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Case Study

Infection Prevention and Control Audit of a Tertiary-Level Care Hospital Hemodialysis Unit in the United Arab Emirates at Times of COVID-19 Pandemic - A Case Study

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A B S T R A C T

Background: Infection prevention and control (IPC) in the hemodialysis unit is a multidisciplinary program that makes the healthcare facilities safe from infection for patients and healthcare personnel. In this audit, we evaluate the utility of the CDC hemodialysis unity infection prevention and control assessment tool at a tertiary-level care hospital in the United Arab Emirates.

Materials and Methods: The research team performed an audit in March 2021 at a tertiary-level care hospital hemodialysis unit on infection prevention and control using the CDC tool. This tool has eleven items that cover different aspects of infection prevention, which have been used in different studies. Short-term areas of improvement identified were acted upon to resolve. Long-term areas of improvement are recommended to the hospital management.

Results: The majority of the CDC IPC items on the checklist were applicable at the study site. Short-term improvements that were already acted upon at the time of audit were additional training and assessment of competencies of HCPs on selected competencies. Educational posters for the patients were displayed using the unit television. Television is there in the patient waiting for areas and for individual HD cabins. Infection control certifications by more nurses at the unit need to be done and more educational videos to be created. More educational posters for patients to be placed in the unit.

Conclusion: The dialysis unit at the study site largely follows CDC guidance and policies to prevent and control infections. Some of the recommendations were implemented while auditing; others were recommended for improvements. The CDC audit tool was found to be useful in IPC at the study site even at times of COVID-19.

Keywords: Infection prevention and control, Hemodialysis, Infection, Training, Hand hygiene

Introduction

Infection prevention and control (IPC) refers to the policy and procedure acquired to reduce the spread of infection in a hospital or any healthcare setting that helps to reduce the infection rate or the transmission of infection among patients and healthcare workers. Reducing the risk of hospital-acquired infection in hemodialysis units can be achieved by implementing CDC regulations in infection control programs which include education, training, competency, and audit; healthcare personnel safety; surveillance and disease reporting; respiratory hygiene/cough etiquette; personnel protective equipment (PPE), environmental cleaning, hand hygiene, vascular access care, injection safety, and dialyzer reuse and reprocessing.[1,2]

End-stage renal disease (ESRD) patients on hemodialysis death due to infection are only second to the cardiovascular event in the US.[3] Tunneled cuffed catheters (TCCs) have a maximum risk of infection than arteriovenous fistulae (AFVs) compared to different HD access routes. Arteriovenous grafts (AVGs) are supposed to be in between these two.[4,5] Different microorganisms may cause infection during hemodialysis.[6] To avoid infection and reduce the mortality rate among hemodialysis patients, IPC must be implemented in the true sense, impacting the safety of patients and healthcare workers. Maximum protection during the vascular access placement (sterile gloves, long-sleeved sterile gowns, mask, cap, and large sterile sheet drape) may reduce the incidence of vascular access-related bloodstream infection compared with standard (sterile gloves and small drape) precautions. Hence, it requires strict safety measures, to reduce the mode of transmission.[7-9]

The objective of this study was to evaluate the utility of the CDC hemodialysis unity infection prevention and control assessment tool at a tertiary-level care hospital in the United Arab Emirates at times of COVID-19 pandemic. It is essential to understand if the CDC IPC audit is applicable or if any major modifications are required for its use at the time of COVID-19 pandemic.

Materials and Methods

The research design was a survey with CDC Infection Prevention and Control tool[1] in March 2021. It is also a case study from one hospital. Two healthcare professionals of the research team who do not work at the hemodialysis unit filled the survey. The information for filling the survey was collected by direct observation and interacting with nurses and nephrologist at the hemodialysis unit. The infection control team at the hospital was also approached to validate the information collected and additional information if any to be filled in the survey. The study site tertiary-level care hospital hemodialysis unit is one of the largest hemodialysis units in the United Arab Emirates (UAE) private sector. The hospital is a tertiary-level care hospital with 350 beds.

The CDC IPC survey covers eleven items including:

- Infection Control Program and Infrastructure
- Infection Control Training, Competency, and Audits
- Healthcare Personnel (HCP) Safety
- Surveillance and Disease Reporting
- Respiratory Hygiene/Cough Etiquette
- Personal Protective Equipment (PPE)
- Environmental Cleaning
- Dialyzer Reuse and (if applicable) Reprocessing
- Hand Hygiene
- Catheter and other Vascular Access Care;
- Injection Safety

Each section has the available option of "Yes," "No" and visible confirmation if needed. The area of improvement column is also available as an optional answer. If the answer does not apply to the study area, then "N/A" can be mentioned in the area of improvement column.

Institutional review board approval was taken before data collection. Oral consent was obtained from healthcare professionals for the survey. The head of the hemodialysis unit is part of the research team. All personal information was kept confidential.

Results

The survey was successfully completed at the study site. Most of the items were applicable and actions were taken for improvement. The audit survey report per session is as follows.

Section 1: Infection Control Program and Infrastructure

Infection control program has the policy and procedures to control and minimize infections in healthcare settings, focusing on reducing infection rates. Table 1 shows information related to infection control programs and infrastructure.

Section 2: Infection Control Training, Competency and Audits

The hospital's infection control department (ICD) is the only department responsible for providing job-specific training on infection prevention policies and procedures. Training and education are recommended for both staff and patients. Training should be appropriate to the cognitive level of the staff member, patient, or family member, and rationales should provide for appropriate infection control behaviors and techniques to increase compliance. Regulations and recommendations regarding infection control training for healthcare workers in general and dialysis personnel in particular. Table 2 shows information related to infection control training, competency and audits.

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Table 1.Infection Control Program and Infrastructure

Elements Assessed	Assessment	Notes/Areas for Improvement
What training did the person in charge of infection control at the facility have?	o√ Certified in Infection Control (CIC) ○ Other training in infection control (specify): ○ No specific training in infection control ○ Not Applicable (no person in charge of infection control at the facility)	• Certified in Infection Control (CIC) • The dialysis unit nurse in-charge and Nephrologist are part of the antimicrobial stewardship committee. • The dialysis unit nurse in charge is frequently being trained through additional certifications is recommended. • Infection control physician and nurse at the hospital is specialized for the job by qualification and experience.
Was the facility participating in their ESRD Network Healthcare-Associated Infection (HAI) Quality Improvement Activity (QI)?	○√ Yes ○ No	• IPC data is shared with APIC (Association of Professionals in Infection Control and Epidemiology), USA. • ESRD networks focusing on HAI are advisable. Joining, e.g., the Emirates Nephrology Society is recommended.
Had the facility participated in the CDC Dialysis BSI Prevention Collaborative?	○√ Yes ○ No	• The facility follows CDC preventive bundles for BSI. • Participation in any additional capacity with CDC at available international networking opportunities to be explored.
In the past 2 years, had the facility participated in any other intensive program focused on HAI prevention? (for example, clinical trial, company-led quality improvement project)	○√ Yes (specify) ○ No	• Infection Control Seminars and frequent training are ongoing. More such participation by the hemodialysis unit staff on tailored HD unit seminars is recommended.
Did the facility have a system for early and efficient detection and management of potentially infectious persons at the early points of patient encounter? Note: This question was not referring to viral hepatitis (B and C) or the vaccination status of hemodialysis patients. This question refers to recognizing draining infected wounds, uncontrolled diarrhea, acute respiratory infection, or influenza-like illness and determining relevant travel history.	○ Yes (specify one below): ○√ The system applies before arrival or immediately upon entering the dialysis facility (i.e., at check-in or while in waiting room) ○ The system applies when the patient arrives in dialysis treatment area (i.e., patient in dialysis treatment station) ○√ No	• Incident reporting forms are available. Both online and on-paper reporting systems facilitate efficient detection and management of potential infection threats. • JCI inspection auditors appreciated the reporting system at a sister hospital hemodialysis unit system in the UAE.
Did the facility have the policy and protocol for implementing Contact Precautions as warranted?	○√ Yes ○ No	• Policies and protocols are available and implemented through HIMS. • The antimicrobial stewardship committee and the unit in-charges frequently do monitor, report, and take action.

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Were there signs posted in inpatient areas within the facility that encouraged patients to take an active role and express their concerns about facility infection control policies or practices? Visual confirmation was suggested. Note: Observe for signs that encouraged patients to speak up and actively report infection control problems. Consider if the facility encouraged active patient engagement in any other ways.	○√ Yes ○ No	• The infection control team provides posters, and all are not posted. Some posters are already posted, especially hand hygiene. It is recommended to place other posters. • The staff engages patients well. A TV screen is provided to each patient while on hemodialysis. Patients usually watch entertainment programs. It is recommended to show educational posters on IPC.
The facility provided standardized education to all patients on the infection prevention topics: i. Vascular access care ii. Hand hygiene iii. Risks related to catheter use iv. Recognizing signs of infection v. Access management when the patient is away from the hemodialysis unit.	i. √ Yes No ii. √ Yes No iii. √ Yes No iv. √ Yes No v. √ Yes No	• Hand hygiene and all other precautionary measures are explained to patients and their caregivers as and when required. There are guiding policies. • It is recommended to play a short video about the importance of IPC in the hospital HD unit screens.
What was the distance separating adjacent dialysis treatment stations? Measure the nearest distance between items of one hemodialysis station (e.g., machine/chair/ objects) and items belonging to the next station. For example, if a computer charting terminal was shared between two adjacent stations, report this as less than 3 feet.	○ < 3 feet ○ Shared computer charting terminal ○√ ≥ 3 feet and <6 feet ○ ≥ 6 feet	• Visually confirmed. • Each patient dialysis station is a separate cabin. No equipment is shared for two patients. Each patient is separated with a full wall on 3 sides and a curtain in the front.
a. If shared computer charting terminal, what was the policy and protocol for routinely cleaning the shared computer terminal? Select the best answer Note: Due to potential cross-contamination and challenges with proper cleaning and disinfection, facilities considered alternatives to shared computer charting terminals.	○√ Shared computer terminal is ○ cleaned after each patient ○ Shared computer terminal is cleaned after each shift ○ Shared computer terminal is ○ cleaned at the end of each day ○ Other (specify):	• It was cleaned after each patient. • Keep a poster near each terminal computer and wipes to emphasize the importance of following the policy.

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	○ N/A, the facility does not have a policy/protocol for routinely cleaning the shared computer terminal	
Did the facility have an isolation room that was available for isolation of infections other than hepatitis B? Visual confirmation was suggested.	○√ Yes ○ No	• Visually confirmed • It was labeled as an isolation room, separate for hepatitis patients and another for COVID-19 patients with negative pressure.
Did the facility use hemodialysis machine Waste Handling Option ports? Note: The Waste Handling Option port is a machine port used for prime waste.	○√ Yes ○ No	• Waste handling option ports are available and being used.

Note: CDC has no recommendation regarding the separation of hemodialysis stations. Question 9 facilitates awareness regarding challenges to infection control in dialysis centers. The education and discussion about potential strategies given physical constraints shall be appropriate. CDC does not expect grantees to regularly recommend changes to physical infrastructure precisely to achieve 6 feet of separation between hemodialysis stations (however, as planning for new hemodialysis stations and centers evolve, this shall be considered).

Table 2.Infection Control Training, Competency, and Audit

Elements Assessed	Assessment	Notes/Areas for Improvement
Facility provides job-specific training to healthcare personnel (HCP) on infection prevention policies and procedures: Upon hire, prior to provision of care Annually	○√ Yes No ○√ Yes No	• Training for staff is provided once in 6 months. The nurse in charge and Nephrologist are members of the antimicrobial stewardship committee. New hires are also trained as part of orientation. Further training happens when an incident is reported.
Facility assesses and documents competency with job-specific infection prevention policies and procedures: i. Upon hire, prior to provision of care ii. Annually	○√ Yes No ○√ Yes No	• IPC is part of the job description and being assessed. Developing a more extensive and specific appraisal tool for the staff for better assessment and improvements is recommended.
Does the facility routinely conduct audits of staff infection control practice?	○√ Yes (facility should be able to show results of these audits) ○ No	• ID nurses and ID physicians routinely conduct audits.
a. If Yes: Does the facility provide feedback on adherence to clinical staff?	○√ Yes (facility should be able to provide examples of feedback) ○ No	• Adequate feedback on adherence is provided routinely. There are frequent visits and assistance from ID team. They are always available.

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Does the facility routinely use standardized tools for educating staff and/or assessing practice?	○ AHRQ/CMS Checklist Tools ○ CDC Tools ○ Corporate Tools ○ No standardized tools used	• CDC and APIC tools are used.
a. If CDC tools indicate the tool(s) used	○ CDC Video: Preventing BSIs in Outpatient Hemodialysis Patients: Best Practices for Dialysis Staff ○√ CDC Approach to BSI Prevention in Dialysis Facilities (i.e., Core Interventions for Dialysis BSI Prevention) ○√ CDC Hemodialysis Central Venous Catheter Scrub-the-Hub Protocol ○ CDC Dialysis audit tools: √ Hand hygiene √ Catheter connection & disconnection √ Catheter exit site care √ Arteriovenous fistula & graft cannulation and decannulation √ Injectable medication preparation & administration √ Routine disinfection of dialysis station ○ CDC Dialysis checklists: √ Catheter connection & disconnection √ Catheter exit site care √ Arteriovenous fistula & graft cannulation and decannulation √ Injectable medication preparation & administration ○√ Routine disinfection of dialysis station	• All of the CDC tools are used by the ID team. • Videos are there, but needs to be circulated.

Table 3.Healthcare Personnel Safety

Elements Assessed	Assessment	Notes/Areas for Improvement
Did the facility provide post-exposure evaluation and follow-up, including prevention of infections as appropriate, to healthcare personnel (HCP) for free following an exposure event?	○√ Yes ○ No	• Yes, hospital-acquired infections are treated for free, and adequate preventive measures are taken to avoid the spread of the infection.
Did the facility track HCP exposure events, evaluate event data, and develop or implement corrective action plans to reduce the incidence of any such events?	○√ Yes ○ No	• Yes, the ID team and the quality department have data on hospital-acquired infections and measures to reduce such events, especially focused training.

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Did the facility offer hepatitis B vaccine to personnel who might have been exposed to blood or body fluids through their work?	○√ Yes ○ No	• Yes, hepatitis B vaccination is offered to HCPs.
Did the facility offer influenza vaccine to all HCP?	○√ Yes ○ No	• HCPs are vaccinated for influenza and COVID-19. Any other required vaccines are also provided.
Did the facility conduct baseline tuberculosis screening of HCP?	○√ Yes ○ No	• Tuberculosis screening is conducted for all HCPs.
Did the facility have work-exclusion policies that encouraged reporting illnesses and did not penalize with loss of wages, benefits, or job status?	○√ Yes ○ No	• Policies exist that protect the staff's rights in case of a job-related injury. For example, leaves are provided when HCPs are sick without penalizing.
Did the facility educate HCP on prompt reporting of illness or job-related injury to supervisor and occupational health?	○√ Yes ○ No	• Well educated and reporting any job-related injury like needle prick is encouraged. • The online incident report form is available, and the supervisor is accessible in multiple communication modes.

Table 4.Surveillance and Disease Reporting

Elements Assessed	Assessment	Notes/Areas for Improvement
Does someone in the facility know the facility's bloodstream infection (BSI) rate in NHSN or BSI standardized infection ratio (SIR)?	○√ Yes ○ No ○ Not applicable	• All HD unit HCPs know the BSI data.
Does the facility routinely share rate data with front-line clinical staff?	○√ Yes ○ No	• Data is shared among staff caring for patients as well as they are reminded by the supervisors when required.
Does the facility have a policy that mandates blood culture collection before antimicrobial administration any time a BSI is suspected?	○√ Yes ○ No	• The policy is in the HIMS.
Does the facility conduct routine screening of hemodialysis patients for hepatitis C antibody at the recommended interval?	○√ Yes ○ No	• On admission and every 6 months thereafter for susceptible patients.
Does the facility know how to report clusters of infections, adverse events, or new hepatitis B/C cases to public health?	○√ Yes ○ No	• Notifications are made to the antimicrobial stewardship committee, internal quality department, and MOHAP.
Does the facility have a system in place to communicate infection or colonization with a multidrug-resistant organism (MDRO) to other healthcare facilities upon transfer?	○√ Yes ○ No	• Laboratory of the hospital shares the antibiogram data. • Integration to other facilities in UAE would be useful in the future as the government is taking the initiative to integrate healthcare data among institutions.

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Section 3: Healthcare Personnel Safety

The health of healthcare personnel and their safety is one of the prime goals of the infection control department in any setting. Healthcare personnel needs to be responsible for spreading infection in the whole facility if it is neglected. Regular vaccination, general health, and prior testing of communicable diseases such as tuberculosis are required. In addition, post-exposure treatment requirements and their protocols are necessary. Table 3 shows information related to healthcare personnel safety.

Section 4: Surveillance and Disease Reporting

Surveillance is a crucial point in the health system as it contributes to better prevention and management of diseases through collecting data and reporting. Table 4 shows information related to surveillance and disease reporting.

Table 5.Respiratory Hygiene and Cough Etiquette

Elements Assessed	Assessment	Notes/Areas for Improvement
In non-clinical areas:		
Did the facility have signs posted at entrances with instructions to patients with signs and symptoms of respiratory infection to: Covered their mouth and nose when coughing or sneezing? Used and disposed of tissues? Performed hand hygiene after contact with respiratory secretions?	○√ Yes ○ No	• Visually confirmed • Posters on COVID-19 and hand hygiene are available. More posters at the entrance and waiting area of the dialysis unit are recommended.
Did the facility provide a means for patients to perform hand hygiene in and near waiting areas?	○√ Yes ○ No	• Visually confirmed • Provided.
Did the facility provide space and encourage persons with symptoms of respiratory infection to stay as far away from others as possible?	○√ Yes ○ No	• Visually confirmed • Directions are provided as appropriate for the facility. Each dialysis areas have separations. The waiting area for patients has chairs spaced as per COVID-19 protocol. A negative pressure room is available for COVID-19 patients to undergo hemodialysis.
Did the facility provide tissues and no-touch receptacles for the disposal of tissues? Applies during periods of the spread of respiratory infections in the community	○√ Yes ○ No ○ Not applicable	• They are provided. All COVID-19 national protocols are followed.
Did the facility offer facemasks upon facility entry by patients with symptoms of respiratory infection? Applies during periods of the spread of respiratory infections in the community	○√ Yes ○ No ○ Not applicable	• A facemask is provided as required. Patients come with their facemasks.
In clinical areas:		
Did the facility have the ability to separate symptomatic patients (by at least 6 feet) from other patients and their stations during dialysis treatment?	○√ Yes ○ No	• Each dialysis cabin is separated well, with walls on three sides. A fully closed negative pressure room is available for COVID-19 patients. The room has airlock doors to enter.

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Section 5: Respiratory Hygiene/Cough Etiquette

If a respiratory hygiene policy is not implemented, the spread of infection in the facility or among patients and healthcare workers is warranted. It requires sharing policy and procedure as well as patient education through posters. Isolation areas for the patients and cough/sneezing etiquettes can help to control infection. Table 5 shows information related to respiratory hygiene and cough etiquette.

Table 6.Personnel Protective Equipment

Elements Assessed	Assessment	Notes/Areas for Improvement
The facility provided job-specific training to HCP on proper selection and use of PPE: i. Upon hire, before the provision of care ii. Annually	i. √ Yes No ii. Yes No	• Provided, more often now because of COVID-19. • Usual training for PPE is every 6 months and at hire.
Did the facility validate HCP competency with the use of PPE?	○√ Yes ○ No	• All HCPs are checked for PPE competency.
Supplies necessary for adherence to PPE recommendations were available and strategically located in or near patient care areas: i. Gloves ii. Gowns iii. Face Shields/Eye Protection iv. Face Masks Visual confirmation suggested.	i. √ Yes No ii. √ Yes No iii. √ Yes No iv. √ Yes No	• Adequate supply of all PPE and other protection materials.
Did the facility have a policy and protocol for staff to routinely change/launder gowns (in the absence of soilage)? Note: This question applied to patients in the general treatment area, not for patients in isolation.	○√ Yes (specify one below): •√ At the end of the shift •√ At the end of the day • Other(specify): ○ No	• At the end of shift and end of the day.

Table 7.Environmental Cleaning

Elements Assessed	Assessment	Notes/Areas for Improvement
Did the facility have written policies and procedures for regular cleaning and disinfection of environmental surfaces, including clearly defining who responsible personnel was? Note: Policy and procedures should identify staff responsible for performing the cleaning and disinfection and those responsible for selection and preparation of disinfectant solutions.	○√ Yes ○ No	• Policies and procedures for regular cleaning and disinfection of environmental surfaces are in place. Specialized cleaners perform this activity.
Did the facility provide job-specific training to the responsible personnel on environmental cleaning and disinfection upon hire, at least annually, and when policies and procedures change? Note: If environmental cleaning was performed by contract personnel, the facility should verify the contracting company provided this.	○√ Yes ○ No	• All cleaning professionals are trained frequently. They are employees of the hospital.

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Did the facility routinely audit (monitor and document) adherence on cleaning and disinfection procedures?	○√ Yes ○ No	• A regular monitoring checklist is being used for cleaning and disinfection procedures.
Did the facility have a policy/procedure for decontamination of spills of blood or other body fluids?	○√ Yes ○ No	• Policy is in place.
a. If Yes: Are supplies necessary to clean the blood spill (e.g., proper disinfectant or spill kit) readily available and strategically located near hemodialysis stations? Visual confirmation suggested.	○√ Yes ○ No ○ Not applicable	• Visually confirmed, enough supply. There is a storeroom within the dialysis unit.
Did the facility have a policy/procedure for routinely emptying AND cleaning reusable waste containers (e.g., leak-proof containers used for disposal of used dialyzers and tubing)? i. Emptying ii. Cleaning	i. √ Yes No ii. √ Yes No	• A leak-proof disposal system is in place.
Did the facility have policies and procedures to make sure reusable medical devices (e.g., thermometers, stethoscopes, and blood pressure cuffs) were cleaned appropriately between patients?	○√ Yes ○ No ○ Not applicable	• Policies and procedures are on HIMS and accessible from all computers. Supervisors monitor compliance.
Did the facility have policies and procedures for regularly cleaning and disinfecting the following items: i. Dialysis Clamps ii. Blood Glucose Monitor(s) iii. Dialysate Conductivity/pH meter(s)	i. √ Yes No ii. √ Yes No iii. √ Yes No	• Policies and procedures are in place. Compliance is monitored.

Table 8.Dialyzer Reuse and Reprocessing

Elements Assessed	Assessment	Notes/Areas for Improvement
Did the facility reused dialyzers? Note: If the facility reprocessed dialyzers onsite, consider performing observations of dialyzer reprocessing.	○ Yes(specify): ○ Dialyzers are reprocessed on-site ○ Dialyzers were reprocessed off-site ○√ No **If No, skip to Hand Hygiene**	• Dialyzers are for single use only.

Table 9.Hand hygiene

Elements Assessed	Assessment	Notes/Areas for Improvement
Supplies necessary for adherence to hand hygiene guidelines were available, maintained clean and sanitary, and strategically located near dialysis stations. i. Alcohol-based hand gel ii. Handwashing sinks iii. Soap iv. Paper Towels	i. √ Yes No ii. √ Yes No iii. √ Yes No iv. √ Yes No	• Visually confirmed • Enough supplies near dialysis stations.

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2. Did the facility perform monthly observations of staff hand hygiene opportunities? (or more frequently)?	○√ Yes (facility should be able to show results of these observations) ○ No	• Monthly and more frequent monitoring of hand hygiene practices are in place.
a. If Yes: Did the facility routinely provide feedback on adherence to clinical staff?	○√ Yes (facility should be able to provide examples of feedback) ○ No ○ Not Applicable (No observations conducted)	• Feedback is given daily by the supervisor nurse as well as the ID team when they visit the HD unit.

Table 10.Catheter and Other Vascular Access Care

Elements Assessed	Assessment	Notes/Areas for Improvement
Did the facility regularly provide training specific to the catheter/vascular access care and aseptic technique for the staff handling catheters or vascular accesses?	○√ Yes ○ No	• Regular training is provided to the concerned staff.
Did the facility perform staff vascular access care observations and catheter accessing practices quarterly (or more frequently)?	○√ Yes ○ No	• Frequent observations are made on vascular access and catheter access practices.
a. If Yes: Did the facility routinely provide feedback on adherence to clinical staff?	○√ Yes ○ No ○ Not applicable	• Feedback is provided frequently on the access practices. Catheter site infections are rarely reported from the HD unit.

Section 6: Personal Protective Equipment

Personal Protective Equipment or PPE is a group of equipment worn by the medical staff to minimize the harm and the spread of infection. PPE refers to various barriers and respirators used alone or together to protect mucous membranes, airways, skin, and clothing from contact with infectious agents. In addition, PPE includes; gloves, gowns, face shields/ eye protection, and face masks. PPE selection is based on the nature of the patient interaction and/or the likely mode(s) of transmission. Table 6 shows information related to personnel protective equipment.

Section 7: Environmental Cleaning

The environment of the facility, especially the dialysis unit, requires policy and procedure for proper cleaning and disinfecting. Regular cleaning and disinfecting with waste control policy and procedure can help keep the environment clean and safe for patients and healthcare personnel. Table 7 shows information related to environmental cleaning.

Section 8: Dialyzer Reuse and Reprocessing

Dialyzer or artificial kidney as it has referred to these days. It is a piece of equipment or device with an artificial semipermeable membrane to filter the blood from excess wastes and fluid. Almost all dialyzers in use in current practice are of the hollow-fiber dialyzer. Table 10 shows information related to dialyzer reuse and reprocessing.

Section 9: Hand Hygiene

Hand hygiene is the cleaning of hands with soap and water or with alcohol-based hand sanitizer. It is a standard practice to control the spread of infection. Therefore, a hand hygiene policy should be implemented and audited with time to check whether HCP follows the policy. Table 8 shows information related to hand hygiene.

Section 10: Catheter and Other Vascular Access Care

Vascular access is a hemodialysis patient's lifeline as this access makes hemodialysis treatments possible and lifesaving. There are three types of vascular access includes; arteriovenous fistula (AFV), arteriovenous graft (AVG), and central venous catheter (CVC). However, this access is lifesaving, but at the same time, they are not problem-free. It can cause further treatment or surgery as the most common problems includes; access infection and poor blood flow due to blood clotting in the access. Table 9 shows information related to the catheter and other vascular access care.

Section 11: Injection Safety

Injection safety means protecting HCP from sharp objects and needles that may be infected and can cause severe infections in HCPs and other patients. Sharp containers and policy and procedures are required, and proper follow-up with staff education can help reduce the infection. Table 11 shows information related to safety injection.

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Table 11.Safety Injection

Elements assessed	Assessment	Notes/areas for improvement
Supplies essential for adherence to safe injection practices were made sure. Visual confirmation suggested. i. Sharps containers (strategically located near dialysis stations) ii. Needles/cannula with a safety feature	i. √ Yes No ii. √ Yes No iii √ Yes No iv. √ Yes No	• Enough supply for safe injection practices. Dialysis stations are well equipped and positioned for injection safety.
Did the facility have policies/procedures to ensure sharps containers are emptied and changed regularly and when needed?	○√ Yes ○ No	• Policies and procedures are in place.
Did the facility use a physically separate cleanroom from the treatment area for storage and preparation of injectable medications?	○√ Yes ○ No	• There are clean areas for storing injectable medications. No sterile cleanroom is available in the dialysis unit as all injectable medications are prepacked. No alterations in the products are made except the usual administration techniques used by nurses for injections.
a. If No, is there a room that exists in the facility that shall be used for storage and preparation of injectable medications?	○√ Yes ○ No	• A room is available to store injectable medications.
Did the facility have a policy and procedure for regularly cleaning surface(s) where injectable medications are prepared?	○√ Yes ○ No	• Injectable medications are not compounded at the HD unit. It is mixed for dilution as per the regular injection practices. Clean space is available for the same.
Did the facility use manufacturer pre-filled saline syringes or single-use saline vials for flushes?	○√ Yes ○ No	• The products are premade, and the saline vials are for single use.

Discussion

The audit shows compliance of IPC in the hemodialysis unit for most of the items. Literature shows the IPC challenge that should be taken care of. The importance of infection control certification and its significant impact on infection rates are published.[10] A study in the US on hemodialysis shows that implementation of quality improvement activity helps to reduce bloodstream infection (BSI).[11] In another study, adherence to infection control standards improved when the ESKD Safety Program was implemented, with procedures being performed correctly.[12] A retrospective study in Saudi Arabia shows the impact of isolation room on the nosocomial HCV transmission during significant hemodialysis decline of annual seroconversion rate from 6.8% to 1.01%.[13]

Need for more trainings were identified in the audit. Educational interventions for nurses had positive effects on improving knowledge and practice concerning infection control in hemodialysis. However, nearly two-thirds of the studied nurses had "poor" knowledge, and half of them had "poor" practices regarding infection prevention and control before the application of the educational interventions.[14] Education and training materials and methods appropriate to the healthcare professional's (HCP's) responsibility, individual learning habits, and language needs might improve the learning experience.[15,16] Studies have shown that in addition to targeted education in improving specific practices, periodic assessment and feedback of the HCPs' knowledge and adherence to recommended practices are necessary to achieve the desired changes and identify continuing education needs.[17,18]

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COVID-19 vaccinations, annual influenza vaccine offered for all the staff, and hepatitis B vaccine is offered too for the staff exposed to blood or body fluid through their duty. The Hepatitis B vaccine has been recommended for hemodialysis patients and staff members.[19] The Joint Commission standards require establishing an influenza vaccination program for staff, setting incremental vaccination goals to increase coverage, and reporting HCP influenza immunization rates to key stakeholders.[20]

Surveillance is an ongoing, systematic collection, analysis, interpretation, and dissemination of data on health-related events for use in public health to reduce morbidity and mortality and improve health.[21] The effect of person-to-person transmission to reduce the transmission of infectious agents is well documented.[22] According to the Joint Commission on Accreditation of Healthcare Organizations (JCAHO), surveillance, investigation, prevention, control, and reporting are infection control programs.[23]

Historically, the surveillance for infections associated with chronic hemodialysis focused on viral hepatitis, particularly hepatitis B virus infection. Bloodstream infection is considered one of the common infections in the dialysis unit due to catheter and/ vascular access. Hepatitis B and other vaccinations are recommended for all maintenance hemodialysis patients and all staff members. Respiratory hygiene is a combination of measures designed to minimize the transmission of respiratory pathogens via droplet or airborne routes (e.g., influenza and cold viruses) in healthcare settings. Hand and respiratory hygiene practices are informed to the patients and visitors.[24-26]

Upon identifying a potentially infectious patient, implementing prevention measures, including prompt separation of potentially infectious patients and implementing appropriate control measures (e.g., Respiratory hygiene/cough etiquette and transmission-based Precautions), can decrease transmission risks. A mask placed on coughing patients limits the potential dissemination of infectious respiratory secretions from the patient to others. Droplet and Contact Precautions, which included using a mask but not a respirator, effectively protected healthcare personnel.[26-28]

Adherence to correct PPE use was not optimal regarding provider type variability and reflected in low infection rate.[29,30] During patient care, the transmission of infectious organisms can reduce by limiting contamination to surfaces. The National Institute for Occupational Safety and Health (NIOSH) states that eye protection must be comfortable, allow for good peripheral vision, and be adjustable to ensure a secure fit. In addition to the staff policy education and performance feedback, some healthcare centers have studied the effects of adding an extra workforce as a responsible person to target frequently touched surfaces within a unit to decrease the transmission of hospital-acquired organisms.[31] Housekeeping was one of the CDC recommendation trainings in hemodialysis units to minimize microorganisms' transmission.[32]

CDC established written protocols for cleaning and disinfecting surfaces and equipment in the dialysis unit, including careful mechanical cleaning before any disinfection process. After each patient treatment, CDC recommends cleaning all the environmental surfaces at the dialysis station, including the countertops, dialysis bed or chair, and external surfaces of the dialysis machine, including containers associated with the prime waste. Use of any soap, other detergents, or detergent germicide. In between uses of medical equipment (e.g., scissors, clamps, hemostats, stethoscopes, blood pressure cuffs), clean and apply a usual hospital disinfectant (i.e., low-level disinfection). If any item is visibly contaminated with blood, use intermediate-level disinfection.[31] Moreover, A study in Japan shows that the number of bacterial cells in hemodialysis devices was lower than in inpatient surroundings. It found that Staphylococcus spp. Predominantly on the hemodialysis device (46.8%), especially on areas frequently touched by healthcare workers that need regular cleaning of the environment of hemodialysis area.[33]

The study site was not reusing dialyzers. Dialyzer reuse defines as using the same dialyzer for multiple hemodialysis treatments; this practice has been in place since the 1960s.[34] Dialyzer reuse involves a complicated multistep process that includes rinsing, cleaning, performance testing, and disinfection of dialyzers before reuse. The process requires the use of cleaning and germicidal agents that are potentially toxic, and accidental contact with these agents may expose both patients and dialysis staff to health hazards.[35] There are also reports of Gram-negative bacteria outbreaks from the breakdown in infection-control systems, and even low-level exposure to toxins and microbiological contamination shall contribute to chronic inflammation.[36,37]

According to the auditor, single-use dialyzers are common at the study site as they do not reuse or reprocess the dialyzers. Single dialyzer use and reuse by chemical reprocessing are both associated with some complications. One study concludes that the reuse of dialyzers is associated with environmental contamination, allergic reactions, residual chemical infusion (rebound release), inadequate disinfectants, and pyrogen reactions.[37] In the same study, the first use of a dialyzer may occur some complications; a new cellophane membrane may activate the complement system, or a noxious agent may be introduced to the dialyzer during production or generated during production storage. These agents may not altogether remove during the routine rinsing procedure.[37] Another study suggests more excellent removal of biochemical biomarkers and fewer pyrogenic episodes when the dialyzer is a single-use.[38]

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Hand hygiene is considered a core element and a primary measure to prevent and control the transmission of infection among dialysis patients and other ill patients. Handwashing with soap and water or rubing alcohol-based products that do not require water use are hand hygiene options.[2] In the absence of visible contamination of hands, approved alcohol-based products for hand hygiene are preferred. Alcohol-based products have superior microbiocidal activity, reduced skin drying, and convenience. The guideline for hand hygiene while in healthcare settings suggests that the contaminated hands of healthcare personnel are essential contributors to indirect contact transmission.[39] Five moments for hand hygiene by WHO is used widely.[40,41]

The absence of or inadequate hand hygiene practices at critical moments is one aspect of IPC that is considered a critical example of defects in the quality of care.[42] For this manner, CDC recommends that handwashing sink, soap, alcohol-based hand gel, and paper towels be available and located near the patient care unit. These recommendations of hand hygiene are mandatory to maintain a clean and sanitary process for each patient. Furthermore, the facility performs staff hand hygiene observations monthly by providing feedback on their adherence. Monitoring hand hygiene adherence and providing performance feedback to health care workers is a critical component of multimodal hand hygiene promotion programs, but significant variations exist in how adherence is measured.[43] An increase in hand hygiene adherence and an overall decrease in catheter line-associated bloodstream infection incidents are linked.[44]

In order to ensure safe practice, Kidney Disease Outcomes Quality Initiative (KDOQI) recommends structured training to the dialysis unit technicians and nurses. Furthermore, KDOQI recommends a routinely annual re-training program to maintain and update the staff's knowledge for optimal vascular access care.[45] Regular training, observing clinical skills, assessing the competency of clinical staff performing catheter/ or vascular access, and providing regular feedback is any facility's prime responsibilities.[46] KDOQI recommends that staff manipulating catheters wear a mask and clean or sterile disposable gloves.[47] With these frequent assessments and precautions, the chance of the access problem will always minimize.

Injection safety, or safe injection practices, is considered one of the CDC's core elements of infection control and prevention. It recommends avoiding reinsertion of used needles into a multi-dose injection container (e.g., saline bag); or the use of a single needle or syringe to administer medication to multiple patients.[48,49] We experienced the CDC IPC audit tool to be relevant at times of COVID-19 pandemic.

Limitations of the Study

The dialysis unit staffs were cooperative in providing the information. In some cases, information was only partially available. There shall be bias in subjective information, so the collected data is verified Nephrologist and a member of the infection control team. There might be several biases involved in collecting data, but the CDC tool is required to visually confirm certain details is useful. Still, interviewer and reporter bias shall be present to report good results. We validated the information in two steps to be more genuine and capture all the details as possible. The hemodialysis unit infection prevention and control measures might have been influenced positively by COVID-19 general infection prevention and control procedures.

Conclusion

The CDC IPC audit tool for the hemodialysis unit was found to be useful in identifying shortcomings and formulating action plans for improvements at the study site. Such auditing exercises improve IPC efforts creating safer healthcare settings for professionals and patients. Precautionary measures are well in place, probably due to the COVID-19 pandemic. Areas of improvement identified are additional training for healthcare professionals, assessment of specific competencies using standardized tools, and multiple educational aids to patients. In our opinion, the CDC IPC audit tool was relevant to use during the COVID-19 pandemic.

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Declaration by Authors

All authors contributed to designing the study, Klaithem and Rajaram collected the data, all authors were involved in data analysis, writing and review of the manuscript. The manuscript has been read and approved by all the authors, the requirements for authorship have been met, and each author believes that the manuscript represents honest work and authors alone are responsible for the content and writing of the paper.

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References

1. CDC [Internet]. Infection prevention and control assessment tool for hemodialysis facilities; [cited 2021 Oct 25]. Available from: https://www.cdc.gov/

infectioncontrol/pdf/icar/dialysis.pdf.
2. Siegel JD, Rhinehart E, Jackson M, Chiarello L. 2007 guideline for isolation precautions: preventing transmission of infectious agents in health care settings. Am J Infect Control. 2007 Dec;35(10):S65-164. [PubMed] [Google Scholar]
3. Camins BC. Prevention and treatment of hemodialysis-related bloodstream infections. Semin Dial. 2013 Jul;26(4):476-81. [PubMed] [Google Scholar]
4. Almasri J, Alsawas M, Mainou M, Mustafa RA, Wang Z, Woo K, Cull DL, Murad MH. Outcomes of vascular access for hemodialysis: A systematic review and meta-analysis. J Vasc Surg. 2016 Jul;64(1):236-43. [PubMed] [Google Scholar]
5. Kumbar L, Yee J. Current concepts in hemodialysis vascular access infections. Adv Chronic Kidney Dis. 2019 Jan;26(1):16-22. [PubMed] [Google Scholar]
6. Raad II, Hohn DC, Gilbreath BJ, Suleiman N, Hill LA, Bruso PA, Marts K, Mansfield PF, Bodey GP. Prevention of central venous catheter-related infections by using maximal sterile barrier precautions during insertion. Infect Control Hosp Epidemiol. 1994 Apr;15(4):231-8. [PubMed] [Google Scholar]
7. Maki DG, Alvarado CJ, Ringer M. Prospective randomised trial of povidone-iodine, alcohol, and chlorhexidine for prevention of infection associated with central venous and arterial catheters. The Lancet. 1991 Aug;338(8763):339–43. [PubMed] [Google Scholar]
8. Levin A, Mason AJ, Jindal KK, Fong IW, Goldstein MB. Prevention of hemodialysis subclavian vein catheter infections by topical povidone-iodine. Kidney Int. 1991 Nov 1;40(5):934-8. [PubMed] [Google Scholar]
9. Kuhar DT, Carrico RM, Cox K, de Perio MA, Irwin KL, Lundstrom T, Overholt ED, Roberts KT, Russi M, Steed C, Sen S. Infection control in healthcare personnel: infrastructure and routine practices for occupational infection prevention and control services. Centers for Disease Control and Prevention. Last accessed on 2019. Available from: https://stacks.cdc.gov/view/cdc/82043.
10. Pogorzelska M, Stone PW, Larson EL. Certification in infection control matters: impact of infection control department characteristics and policies on rates of multidrug-resistant infections. Am J Infect Control. 2012 Mar;40(2):96-101. [PubMed] [Google Scholar]
11. Ball LK, George CA, Duval L, Hedrick NN. Reduce bloodstream infection in patients on hemodialysis: Incorporating patient engagement into a quality improvement activity. Hemodial Int. 2016 Oct;20:S7-11. [PubMed] [Google Scholar]
12. Millson T, Hackbarth D, Bernard HL. A demonstration project on the impact of safety culture on infection control practices in hemodialysis. Am J Infect Control. 2019 Sep;47(9):1122-9. [PubMed] [Google Scholar]
13. Saxena AK, Panhotra BR, Sundaram DS, Naguib M, Venkateshappa CK, Uzzaman W, Al Mulhim K. Impact of dedicated space, dialysis equipment, and nursing staff on the transmission of hepatitis C virus in a hemodialysis unit of the middle east. Am J Infect Control. 2003 Feb;31(1):26-33. [PubMed] [Google Scholar]
14. Osman FK, El Banna HM, Sharaf AY, Mohammed YF. The effects of educational interventions on nurses' knowledge and practices in hemodialysis unit regarding infection control practices. Egypt J Hosp Med. 2021 Jul;84(1):1739-48. [Google Scholar]
15. Goldrick B, Gruendemann B, Larson E. Learning styles and teaching/learning strategy preferences: implications for educating nurses in critical care, the operating room, and infection control. Heart Lung. 1993 Mar 1;22(2):176-82. [PubMed] [Google Scholar]
16. Diekema DJ, Schuldt SS, Albanese MA, Doebbeling BN. Universal precautions training of preclinical students: impact on knowledge, attitudes, and compliance. Prev Med. 1995 Nov;24(6):580-5. [PubMed] [Google Scholar]
17. Babcock HM, Zack JE, Garrison T, Trovillion E, Jones M, Fraser VJ, Kollef MH. An educational intervention to reduce ventilator-associated pneumonia in an integrated health system: a comparison of effects. Chest. 2004 Jun;125(6):2224-31. [PubMed] [Google Scholar]
18. Avila-Agüero ML, Umana MA, Jimenez AL, Faingezicht I, Paris MM. Handwashing practices in a tertiary-care, pediatric hospital and the effect on an educational program. Clin Perform Qual Health Care. 1998 Apr;6(2):70-2. [PubMed] [Google Scholar]
19. Bel'eed K, Wright M, Eadington D, Farr M, Sellars L. Vaccination against hepatitis B infection in patients with end stage renal disease. Postgrad Med J. 2002 Sep;78(923):538-40. [PubMed] [Google Scholar]
20. NHS [Internet]. Infection prevention and control safe use and disposal of sharps; [cited 2021 Oct 25]. Available from: https://www.candi.nhs.uk/sites/default/files/Safe%20Use%20and%20Disposal%20of%20Sharps_Infection%20Control_CL05C_May%202018.pdf.
21. Calba C, Goutard FL, Hoinville L, Hendrikx P, Lindberg A, Saegerman C, Peyre M. Surveillance systems evaluation: a systematic review of the existing approaches. BMC Public Health. 2015 Dec;15(1):1-3. [PubMed] [Google Scholar]
22. Van Seventer JM, Hochberg NS. Principles of infectious diseases: transmission, diagnosis, prevention, and control. Int Encyclopedia Public Health. 2017, p. 22. [Google Scholar]
23. Goldrick BA. The Certification Board of Infection Control and Epidemiology white paper: the value of certification for infection control professionals. Am J Infect Control.

ISSN: 0019-5138
DOI: https://doi.org/10.24321/0019.5138.202235

2007 Apr;35(3):150-6. [PubMed] [Google Scholar]
24. Burdick RA, Bragg-Gresham JL, Woods JD, Hedderwick SA, Kurokawa K, Combe C, Saito A, Labrecque J, Port FK, Young EW. Patterns of hepatitis B prevalence and seroconversion in hemodialysis units from three continents: the DOPPS. Kidney Int. 2003 Jun;63(6):2222-9. [PubMed] [Google Scholar]
25. Patel PR, Kallen AJ, Arduino MJ. Epidemiology, surveillance, and prevention of bloodstream infections in hemodialysis patients. Am J Kidney Dis. 2010 Sep;56(3):566-77. [PubMed] [Google Scholar]
26. Srinivasan A, McDonald LC, Jernigan D, Helfand R, Ginsheimer K, Jernigan J, Chiarello L, Chinn R, Parashar U, Anderson L, Cardo D. Foundations of the severe acute respiratory syndrome preparedness and response plan for healthcare facilities. Infect Control Hosp Epidemiol. 2004 Dec;25(12):1020-5. [PubMed] [Google Scholar]
27. Jensen PA, Lambert LA, Iademarco MF, Ridzon R. Guidelines for preventing the transmission of Mycobacterium tuberculosis in healthcare settings. MMWR Recomm Rep. 2005 Dec;54(RR-17):1-141. [PubMed] [Google Scholar]
28. Seto WH, Tsang D, Yung RW, Ching TY, Ng TK, Ho M, Ho LM, Peiris JS, Advisors of Expert SARS group of Hospital Authority. Effectiveness of precautions against droplets and contact in prevention of nosocomial transmission of severe acute respiratory syndrome (SARS). The Lancet. 2003 May;361(9368):1519-20. [PubMed] [Google Scholar]
29. Reddy SC, Valderrama AL, Kuhar DT. Improving the use of personal protective equipment: applying lessons learned. Clin Infect Dis. 2019 Sep;69(Supplement_3):S165-70. [PubMed] [Google Scholar]
30. Katanami Y, Hayakawa K, Shimazaki T, Sugiki Y, Takaya S, Yamamoto K, Kutsuna S, Kato Y, Ohmagari N. Adherence to contact precautions by different types of healthcare workers through video monitoring in a tertiary hospital. J Hosp Infect. 2018 Sep;100(1):70-5. [PubMed] [Google Scholar]
31. Garthwaite E, Reddy V, Douthwaite S, Lines S, Tyerman K, Eccles J. Clinical practice guideline management of blood borne viruses within the haemodialysis unit. BMC Nephro. 2019 Dec;20(1):1-22. [PubMed] [Google Scholar]
32. Dancer SJ, White LF, Lamb J, Girvan EK, Robertson C. Measuring the effect of enhanced cleaning in a UK hospital: a prospective cross-over study. BMC Med. 2009 Jun;7:28. [PubMed] [Google Scholar]
33. Shimohata T, Mawatari K, Uebanso T, Honjo A, Tsunedomi A, Hatayama S, Sato Y, Kido J, Nishisaka R, Yoshimoto A, Yamashita T. Bacterial contamination of hemodialysis devices in hospital dialysis wards. J Med Invest. 2019;66(1.2):148-52. [PubMed] [Google Scholar]
34. Yong K, Marquez P, Terashita D, Rivas H, Deak E, Mascola L. Outbreak of bloodstream infections associated with multiuse dialyzers containing O-rings. Infect Control Hosp Epidemiol. 2014 Jan;35(1):89-91. [PubMed] [Google Scholar]
35. Edens C, Wong J, Lyman M, Rizzo K, Nguyen D, Blain M, Horwich-Scholefield S, Moulton-Meissner H, Epson E, Rosenberg J, Patel PR. Hemodialyzer reuse and gram-negative bloodstream infections. Am J Kidney Dis. 2017 Jun;69(6):726-33. [PubMed] [Google Scholar]
36. Twardowski ZJ. Dialyzer reuse - part II: Advantages and disadvantages. Semin Dial. 2006 May-Jun;19(3):217-26. [PubMed] [Google Scholar]
37. Silva OM, Karohl C, Proença MC, Vicari AR, Fengler KP, Rabelo-Silva ER. Dialyzer reuse and single-use: petrogenesis and bacteremia episodes. Acta Paul Enferm. 2020 Oct;33. [Google Scholar]
38. Galvao TF, Silva MT, de Almeida Araujo ME, Bulbol WS, Cardoso AL. Dialyzer reuse and mortality risk in patients with end-stage renal disease: a systematic review. Am J Nephrol. 2012;35(3):249-58. [PubMed] [Google Scholar]
39. Boyce JM, Pittet D; Healthcare Infection Control Practices Advisory Committee; HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. Guideline for Hand Hygiene in Health-Care Settings. Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. Society for Healthcare Epidemiology of America/Association for Professionals in Infection Control/Infectious Diseases Society of America. MMWR Recomm Rep 2002;51(RR-16):1-45, quiz CE1-4. [PubMed] [Google Scholar]
40. Sax H, Allegranzi B, Uckay I, Larson E, Boyce J, Pittet D. My five moments for hand hygiene: a user-centred design approach to understand, train, monitor and report hand hygiene. J Hosp Infect. 2007 Sep;67(1):9-21. [PubMed] [Google Scholar]
41. Chou DT, Achan P, Ramachandran M. The World Health Organization '5 Moments of Hand Hygiene The scientific foundation. J Bone Joint Surg. 2012 Apr;94(4):441-5. [PubMed] [Google Scholar]
42. World Health Organization. Evidence of hand hygiene as the building block for infection prevention and control: an extract from the systematic literature reviews undertaken as the background for the WHO guidelines on core components of infection prevention and control programmes at the national and acute health care facility level. 2017. [Google Scholar]
43. Sax H, Allegranzi B, Chraïti MN, Boyce J, Larson E, Pittet D. The World Health Organization hand hygiene

ISSN: 0019-5138
DOI: https://doi.org/10.24321/0019.5138.202235

observation method. Am J Infect Control. 2009 Dec;37(10):827-34. [PubMed] [Google Scholar]
44. Johnson L, Grueber S, Schlotzhauer C, Phillips E, Bullock P, Basnett J, Hahn-Cover K. A multifactorial action plan improves hand hygiene adherence and significantly reduces central line-associated bloodstream infections. Am J Infect Control. 2014 Nov;42(11):1146-51. [PubMed] [Google Scholar]
45. Lok CE, Huber TS, Lee T, Shenoy S, Yevzlin AS, Abreo K, Allon M, Asif A, Astor BC, Glickman MH, Graham J, Moist LM, Rajan DK, Roberts C, Vachharajani TJ, Valentini RP; National Kidney Foundation. KDOQI clinical practice guideline for vascular access: 2019 update. Am J Kidney Dis. 2020 Apr;75(4): S1-64. [PubMed] [Google Scholar]
46. McGuire R. Assessing standards of vascular access device care. Br J Nurs. 2015 Apr-May;24(8):S29-35. [PubMed] [Google Scholar]
47. Lok CE, Mokrzycki MH. Prevention and management of catheter-related infection in hemodialysis patients. Kidney Int. 2011 Mar;79(6):587-98. [PubMed] [Google Scholar]
48. Upadhyay A. Dialyzer reuse: is it safe and worth it? Braz J Nephrol. 2019 Sep;41(3):312-4. [PubMed] [Google Scholar]
49. Birkhead G, Hamilton TE, Kossover R, Perz J, Gangadharan D, Iskander J. CDC grand rounds: preventing unsafe injection practices in the US healthcare system. MMWR Morb Mortal Wkly Rep. 2013 May;62(21):423. [PubMed] [Google Scholar]

ISSN: 0019-5138
DOI: https://doi.org/10.24321/0019.5138.202235