

Nurses' knowledge and practice regarding care for patients undergoing hemodialysis

P. Vanaja¹, Sheeja CV^{2*}, Ritu³, Sathiyaseelan G.⁴, Gifty Thomas⁵, Jamana Vaishnav⁶,
Neha Thakur⁷, Velladurai Narayanan⁸, Himanshu Singhal⁹

¹Nursing Tutor, College of Nursing, Madras Medical College, Chennai, Tamil Nadu, India

^{2*}Principal, MIMS College of Nursing, Malappuram, Kerala, India (*Corresponding Author)

³Nursing Tutor, Faculty of Nursing, SGT University, Gurugram, Haryana, India

⁴Vice Principal cum Professor, Faculty of Nursing, TS Mishra University, Lucknow, Uttar Pradesh, India

⁵Clinical Instructor, RAK Medical & Health Sciences University, Ras Al-Khaimah, United Arab Emirates

⁶Assistant Professor, Geetanjali College and School of Nursing, Udaipur, Rajasthan, India

⁷Assistant Professor, Mother Mary's Institute of Nursing, Hoshiarpur, Punjab, India

⁸Professor, HOD, Mental Health Nursing, Rohilkhand College of Nursing, Bareilly, Uttar Pradesh, India

⁹Assistant Professor, Faculty of Pharmacy, Tanta University, Sri Ganganagar, Rajasthan, India

Abstract

Hemodialysis is a life-sustaining renal replacement therapy for patients with end-stage renal disease (ESRD) and advanced chronic kidney disease (CKD). Nurses play a pivotal role in ensuring safe, effective, and high-quality hemodialysis care through their knowledge, clinical competence, and evidence-based practices. Adequate nursing knowledge regarding vascular access management, infection prevention, fluid and electrolyte balance, patient education, and complication management is essential for optimal patient outcomes. However, variations in nurses' knowledge and practice have been reported globally, influencing the quality of dialysis care and patient safety. This review article synthesizes evidence from the last ten years to examine nurses' knowledge and practice related to the care of patients undergoing hemodialysis. Emphasis is placed on key domains of nursing care, factors influencing knowledge and practice, clinical outcomes, and implications for nursing education and practice. Eight figures and three tables are integrated to enhance conceptual understanding. The findings underscore the need for continuous education, standardized protocols, and institutional support to strengthen nursing practice in hemodialysis units.

Keywords: Hemodialysis, end-stage renal disease, advanced chronic kidney disease, nurses' knowledge, nursing practice, chronic kidney disease, renal replacement therapy, dialysis nursing, standardized protocols.

How to cite this article: Vanaja P, Sheeja CV, Ritu, Sathiyaseelan G, Thomas G, Vaishnav J, Thakur N, Narayanan V, Singhal H. Nurses' knowledge and practice regarding care for patients undergoing hemodialysis. *Int J Drug Deliv Technol.* 2026;16(6s): 430-441; DOI: 10.25258/ijddt.16.6s.44

Introduction

Chronic kidney disease (CKD) has emerged as one of the most significant global public health challenges of the twenty-first century, with its prevalence steadily increasing across both developed and developing countries. This rise is largely attributed to demographic transitions such as aging populations, along with the growing burden of non-communicable diseases including diabetes mellitus, hypertension, obesity, and lifestyle-related risk factors such as physical inactivity and unhealthy dietary patterns (Jager et al., 2017). CKD is a progressive condition characterized by a gradual and irreversible decline in kidney function, often remaining asymptomatic in its early stages. As the disease advances, patients experience significant metabolic disturbances, fluid overload, electrolyte imbalance, and accumulation of uremic toxins, ultimately leading to end-stage renal disease (ESRD) if untreated. When CKD progresses to ESRD, renal

replacement therapy becomes essential for patient survival. Renal replacement therapy includes hemodialysis, peritoneal dialysis, and kidney transplantation, among which hemodialysis remains the most commonly utilized modality worldwide due to its wide availability and suitability for a large proportion of patients (Luyckx et al., 2021). Hemodialysis involves the extracorporeal circulation of blood through a dialysis machine, where waste products, excess fluids, and toxins are removed via diffusion and ultrafiltration across a semipermeable membrane. This highly technical procedure requires precise control of machine parameters, continuous patient monitoring, and prompt recognition of complications, making specialized nursing care indispensable (Thomas-Hawkins & Flynn, 2019). Nurses occupy a central role in the delivery of hemodialysis care and are integral members of the multidisciplinary renal healthcare team. Their

Nurses' knowledge and practice regarding care for patients undergoing hemodialysis

responsibilities extend beyond the technical aspects of operating dialysis machines to include comprehensive patient assessment, vascular access care, infection prevention, medication administration, patient education, psychosocial support, and emergency management (Hussein et al., 2018). Dialysis nurses are responsible for assessing patients before, during, and after dialysis sessions, monitoring vital signs, evaluating fluid status, and ensuring patient comfort and safety throughout the procedure. In addition, nurses play a crucial role in educating patients and their families about disease management, dietary and fluid restrictions, medication adherence, and lifestyle modifications necessary for long-term survival and improved quality of life. The complexity and intensity of hemodialysis demand a high level of nursing knowledge, clinical competence, and critical thinking skills. Errors in nursing practice or deficiencies in knowledge can result in serious and potentially life-threatening complications, including hypotension, arrhythmias, bleeding, infection, electrolyte imbalance, vascular access failure, dialysis disequilibrium syndrome, and increased morbidity and mortality (Alikari et al., 2019). Vascular access complications alone are a major cause of hospitalization and increased healthcare costs among hemodialysis patients, underscoring the importance of skilled nursing care. Consequently, nurses' knowledge and practice regarding hemodialysis care are widely recognized as critical determinants of patient safety, treatment effectiveness, and overall clinical outcomes. Figure 1 illustrates the global burden of CKD and the increasing dependence on hemodialysis as a life-sustaining therapy. The figure highlights not only the rising number of patients requiring dialysis worldwide but also emphasizes the expanding and increasingly complex role of dialysis nurses within modern healthcare systems (Luyckx et al., 2021). As the prevalence of CKD continues to rise, the demand for well-trained and knowledgeable dialysis nurses is expected to grow correspondingly, placing greater emphasis on nursing education and workforce development in renal care settings.

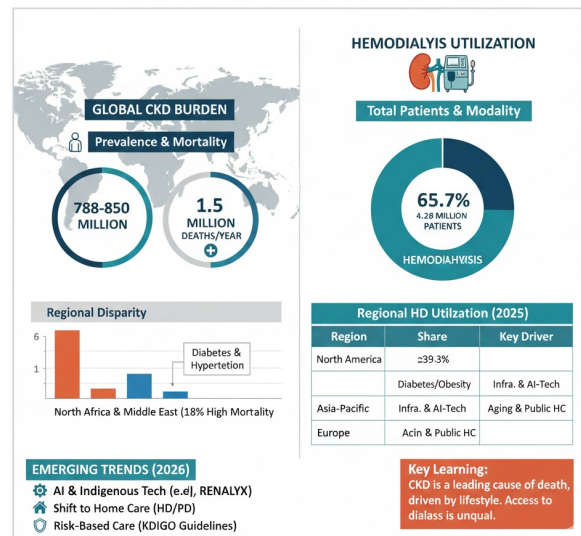


Figure 1. Global Burden of Chronic Kidney Disease and Utilization of Hemodialysis

Despite continuous technological advancements in dialysis machines, water treatment systems, and vascular access devices, patient outcomes remain closely linked to the competence, vigilance, and clinical judgment of nursing staff (Mollaoglu et al., 2017). Technological improvements alone cannot ensure safe and effective hemodialysis care without the support of skilled nurses who can appropriately apply these technologies in clinical practice. Several recent studies have reported notable gaps in nurses' knowledge and inconsistencies in practice, particularly in critical areas such as infection control, vascular access management, fluid and electrolyte monitoring, and emergency response during dialysis sessions (Ahmed et al., 2020; Ibrahim et al., 2022). These deficiencies may stem from inadequate training, limited continuing education opportunities, high workload, staff shortages, or lack of standardized clinical protocols within dialysis units. Infection control is one of the most challenging aspects of hemodialysis nursing practice, as patients are repeatedly exposed to invasive procedures and extracorporeal circulation. Failure to adhere strictly to aseptic techniques and infection prevention guidelines can lead to bloodstream infections, which are associated with high morbidity and mortality among dialysis patients (Ahmed et al., 2020). Similarly, improper vascular access care can result in thrombosis, stenosis, or access loss, significantly affecting treatment continuity and patient outcomes. Emergency situations such as intradialytic hypotension, air embolism, or cardiac events require prompt recognition and rapid nursing intervention, further emphasizing the need for comprehensive knowledge and preparedness. Figure 2 presents a conceptual

framework linking nurses' knowledge and practice with patient safety and hemodialysis outcomes. The framework illustrates the interdependence of nursing education, clinical competence, adherence to evidence-based practice, and quality of care in achieving optimal patient outcomes (Thomas-Hawkins & Flynn, 2019). According to this framework, nurses' knowledge serves as the foundation upon which safe and effective clinical practice is built, while continuous education and organizational support enhance competence and consistency in care delivery. The presence of documented gaps in nursing knowledge and practice highlights the need for ongoing assessment, targeted educational interventions, and structured training programs for nurses working in hemodialysis units. Continuous professional development, competency-based training, and adherence to standardized clinical guidelines are essential strategies for improving nursing performance and ensuring patient safety. Moreover, fostering a supportive work environment that encourages learning, collaboration, and quality improvement can further enhance nurses' confidence and effectiveness in providing dialysis care. In light of these considerations, this article aims to provide a comprehensive review of nurses' knowledge and practice regarding the care of patients undergoing hemodialysis. By synthesizing evidence from the last ten years, the article seeks to identify key knowledge domains, common practice gaps, and factors influencing nursing performance in dialysis settings. Additionally, the review highlights important implications for nursing education, clinical practice, and healthcare policy, emphasizing the critical role of nurses in improving outcomes for patients undergoing hemodialysis.

impairment or complete failure of kidney function. When the kidneys are no longer able to effectively remove metabolic waste products, excess fluid, and toxins from the bloodstream, hemodialysis serves as an artificial substitute for these vital renal functions (Daugirdas et al., 2018). The therapy plays a crucial role in managing patients with end-stage renal disease as well as those experiencing acute kidney injury requiring temporary renal support. Through the regular removal of uremic toxins and maintenance of fluid and electrolyte balance, hemodialysis significantly reduces symptoms of uremia and improves patient survival and quality of life (Lopes et al., 2019). The hemodialysis procedure involves the circulation of the patient's blood through an extracorporeal circuit, where it passes through a dialyzer commonly referred to as an artificial kidney. Within the dialyzer, blood flows on one side of a semipermeable membrane, while a specially formulated dialysis solution flows on the opposite side (Daugirdas et al., 2018). The semipermeable membrane allows selective movement of substances based on concentration gradients and pressure differences. Diffusion facilitates the transfer of waste products such as urea, creatinine, and excess electrolytes from the blood into the dialysate, while ultrafiltration enables the controlled removal of excess fluid through transmembrane pressure (Lopes et al., 2019). This sophisticated process requires precise regulation of blood flow rate, dialysate composition, and ultrafiltration volume to ensure patient safety and treatment efficacy. Figure 3 demonstrates the basic components of the hemodialysis process, including the dialyzer, bloodlines, vascular access, and dialysis machine (Daugirdas et al., 2018). The dialysis machine functions as the central control unit, regulating blood and dialysate flow, monitoring pressure changes, and detecting alarms that signal potential complications. Bloodlines connect the patient's vascular access to the dialyzer, forming the extracorporeal circuit through which blood is circulated. Vascular access, such as an arteriovenous fistula, arteriovenous graft, or central venous catheter, serves as the lifeline for patients undergoing hemodialysis and must be carefully maintained to ensure adequate blood flow and prevent infection or thrombosis. Understanding the structure and function of these components is essential for nurses, as proper setup and monitoring directly influence treatment outcomes and patient safety.

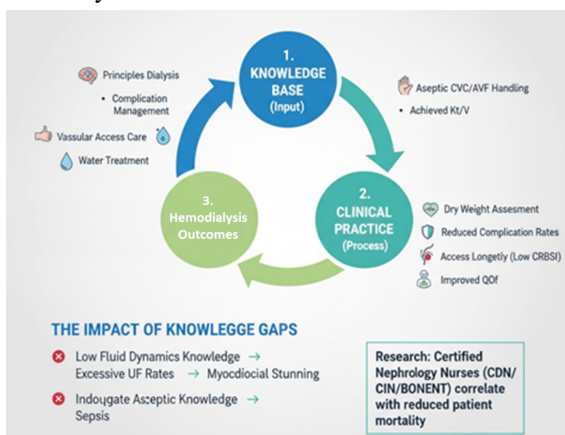
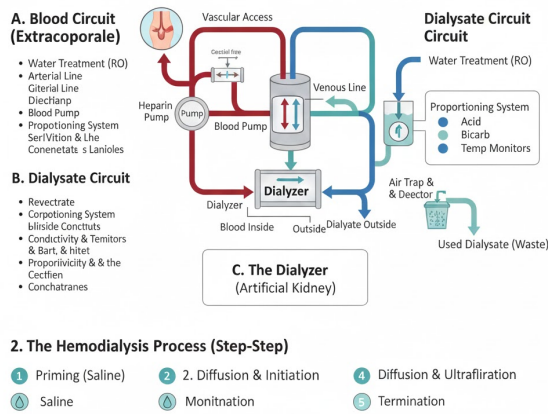


Figure 2. Relationship Between Nurses' Knowledge, Practice, and Hemodialysis Outcomes Overview of Hemodialysis

Hemodialysis is a widely used renal replacement therapy designed to sustain life in patients with severe

Nurses' knowledge and practice regarding care for patients undergoing hemodialysis



Nursing Priorities in the Process			
Timing	Pre-HD	Key Nursing Action	Rationale
Durig HD Pos-HD	Check Dry Weight	Monitor BP & Alarms	Assess Access Bruit/Thrill

Figure 3. Basic Components and Process of Hemodialysis

Hemodialysis is generally prescribed three times per week, with each session lasting approximately three to five hours, depending on the patient's clinical condition, body size, residual kidney function, and dialysis prescription (Lopes et al., 2019). The frequency and duration of treatment are individualized to achieve optimal clearance of toxins and maintenance of fluid balance. Some patients may require longer or more frequent sessions due to higher metabolic demands or complications, highlighting the need for ongoing assessment and adjustment of the dialysis regimen. During each session, patients are exposed to significant physiological stress due to rapid fluid shifts and changes in electrolyte levels, which necessitates vigilant monitoring by nursing staff (Alikari et al., 2019). Nurses play a central role during hemodialysis sessions by continuously assessing the patient's physiological responses and ensuring the safe operation of dialysis equipment. Vital signs such as blood pressure, heart rate, respiratory rate, and temperature are monitored regularly, as hypotension is one of the most common complications associated with hemodialysis (Alikari et al., 2019). Sudden drops in blood pressure can lead to symptoms such as dizziness, nausea, muscle cramps, and loss of consciousness, requiring immediate nursing intervention. Nurses also monitor machine parameters, including blood flow rate, dialysate conductivity, transmembrane pressure, and ultrafiltration rate, to ensure that the dialysis process remains within prescribed limits. In addition to physiological monitoring, nurses observe patients for signs of discomfort, anxiety, or adverse reactions throughout the session. Patient responses such as fatigue, headache, chest pain, or shortness of breath may indicate complications requiring prompt

assessment and action. Clinical judgment is essential in interpreting these signs and deciding when to intervene, adjust treatment parameters, or notify the nephrologist (Alikari et al., 2019). Effective nursing practice during hemodialysis relies on the integration of theoretical knowledge, technical skills, and critical thinking to respond appropriately to rapidly changing clinical situations. Furthermore, nurses are responsible for ensuring infection control and maintaining vascular access integrity during and after hemodialysis sessions. Strict adherence to aseptic techniques during cannulation, connection, and disconnection of bloodlines is critical to prevent bloodstream infections, which remain a leading cause of morbidity and mortality among dialysis patients (Daugirdas et al., 2018). Post-dialysis care includes assessing the vascular access site for bleeding, infection, or dysfunction and providing patient education on access protection and self-care practices.

Nurses' Knowledge Regarding Hemodialysis Care

Nurses' knowledge regarding hemodialysis care encompasses a comprehensive understanding of theoretical principles and clinical applications required to provide safe and effective treatment for patients with renal failure. This knowledge includes familiarity with the pathophysiology of chronic kidney disease, the principles of renal replacement therapy, the functioning of hemodialysis equipment, patient assessment techniques, and the management of potential complications associated with dialysis therapy (Hussein et al., 2018). Adequate nursing knowledge forms the foundation for competent clinical practice and is essential for minimizing risks, preventing complications, and improving patient outcomes in hemodialysis units. A key component of nurses' knowledge relates to the principles and mechanisms of hemodialysis. Nurses must understand how diffusion, osmosis, and ultrafiltration facilitate the removal of waste products and excess fluid from the blood. Knowledge of dialysate composition, blood flow rates, ultrafiltration targets, and treatment duration enables nurses to recognize deviations from prescribed therapy and respond appropriately (Daugirdas et al., 2018). Without this fundamental understanding, nurses may be unable to identify machine-related errors or physiological changes that could compromise patient safety. Knowledge of hemodialysis equipment is another critical domain. Nurses are required to operate complex dialysis machines, monitor alarms, and ensure the integrity of the extracorporeal circuit. Familiarity with the components of the dialysis machine, including the

dialyzer, bloodlines, and monitoring systems, allows nurses to troubleshoot technical issues promptly and reduce the risk of complications such as air embolism, blood loss, or inadequate dialysis (Lopes et al., 2019). Competence in equipment handling is particularly important in high-volume dialysis units where nurses manage multiple patients simultaneously.

Patient assessment knowledge is equally essential in hemodialysis care. Nurses must be skilled in pre-dialysis, intra-dialysis, and post-dialysis assessment, including evaluation of vital signs, fluid status, weight changes, and vascular access condition. Knowledge of normal and abnormal findings enables early detection of complications such as hypotension, fluid overload, electrolyte imbalance, and access dysfunction (Alikari et al., 2019). Accurate assessment guides timely interventions and prevents progression of adverse events during dialysis sessions. Another vital aspect of nurses' knowledge involves the recognition and management of hemodialysis-related complications. Nurses should be knowledgeable about common complications such as intradialytic hypotension, muscle cramps, nausea, vomiting, bleeding, infection, and dialysis disequilibrium syndrome. Understanding the causes, signs, and preventive strategies for these complications enables nurses to respond effectively and reduce patient morbidity (Hussein et al., 2018). Knowledge-based interventions, such as adjusting ultrafiltration rates or positioning the patient appropriately, play a crucial role in managing these conditions. In addition, nurses must possess knowledge related to patient education and psychosocial support. Hemodialysis patients require continuous guidance regarding dietary restrictions, fluid management, medication adherence, and care of vascular access. Educating patients based on accurate and up-to-date knowledge empowers them to participate actively in their care and improves adherence to treatment regimens (Alikari et al., 2019). Overall, comprehensive knowledge in hemodialysis care is essential for nurses to deliver safe, effective, and patient-centered care, highlighting the need for continuous education and professional development in dialysis nursing practice.

Knowledge of Vascular Access Care

Vascular access is universally recognized as the lifeline of patients undergoing hemodialysis, as it provides the essential route through which blood is removed, purified, and returned to the body during dialysis sessions. The effectiveness, safety, and continuity of hemodialysis treatment depend largely on the integrity and proper functioning of vascular access (Lok et al., 2020). The primary types of vascular access used in

hemodialysis include arteriovenous fistulas (AVFs), arteriovenous grafts (AVGs), and central venous catheters, each with specific indications, advantages, and risks. Among these, arteriovenous fistulas are considered the gold standard due to their longer lifespan and lower rates of infection and thrombosis compared to other access types (Lok et al., 2020). Nurses must possess in-depth knowledge regarding the assessment and management of vascular access to ensure safe and effective dialysis care. This knowledge includes understanding the anatomical location of access sites, recognizing normal and abnormal findings, and identifying early signs of complications. Routine assessment of vascular access involves inspection for redness, swelling, or discharge; palpation for thrill; and auscultation for bruit, all of which indicate access patency and functionality (Ahmed et al., 2020). Inadequate assessment or delayed recognition of abnormalities can lead to access failure, interruption of dialysis treatment, and increased morbidity. Cannulation techniques represent another critical area of nursing knowledge in vascular access care. Nurses must be proficient in selecting appropriate needle size, angle of insertion, and rotation of puncture sites to prevent vessel damage and prolong access longevity. Knowledge of aseptic cannulation techniques is essential to minimize the risk of infection, particularly bloodstream infections, which remain a leading cause of hospitalization and mortality among hemodialysis patients (Ibrahim et al., 2022). Strict adherence to infection prevention protocols, including hand hygiene, skin antisepsis, and proper handling of access devices, is a fundamental nursing responsibility. Figure 4 illustrates the common types of vascular access used in hemodialysis, including arteriovenous fistulas, arteriovenous grafts, and central venous catheters, along with the associated nursing responsibilities for each type (Lok et al., 2020). The figure highlights the importance of individualized nursing care based on access type, as central venous catheters require meticulous exit-site care and monitoring for signs of infection, while AVFs and AVGs demand careful cannulation and ongoing surveillance to detect stenosis or thrombosis. Evidence from recent studies indicates that nurses with higher levels of knowledge regarding vascular access care demonstrate significantly better adherence to aseptic techniques and evidence-based practices, resulting in reduced rates of access-related infections and complications (Ibrahim et al., 2022). Knowledgeable nurses are more likely to educate patients on protecting their access, such as avoiding blood pressure

Nurses' knowledge and practice regarding care for patients undergoing hemodialysis

measurement or venipuncture on the access arm and recognizing early warning signs of infection or dysfunction. Therefore, strengthening nurses' knowledge related to vascular access assessment, cannulation, and infection prevention is essential for improving hemodialysis outcomes and ensuring patient safety.

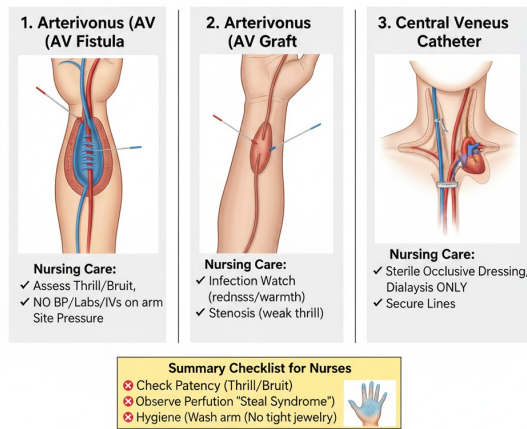


Figure 4. Types of Vascular Access and Nursing Care Considerations

Knowledge of Infection Control

Hemodialysis patients are at a significantly increased risk of infection due to multiple factors, including repeated exposure to invasive vascular access procedures, frequent contact with healthcare environments, and an immunocompromised physiological state associated with chronic kidney disease (Nguyen et al., 2017). Bloodstream infections remain one of the leading causes of hospitalization and mortality among patients receiving hemodialysis, underscoring the critical importance of infection prevention and control measures within dialysis units. Nurses, as primary caregivers during dialysis sessions, play a central role in minimizing infection risk through the application of evidence-based practices and strict adherence to infection control protocols. Comprehensive knowledge of standard precautions is essential for nurses providing hemodialysis care. Standard precautions include proper hand hygiene, use of personal protective equipment, safe handling of blood and body fluids, and appropriate disposal of sharps and contaminated materials. Hand hygiene, in particular, is recognized as the most effective intervention in preventing healthcare-associated infections. Nurses must be knowledgeable about the correct timing and techniques for handwashing and use of alcohol-based hand rubs before and after patient contact, vascular access manipulation, and equipment handling (Alikari et al., 2019). In addition to standard precautions, nurses must have a thorough

understanding of disinfection and environmental cleaning protocols specific to hemodialysis units. Dialysis machines, chairs, blood pressure cuffs, and other shared equipment can serve as reservoirs for pathogenic microorganisms if not adequately disinfected between patients. Knowledge of appropriate disinfectants, contact time, and cleaning procedures is essential to prevent cross-contamination and infection transmission (Nguyen et al., 2017). Nurses are also responsible for ensuring proper disinfection of vascular access sites before cannulation and maintaining aseptic technique throughout the dialysis procedure. Isolation practices constitute another important aspect of infection control knowledge in hemodialysis settings. Patients with known or suspected infections, particularly bloodborne infections such as hepatitis B, may require dedicated machines, separate treatment areas, or specific isolation measures to prevent transmission to other patients and staff (Alikari et al., 2019). Nurses must be aware of institutional policies and national guidelines governing isolation and cohorting practices in dialysis units and apply them consistently in clinical practice. Figure 5 depicts common infection transmission pathways in hemodialysis units, including patient-to-patient, staff-to-patient, and equipment-mediated transmission, along with preventive nursing interventions aimed at interrupting these pathways (Nguyen et al., 2017). The figure highlights the pivotal role of nurses in breaking the chain of infection through meticulous hand hygiene, environmental cleaning, use of personal protective equipment, and patient education. Overall, adequate nursing knowledge regarding infection control practices is fundamental to safeguarding hemodialysis patients from preventable infections. Continuous education, regular training updates, and strict adherence to established infection prevention protocols are essential strategies for reducing infection rates and improving patient safety in hemodialysis units.

Nurses' knowledge and practice regarding care for patients undergoing hemodialysis

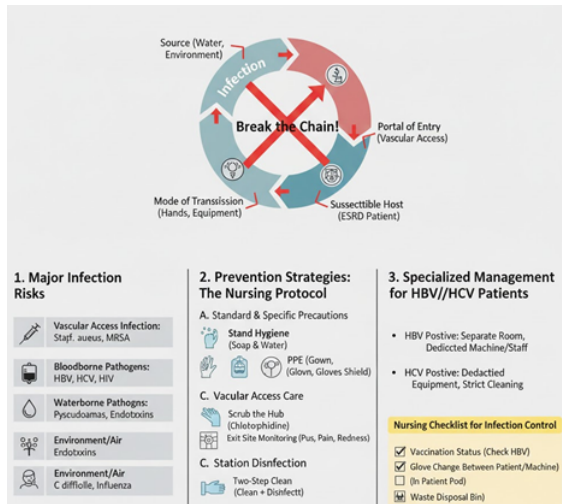


Figure 5. Infection Risks and Prevention in Hemodialysis Units

Nurses' Practice in Hemodialysis Care

Nursing practice refers to the effective application of theoretical knowledge through psychomotor skills, critical thinking, clinical judgment, and patient-centered interventions aimed at achieving optimal health outcomes (Mollaoglu et al., 2017). In hemodialysis settings, nursing practice is particularly complex due to the technical nature of the procedure, the physiological instability of patients, and the high risk of acute and chronic complications. Effective nursing practice plays a decisive role in ensuring patient safety, maintaining treatment efficacy, and improving quality of life for patients undergoing long-term hemodialysis therapy. In hemodialysis units, nursing practice is closely linked to nurses' level of knowledge regarding dialysis principles, equipment, vascular access care, infection control, and complication management. These essential knowledge areas, summarized in table 1 Domains of Nurses' Knowledge in Hemodialysis Care, form the foundation upon which safe and competent clinical practice is built. When nurses possess comprehensive knowledge across these domains, they are better equipped to translate theory into practice and respond appropriately to the dynamic clinical situations encountered during dialysis sessions.

Table 1. Domains of Nurses' Knowledge in Hemodialysis Care

Domain	Key Knowledge Areas
Vascular access	AV fistula care, infection prevention
Dialysis procedure	Principles, machine operation

Complication management	Hypotension, bleeding
Patient education	Diet, fluid restriction

Practice Related to Patient Monitoring

Continuous and systematic patient monitoring is a core nursing responsibility throughout the hemodialysis procedure. Nurses are required to closely observe patients before, during, and after dialysis to detect early signs of physiological instability or treatment-related complications (Daugirdas et al., 2018). Pre-dialysis assessment includes measurement of baseline vital signs, weight, fluid status, and evaluation of vascular access patency. These assessments guide the dialysis prescription and help determine safe ultrafiltration goals. During dialysis, nurses continuously monitor vital signs such as blood pressure, heart rate, respiratory rate, and temperature at regular intervals. Hypotension is the most frequently encountered intradialytic complication and may occur due to rapid fluid removal or impaired cardiovascular response (Thomas-Hawkins & Flynn, 2019). Effective nursing practice involves early recognition of blood pressure trends, prompt positioning of the patient, adjustment of ultrafiltration rates, and timely communication with the healthcare team. In addition to vital signs, nurses monitor fluid balance by assessing weight changes, intake and output, and signs of fluid overload or dehydration. Monitoring of machine parameters is equally important in ensuring treatment safety. Nurses must ensure appropriate blood flow rate, dialysate conductivity, transmembrane pressure, and ultrafiltration settings throughout the session. Alarms generated by dialysis machines require immediate assessment and action to prevent adverse events such as air embolism, blood loss, or inadequate dialysis. Competent monitoring practice allows nurses to identify deviations early and intervene before complications escalate (Daugirdas et al., 2018).

Practice in Managing Hemodialysis Complications

Effective nursing practice is critical in the prompt management of acute hemodialysis-related complications. Common complications include hypotension, muscle cramps, nausea, vomiting, bleeding from vascular access sites, allergic reactions, and cardiac arrhythmias (Alikari et al., 2019). Nurses must demonstrate clinical competence and sound judgment when managing these conditions, as delays or inappropriate responses can lead to serious morbidity or mortality. Management of intradialytic hypotension requires rapid assessment and intervention, including reducing ultrafiltration, placing

Nurses' knowledge and practice regarding care for patients undergoing hemodialysis

the patient in a supine or Trendelenburg position, administering fluids if prescribed, and closely monitoring vital signs. Similarly, muscle cramps may be managed through adjustment of fluid removal rates, limb repositioning, and patient reassurance. Bleeding from access sites necessitates immediate application of pressure, assessment of coagulation status, and careful post-dialysis monitoring (Alikari et al., 2019). Nurses must also be prepared to manage less frequent but life-threatening complications such as dialysis disequilibrium syndrome, air embolism, or severe arrhythmias. This requires not only technical skill but also the ability to recognize early warning signs, initiate emergency protocols, and collaborate effectively with the multidisciplinary team. Competent complication management reflects the integration of knowledge domains outlined in Table 1 with real-time clinical decision-making. Figure 6 summarizes common hemodialysis complications and corresponding nursing management strategies, emphasizing the central role of nurses in identifying complications early and implementing appropriate interventions to maintain patient stability (Hussein et al., 2018). The figure highlights how timely nursing actions can significantly reduce adverse outcomes and enhance treatment safety.

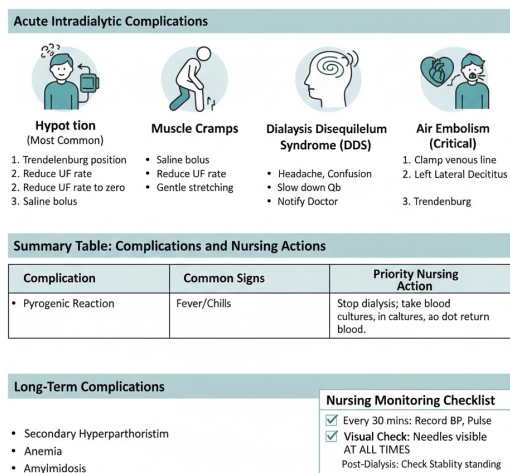


Figure 6. Common Hemodialysis Complications and Nursing Interventions

Importance of Patient-Centered Nursing Practice
Beyond technical skills and emergency management, effective nursing practice in hemodialysis includes patient-centered care that addresses physical, emotional, and psychosocial needs. Hemodialysis patients often experience anxiety, fatigue, depression, and reduced quality of life due to the chronic nature of their condition. Nurses play a key role in providing emotional support, health education, and counseling, thereby fostering patient engagement and adherence to

treatment regimens (Mollaoglu et al., 2017). Patient education related to fluid restriction, dietary management, medication adherence, and vascular access care is an integral component of nursing practice. By applying knowledge in a practical and empathetic manner, nurses empower patients to participate actively in their care, reduce complications, and improve long-term outcomes.

Factors Influencing Nurses' Knowledge and Practice

Nurses' knowledge and practice in hemodialysis care are shaped by a complex interaction of individual, organizational, and systemic factors. The quality of nursing care delivered in dialysis units depends not only on personal competence but also on the educational environment, clinical exposure, availability of resources, and institutional support systems. Understanding these influencing factors is essential for identifying gaps in practice and developing strategies to enhance nursing performance and patient outcomes (Ahmed et al., 2020). These multidimensional influences are summarized in table 2 Factors Affecting Nursing Practice in Hemodialysis, which highlights key individual and organizational determinants impacting clinical performance. Educational background is one of the primary determinants of nurses' knowledge regarding hemodialysis care. Nurses with higher academic qualifications or specialized training in nephrology nursing tend to demonstrate better understanding of dialysis principles, equipment operation, infection control, and complication management. Formal education provides the theoretical foundation required to interpret clinical situations accurately and apply evidence-based interventions (Ahmed et al., 2020). In contrast, nurses without specialized renal education may rely on routine practices, limiting their ability to manage complex dialysis-related challenges effectively.

Table 2. Factors Affecting Nursing Practice in Hemodialysis

Factor	Influence
Education level	Improves clinical competence
Experience	Enhances decision-making
Training programs	Updates evidence-based practice

Nurses' knowledge and practice regarding care for patients undergoing hemodialysis

Workload	Affects quality of care
----------	-------------------------

Clinical experience is another significant factor influencing nurses' knowledge and practice. Increased years of experience in hemodialysis units contribute to enhanced technical proficiency, confidence, and clinical judgment. Experienced nurses are more likely to recognize early signs of complications and initiate timely interventions. However, experience alone does not guarantee current knowledge, especially with advancements in dialysis technology and evolving clinical guidelines, emphasizing the importance of ongoing education and training (Ibrahim et al., 2022). The availability of in-service training and continuing education programs plays a crucial role in strengthening nurses' competence in hemodialysis care. Regular training updates, workshops, and competency-based programs enable nurses to refine their skills and remain aligned with evidence-based practices. Research indicates that nurses who participate in structured training programs exhibit improved adherence to infection control measures and safer vascular access practices (Ahmed et al., 2020). Limited access to training opportunities can contribute to knowledge deficits and inconsistent nursing practices. Institutional support is a critical organizational factor affecting nursing knowledge and practice. Supportive leadership, adequate staffing levels, access to up-to-date clinical guidelines, and availability of necessary equipment foster a safe and effective work environment. Conversely, high workload, staffing shortages, and inadequate resources can hinder the application of knowledge in practice and negatively impact patient care outcomes (Ibrahim et al., 2022).

Impact of Nurses' Knowledge and Practice on Patient Outcomes

Evidence consistently indicates that higher levels of nursing knowledge and strict adherence to evidence-based best practices are strongly associated with improved patient outcomes in hemodialysis care. Competent nursing practice has been shown to significantly reduce infection rates, minimize treatment-related complications, and enhance the overall quality of life of patients undergoing long-term hemodialysis therapy (Alikari et al., 2019; Lopes et al., 2019). Given the chronic and complex nature of kidney failure, the quality of nursing care plays a decisive role in determining both short-term safety and long-term patient well-being. Infection prevention is one of the most critical areas influenced by nursing knowledge and practice. Studies demonstrate that dialysis units

staffed by nurses with higher levels of clinical competence and adherence to aseptic protocols report lower rates of vascular access-related bloodstream infections (Alikari et al., 2019). Knowledgeable nurses are more likely to comply with hand hygiene guidelines, proper disinfection procedures, and isolation protocols, thereby reducing exposure to pathogenic microorganisms. These practices are particularly important in hemodialysis settings, where patients are repeatedly exposed to invasive procedures and shared equipment. Nursing competence also directly impacts the frequency and severity of hemodialysis-related complications. Effective patient monitoring, accurate assessment of fluid status, and timely intervention during dialysis sessions help prevent complications such as hypotension, muscle cramps, bleeding, and dialysis disequilibrium syndrome (Lopes et al., 2019). Nurses with strong clinical judgment are better equipped to identify early warning signs, adjust treatment parameters appropriately, and collaborate with the multidisciplinary team to maintain patient stability. As a result, patients experience fewer interruptions in treatment and reduced hospitalization rates. Beyond physical outcomes, nursing knowledge and practice significantly influence patients' psychosocial well-being and quality of life. Hemodialysis patients often face emotional distress, fatigue, dependency, and lifestyle restrictions. Nurses who possess strong communication skills and comprehensive knowledge are better positioned to provide education, emotional support, and counseling, empowering patients to cope effectively with their condition (Thomas-Hawkins & Flynn, 2019). Improved patient understanding of self-care practices, dietary restrictions, and vascular access protection further contributes to better treatment adherence and health-related quality of life. Figure 7 highlights the relationship between nursing competence and patient outcomes in hemodialysis care, illustrating how enhanced knowledge and clinical skills translate into safer care, fewer complications, and improved patient satisfaction (Thomas-Hawkins & Flynn, 2019). The figure emphasizes that nursing competence serves as a critical link between healthcare systems and patient outcomes.

Nurses' knowledge and practice regarding care for patients undergoing hemodialysis

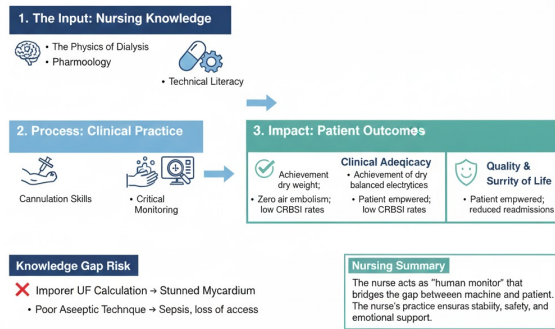


Figure 7. Impact of Nursing Knowledge and Practice on Hemodialysis Outcomes

Implications for Nursing Education and Practice

The findings from recent evidence underscore the critical importance of strengthening nursing education and clinical practice to enhance the quality of care provided to patients undergoing hemodialysis. Given the complexity of hemodialysis therapy and the high risk of complications associated with renal failure, continuous professional development is essential for maintaining and improving nurses' knowledge and clinical competence (Ibrahim et al., 2022). Structured training programs and competency-based assessments play a pivotal role in ensuring that nurses are adequately prepared to meet the demands of modern dialysis care. In nursing education, curricula should place greater emphasis on evidence-based hemodialysis care, integrating current clinical guidelines, technological advancements, and patient safety principles. Undergraduate and postgraduate nursing programs should include comprehensive content on renal physiology, dialysis principles, vascular access management, infection prevention, and emergency response during hemodialysis. Incorporating these topics early in nursing education can build a strong theoretical foundation and facilitate the development of critical thinking skills required in specialized renal care settings. Simulation-based learning is an effective educational strategy that allows nursing students and practicing nurses to apply theoretical knowledge in a controlled and safe environment. High-fidelity simulation scenarios can replicate common and emergency situations encountered in hemodialysis units, such as intradialytic hypotension, vascular access complications, and machine-related alarms. Simulation-based training enhances clinical judgment, technical proficiency, and confidence, thereby improving nurses' readiness to manage real-life dialysis challenges (Ibrahim et al., 2022). Additionally, simulation enables learners to practice teamwork, communication, and decision-making without risking patient safety. In clinical

practice, healthcare institutions should prioritize ongoing in-service education and regular competency assessments for nurses working in hemodialysis units. Continuous training programs ensure that nurses remain updated on evolving dialysis technologies, infection control standards, and evidence-based practices. Competency-based assessments, including skill evaluations and knowledge tests, help identify learning needs and promote accountability in clinical performance. Such assessments also support quality improvement initiatives by ensuring consistent adherence to established standards of care. Furthermore, creating a supportive practice environment is essential for translating knowledge into effective nursing practice. Adequate staffing levels, access to updated clinical guidelines, availability of essential equipment, and supportive leadership contribute to improved nursing performance and patient outcomes. Encouraging a culture of lifelong learning and professional growth empowers nurses to engage in self-directed learning and continuous improvement.

Conclusion

Nurses' knowledge and clinical practice are fundamental determinants of safe, effective, and high-quality care for patients undergoing hemodialysis. Comprehensive understanding of dialysis principles, vascular access management, infection prevention, and the early recognition and management of complications enables nurses to deliver care that minimizes risks and optimizes treatment outcomes. As frontline caregivers in hemodialysis units, nurses play a pivotal role in monitoring patient status, operating complex dialysis equipment, and responding promptly to physiological changes during treatment sessions. Despite significant advancements in dialysis technology and clinical protocols, evidence indicates that gaps in nursing knowledge and inconsistencies in practice continue to exist. These gaps may compromise patient safety, increase the risk of complications, and negatively affect the quality of life of individuals receiving long-term hemodialysis. Contributing factors include variations in educational preparation, limited access to continuing education, high workload, and insufficient institutional support. Addressing these challenges requires a comprehensive and sustained approach that prioritizes ongoing professional development, structured training programs, and competency-based assessments for nurses working in dialysis settings. Strengthening nursing education through evidence-based curricula, simulation-based learning, and adherence to standardized clinical

guidelines is essential for enhancing clinical competence and confidence. Additionally, supportive organizational policies and leadership are crucial in fostering a culture of safety, learning, and quality improvement. Overall, investing in the continuous enhancement of nurses' knowledge and practice is essential for improving patient safety, ensuring effective hemodialysis care, and achieving better clinical outcomes. Strengthened nursing competence ultimately contributes to improved quality of care and overall well-being for patients undergoing hemodialysis.

References

1. Ahmed, A. M., Ali, S. R., & Hassan, M. H. (2020). Nurses' knowledge and practice regarding hemodialysis care. *Journal of Renal Nursing, 12*(3), 145–152.
2. Alikari, V., Fradelos, E. C., Tsaras, K., Papatheanasiou, I. V., & Zyga, S. (2019). Hemodialysis nursing care and patient outcomes: A systematic review. *International Journal of Nursing Practice, 25*(2), e12719.
3. Bello, A. K., Levin, A., Tonelli, M., Okpechi, I. G., Feehally, J., Harris, D., & Jindal, K. (2017). Assessment of global kidney health care status. *The Lancet, 390*(10105), 164–173.
4. Daugirdas, J. T., Blake, P. G., & Ing, T. S. (2018). *Handbook of dialysis* (5th ed.). Wolters Kluwer.
5. Feroze, U., Molnar, M. Z., Dukkipati, R., Kovesdy, C. P., Kalantar-Zadeh, K. (2017). Insights into dialysis complications and nursing management. *Seminars in Dialysis, 30*(3), 229–236.
6. Himmelfarb, J., & Ikizler, T. A. (2020). Hemodialysis. *New England Journal of Medicine, 383*(19), 1833–1845.
7. Hussein, W. F., Bennett, P. N., & Costello, S. (2018). Dialysis nursing competencies and patient safety. *Nephrology Nursing Journal, 45*(1), 23–31.
8. Ibrahim, S. A., Mohammed, R. A., & Abdelrahman, S. M. (2022). Factors affecting nurses' practice in hemodialysis units. *BMC Nursing, 21*, 312.
9. Jager, K. J., Kovesdy, C., Langham, R., Rosenberg, M., Jha, V., & Zoccali, C. (2017). Chronic kidney disease epidemiology. *Kidney International Supplements, 7*(2), 1–59.
10. Kalantar-Zadeh, K., Lockwood, M. B., Rhee, C. M., Tantisattamo, E., & Kovesdy, C. P. (2021). Patient-centered approaches in dialysis care. *American Journal of Kidney Diseases, 77*(2), 276–285.
11. Lok, C. E., Huber, T. S., Lee, T., Shenoy, S., Yevzlin, A. S., Abreo, K., & KDOQI Work Group. (2020). Vascular access care in hemodialysis. *Clinical Journal of the American Society of Nephrology, 15*(3), 449–458.
12. Lopes, A. A., Bragg-Gresham, J. L., Goodkin, D. A., Fukuhara, S., Mapes, D. L., Young, E. W., & Port, F. K. (2019). Dialysis care, practice patterns, and outcomes. *American Journal of Kidney Diseases, 73*(3), 390–399.
13. Luyckx, V. A., Tonelli, M., & Stanifer, J. W. (2021). The global burden of kidney disease. *The Lancet, 398*(10302), 786–802.
14. Mollaoglu, M., Kayatas, M., & Yilmaz, E. (2017). Quality of nursing care in hemodialysis units. *Journal of Clinical Nursing, 26*(23–24), 4441–4449.
15. Nguyen, D. B., Shugart, A., Lines, C., Shah, A. B., Edwards, J., Pollock, D., & Patel, P. R. (2017). Infection prevention in dialysis facilities. *Clinical Infectious Diseases, 65*(5), 760–766.
16. Ong, S. W., Jassal, S. V., Miller, J. A., & Garg, A. X. (2019). Dialysis safety and nursing surveillance. *Kidney International Reports, 4*(4), 557–566.
17. Polaschek, N. (2016). Living on dialysis: Nurses' role in patient adaptation. *Journal of Renal Care, 42*(1), 3–10.
18. Saran, R., Robinson, B., Abbott, K. C., Agodoa, L. Y. C., Bhave, N., Bragg-Gresham, J., & Shahinian, V. (2020). US Renal Data System report. *American Journal of Kidney Diseases, 75*(1 Suppl 1), S1–S64.
19. Sullivan, C., Sayre, S. S., Leon, J. B., Machekano, R., Love, T. E., Porter, D., & Finkelstein, F. O. (2019). Patient education and outcomes in dialysis. *Clinical Journal of the American Society of Nephrology, 14*(5), 720–729.
20. Thomas-Hawkins, C., & Flynn, L. (2019). Hemodialysis nursing practice and patient outcomes. *Nephrology Nursing Journal, 46*(2), 131–138.
21. Twardowski, Z. J. (2017). Complications of hemodialysis. *Seminars in Dialysis, 30*(6), 497–502.

22. Vanholder, R., Annemans, L., Brown, E., Gansevoort, R., Gout-Zwart, J. J., Lameire, N., & Zoccali, C. (2017). Reducing the costs of chronic kidney disease. *The Lancet*, 389(10075), 1066–1078.
23. Wang, C., Kane, R. L., Xu, D., & Li, Q. (2020). Nursing workload and dialysis outcomes. *Journal of Nursing Management*, 28(5), 1045–1053.
24. Wong, B., Ravani, P., Oliver, M. J., Holroyd-Leduc, J., Straus, S., & Tonelli, M. (2017). Care delivery models in dialysis. *American Journal of Kidney Diseases*, 69(4), 493–502.
25. World Health Organization. (2020). *Improving the prevention, diagnosis and management of chronic kidney disease*. WHO.
26. Yeh, S. C. J., Huang, C. H., & Chou, H. F. (2018). Nursing competence and patient safety in dialysis units. *Journal of Nursing Research*, 26(6), 403–411.
27. Zyga, S., Alikari, V., Sachlas, A., Stathoulis, J., Aroni, A., Theofilou, P., & Panoutsopoulos, G. (2018). Management of complications in hemodialysis patients. *Health Psychology Research*, 6(1), 7277.