Dialysis Patients Immunizations

Hepatitis B Immunization

- Hepatitis B vaccine is recommended for all susceptible hemodialysis patients.
- 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.
- Give booster dose of vaccine if anti-HBs declines to below 10 mIU/ml and continue to retest annually.
- Influenza vaccine should be administered annually to all dialysis patients before the onset of each influenza season to reduce the risk of infection and its complications.

HBsAg-Positive Seroconversion

- Report HBsAg-positive seroconversion in a chronic hemodialysis patient to local health authority as required by national 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.

Anti-HCV Seroconversion:

- Report HCV seroconversion in a chronic hemodialysis patient to the local health authority as required by national 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.
- If >1 patient seroconverts from anti-HCV negative to positive during a 6-month period, more frequent (e.g., every 1–3 months) anti-HCV testing of HCV-negative patients could be warranted for a limited time (e.g., 3–6 months) to detect additional infections.
- If additional cases are identified, possible control measures should be identified.
- Implementation of control measures should be carefully monitored for consistent application.
- Perform counselling and medical evaluation of newly HCV infected patients.

Routine Serologic Testing of Dialysis Staff

Routine testing of dialysis healthcare workers for blood-borne pathogens is generally not recommended, as their occupational risk is not higher than that of the general healthcare workforce. Testing may be indicated only to document immunity or response to vaccination, such as for hepatitis B virus (HBV). This applies to other blood-borne pathogens, including hepatitis C virus (HCV), hepatitis D virus (HDV), and human immunodeficiency virus (HIV), for which routine screening of staff is not advised.

Routine Dialysis Staff Immunization

The occupational health program should be implemented for all healthcare workers (HCWs), with no special considerations or additional routine immunizations specifically for dialysis staff. For personnel who respond adequately to the hepatitis B vaccine, booster doses are not required, and periodic serologic testing to monitor antibody levels is not recommended.

Section 6: Healthcare Associated Infections (HAIs) Surveillance and Outbreak Management

Healthcare Associated Infections (HAIs) Surveillance

Surveillance in dialysis units is a cornerstone of infection prevention and control, serving as a systematic process to monitor, analyze, and respond to healthcare-associated infections (HAIs). Given the increased vulnerability of dialysis patients due to frequent vascular access and repeated exposure to the healthcare environment, robust surveillance systems are essential to improve patient safety and clinical outcomes.

All dialysis staff must ensure strict compliance with care bundle components as part of routine process surveillance to reduce infection risks.

Healthcare Associated Infections (HAIs) Outbreak Management

Outbreak management should be initiated whenever there is a noticeable increase in infections caused by a specific microorganism. This process begins with identifying common risk factors that may contribute to the transmission or acquisition of the infection. At the same time, all infection prevention practices should be carefully reviewed, including adherence to hand hygiene, aseptic techniques, and proper disinfection procedures. Patients who are infected should be promptly identified and isolated to prevent further spread. Hemodialysis units are encouraged to establish a dedicated Outbreak Management Team (OMT), led by the facility director or medical director, with clearly defined roles and representation from all key personnel involved in outbreak management. In addition, an effective notification system should be in place to facilitate timely communication through the approved national reporting platform.

Section 7: Staff and Patient Education

Staff Training and Education

Education and training of dialysis healthcare personnel are essential components of effective infection prevention and patient safety. Due to the complexity of dialysis procedures, frequent vascular or catheter access, and the heightened vulnerability of dialysis patients to infection, staff must possess up-to-date knowledge, technical competency, and consistent adherence to infection prevention and control practices. Structured staff education programs support safe dialysis delivery, reduce healthcare-associated infections, and promote a culture of safety and accountability within dialysis units. Key educational activities include:

1. **Orientation and Baseline Training**
    - Provide comprehensive orientation for all newly assigned dialysis staff before independent practice.
    - Cover dialysis fundamentals, infection prevention principles, and unit-specific policies and procedures.
2. **Competency-Based Education**
    - Ensure staff demonstrate competency in critical dialysis procedures, including vascular access handling, dialysis events and care bundles, catheter insertion and maintenance, aseptic technique, machine operation, cleaning and disinfection, and safe handling of supplies.
    - Provide training on water treatment systems, dialysate quality standards, and monitoring requirements.
    - Emphasize early recognition and reporting of access-related infections and complications.
    - Educate staff on standard and transmission-based precautions.
    - Reinforce hand hygiene, appropriate PPE use, and environmental cleaning and disinfection practices specific to dialysis units, and medical waste management.
    - Train staff on healthcare-associated infection surveillance, dialysis event reporting, and outbreak recognition.
    - Use direct observation, return demonstrations, and skills checklists.
    - Emphasize accurate documentation and timely notification through established reporting systems.

3. **Ongoing Education and Updates**
    - Conduct regular refresher training at least annually and whenever policies or practices change.
    - Incorporate lessons learned from audits, surveillance data, and incident investigations.
4. **Assessment and Feedback**
    - Periodically assess staff knowledge and practice compliance.
    - Provide constructive feedback, targeted retraining, and corrective actions as needed.
5. **Interdisciplinary Collaboration**
    - Promote collaboration between clinical staff, infection prevention professionals, biomedical engineers, and environmental services.
    - Ensure consistent messaging and shared responsibility for infection prevention.

Patient and Caregivers Education

Patient education is a critical component of safe and effective dialysis care, particularly given the need for long-term self-management in chronic kidney disease. Structured education programs are the most effective approach to preparing patients to perform required procedures, develop problem-solving skills, and adopt sustained behavioral changes. Such programs should be grounded in adult learning principles and tailored to patients' health literacy levels to ensure understanding, skill acquisition, and safe application of infection prevention and self-care practices. These educational sessions must cover the following key areas:

- Basic understanding of kidney function, chronic kidney disease, and the purpose of dialysis.
- Overview of dialysis treatment, including hemodialysis and peritoneal dialysis, and patient responsibilities.
- Infection prevention and control principles and the role of patients and caregivers in preventing infection transmission.
- Common dialysis-associated infections, including bloodstream infections, access-related infections, and peritonitis.
- Hand hygiene and personal hygiene practices.
- Daily inspection, protection, and care of access or catheter sites.
- Safe handling and storage of dialysis equipment and supplies.
- Signs and symptoms of infection, including redness, pain, swelling, fever, or cloudy dialysate.
- Medication awareness and adherence.
- Encouraging patient engagement, confidence, and shared decision-making

References

AlQahtani, et al. (2025). Infection control surveillance of dialysis events at outpatient hemodialysis centers in Saudi Arabia: A three-year national data. Retrieved from https://www.researchgate.net/publication/388390164_Infection_control_Surveillance_of_dialysis_events_at_outpatient_hemodialysis_centers_in_Saudi_Arabia_A_3-year_national_data

Alsheddi, et al. (2023). National healthcare-associated infections report 2022 – Saudi Arabia. Riyadh, Saudi Arabia: Ministry of Health. Retrieved from https://jed-s3.bluvalt.com/psj1-ifn-s3-ifn01/files/11/Publications/National%20HealthcareAssociated%20Infections%20Report%202022%20%E2%80%93%20Saudi%20Arabia.pdf

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

Association for Professionals in Infection Control and Epidemiology. (2024). APIC text of infection control and epidemiology (Chap. 40).

Centers for Disease Control and Prevention. (2001). Recommendations for preventing transmission of infections among chronic hemodialysis patients. Retrieved from https://www.cdc.gov/dialysis-safety/hcp/recommendations-resources/index.html

International Society for Peritoneal Dialysis. (2022). ISPD peritonitis guideline recommendations: 2022 update on prevention and treatment.

Ministry of Health. (2023). Healthcare-associated infections (HAIs) surveillance manual (2nd ed.). Riyadh, Saudi Arabia: General Directorate of Infection Prevention and Control, Ministry of Health.

Ministry of Health. (2025). Healthcare-associated infection outbreak manual (Version 7.2.1). Riyadh, Saudi Arabia: General Directorate of Infection Prevention and Control, Ministry of Health.

UK Health Security Agency. (2025). Examining food, water and environmental samples from healthcare environments: Microbiological guidelines. London, UK: Author.

UK Renal Association. (2020). Guideline on water treatment facilities and water quality for hemodialysis and related therapies. Bristol, UK: UK Renal Association.