# Quality improvement in hemodialysis: A systematic review

## Amélioration de la qualité en hémodialyse: Une revue systématique

Abdelmounir El bachiri[1], Intissar Haddiya[1,2]

1. Laboratory of Epidemiology, Clinical Research and Public Health, Faculty of Medicine and Pharmacy of Oujda, University Mohammed First
2. Department of Nephrology, Mohammed VI University Hospital, Oujda, Morocco

**Abstract**

The predominant modality of renal replacement therapy, hemodialysis (HD), is a specialized area associated with a heightened susceptibility to infections, partly due to patients' vulnerability, the invasiveness of procedures necessitating vascular access, and the cyclical nature of the treatment. These factors, along with a notable incidence of infections, present a significant public health challenge owing to their implications on both human health and economic resources.

Mortality rates in dialysis patients are markedly elevated, typically ranging from 10 to 20%, primarily linked to cardiovascular (40%) and infectious (10%) etiologies. Enhancing the caliber of care, patient safety, and clinical outcomes represents a pivotal focal point for healthcare systems globally. Nevertheless, could the adherence to universally acknowledged and validated benchmarks engender variability in outcomes within hemodialysis environments? Can interventions aim at improving quality lead to positive outcomes by reducing infections and improving results for patients undergoing hemodialysis? To respond to these inquiries, a systematic review based on the PRISMA guidelines was carried out over 14 years across various databases, identifying cases of quality improvement initiatives and detailing their effectiveness in infection prevention and quality-centred approaches to risk management. Multiple forms of interventions aimed at enhancing quality have been outlined and considered relevant, including (i) integrating the PDCA (Plan-Do-Check-Act) cycle with oversight of risk factors, (ii) utilizing the Failure Mode, Effects, and Criticality Analysis (FMECA) framework, (iii) applying LEAN management principles, and (iv) strictly following the guidelines established by the Centers for Disease Control and Prevention (CDC) and the kidney disease: Improving Global Outcomes (KDIGO). Adopting these quality approaches has significantly reduced infection rates in hemodialysis contexts.

However, these quality improvement interventions are elementary and not comprehensive, with limited long-term effectiveness. A comprehensive management initiative must therefore bring together successful improvement practices, pertinent methodologies, and current quality standards to establish an integral management system based on quality control, quality assurance, and continuous improvement.

**Key words**: Quality improvement - Hemodialysis - Infections

**Résumé**

L'hémodialyse, modalité prédominante de la thérapie de remplacement rénal, est une spécialité associée à une susceptibilité accrue aux infections et, constitue un problème majeur de santé publique en raison de l'incidence des infections dans les milieux d'hémodialyse. Les taux de mortalité chez les patients dialysés sont plus élevés. Ils varient entre 10 et 20%, attribués à des causes cardiovasculaires (40 %) et infectieuses (10 %).

La recherche constante de management et de l'amélioration de la qualité des soins, de la sécurité des patients et des résultats cliniques est au cœur des préoccupations des systèmes de santé mondiaux, dans ce contexte, l'adoption des normes de références validées peut-il contribuer à la variabilité des résultats dans les milieux d'hémodialyse ? y a-t-il un apport positif de l'adoption de la qualité dans la réduction des infections et l'amélioration des résultats pour les patients ?

Pour ceci une revue systématique basée sur le protocole PRISMA a été menée sur une période de plus 14 ans, dans différentes bases de données, pour identifier les expériences d'interventions d'amélioration de la qualité, et de présenter les données probantes sur l'impact de ces interventions dans la prévention des infections ainsi les approches qualité de gestion des risques associés.

Plusieurs types d'interventions ont été identifiée pertinentes, notamment (i) l'adoption du cycle PDCA associé à la gestion des facteurs de risque , (ii) l'utilisation du système FMECA (iii) l'application des principes de LEAN management, et (iv) le respect des directives CDC et KDIGO, l'adoption de ces approches ont contribués de façon significative à la réduction des taux d'infections dans les milieux d'hémodialyse.

Néanmoins, ces interventions restent élémentaires , dont l'efficacité à long terme est limitée. De ce fait une initiative de gestion globale doit réunir les pratiques d'amélioration , les méthodologies pertinentes et les normes de qualité pour établir un système de gestion intégral basé sur les principes du contrôle qualité, de l'assurance qualité et ceux de l'amélioration continue.

**Mots clés**: Management de la qualité - Amélioration de la qualité - Hémodialyse – Infections

Correspondance
Abdelmounir El bachiri
Laboratory of Epidemiology, Clinical Research and Public Health, Faculty of Medicine and Pharmacy of Oujda, University Mohammed First
Email: mounirbachiry@gmail.com

LA TUNISIE MEDICALE-2025; Vol 103 (05): 531-537 DOI: 10.62438/tunismed.v103i5.5567

## Introduction

Hemodialysis (HD) is the primary method of renal replacement therapy (1), where the blood filtering function of the kidney is supplemented by artificial machinery, eliminating surplus water, solutes, and toxins, and maintaining homeostasis in individuals with a sudden or extended decline in renal function. This serves as a strategy to address sudden kidney damage, to provide a temporary solution until kidney transplantation can be carried out, or to aid individuals who are not suitable for one. Higher mortality rates are observed in individuals undergoing dialysis in the younger age brackets, with cardiovascular (40%) and infectious (10%) causes being the main factors (2).

Hemodialysis is a specialty with a high risk of infection, due in part to the fragility of the patients, and the invasive procedures (3) involving vascular access and the periodic nature of the hemodialysis procedure also contribute to a significant incidence of infection as a complication (4). This incidence constitutes a major public health problem, due to its impact on human health and economic resources (5).

The frequency of infections in dialysis patients is 100 times higher than in the general population (6), exposing these patients to a high cumulative risk of diseases, including bloodstream infections, vascular access infections, and blood-borne infections (5).

An investigation project in Morocco, conducted from May to August 2018 at the Ibn Sina Hospital in Rabat, using the Failure Mode, Effect, and Criticality Analysis (FMECA) methodology to assess and manage infectious risks in hemodialysis facilities, identified twenty-eight failure modes related to the hemodialysis procedure (4) increasing the risk of infection and complicating the control of critical points in this process.

The indispensable measures for controlling infections, such as routine sanitation and supervision, serological monitoring, and quarantine guidelines, are advised as proactive strategies against infection in hemodialysis establishments (5). However, the fatality rate of individuals undergoing hemodialysis, ranging from 10 to 20%, with infections contributing to approximately 2% of cases, poses a significant challenge to public health (1). Furthermore, the existing model of hospital administration, primarily centered on financial efficacy, where principles are disregarded (7), necessitates further investigation, posing numerous inquiries, notably regarding the identification of pivotal checkpoints linked to infectious hazards in the hemodialysis procedure and the formulation of a plan for administering secure, top-notch healthcare, all the while ensuring consistent, enduring mitigation of potential risks.

The constant quest to improve the quality of care is at the heart of the concerns of healthcare systems worldwide. Several studies have shown that multidimensional quality improvement interventions in hemodialysis settings have the potential to prevent bloodstream infections, particularly those associated with catheters (8), however, the absence of universally accepted standards and benchmarks contributes significantly to the variability of results observed in different contexts (1), which significantly hinders the comparison of performance between healthcare organizations (9).

Guideline-based quality indicators are crucial to ensuring appropriate care for hemodialysis patients (10), so monitoring these indicators is essential to achieving set targets, increasing survival rates, and reducing hospitalizations among dialysis patients (11).

This systematic review aims to identify experiences of quality improvement interventions, and present evidence on the role of these interventions in infection prevention and associated quality risk management approaches. The ultimate goal is to contribute to the development of an integral, robust, and sustainable quality management system, aimed at reintroducing quality principles into hospital management, preventing infections, and managing infectious risks, particularly in hemodialysis centers.

## Methods

We adopted a rigorous methodology based on PRISMA recommendations. Searches were carried out independently by two people on the PubMed, PMC, Science Direct, Scopus and Cochrane Library databases, using specific keywords, without language restriction, in the titles, abstracts or keywords of documents in the period between 01 January 2010 and 29 February 2024 (Table 1).

**Table 1.** Search terms

| | |
|---|---|
| Tentative 1: | «Quality improvement» OR «quality management» AND «hemodialysis» OR «renal dialysis» AND «prevention» AND «infection» OR «infectious risk» |
| Tentative 2: | «Quality system» OR « Quality management» OR «quality system» AND «dialysis centers» OR «hospital» |

All reviews, systematic reviews, meta-analyses, articles, books, or scientific documents available in full-text form and containing the search keywords were included, however, documents not available in full-text or those whose content did not correspond to the objectives of this research were excluded (Figure 1).

The full texts of the selected studies were examined to identify the methodology, synthesis of principal results, effect measures, recommendations and assessing risk of bias for each study. Risk of bias was assessed using the ROBIS and JBI method. Only results that had a direct and/or indirect relationship with the objectives of this review were retained.

A literature search was conducted by two individuals (H.I and E.A) in five databases (PubMed, PMC, Science Direct, Scopus, and Cochrane Library) between 01/01/2010 and 29/02/2024 to reveal 4664 titles. After removing duplicate articles, and reviewing titles and abstracts, 4,575 articles were excluded on the grounds of non-availability in full text or incoherence of content with research objectives. The 89 articles selected were examined in full text, and 75 articles were subsequently rejected because the data did not meet the specific inclusion criteria. (Figure 1)

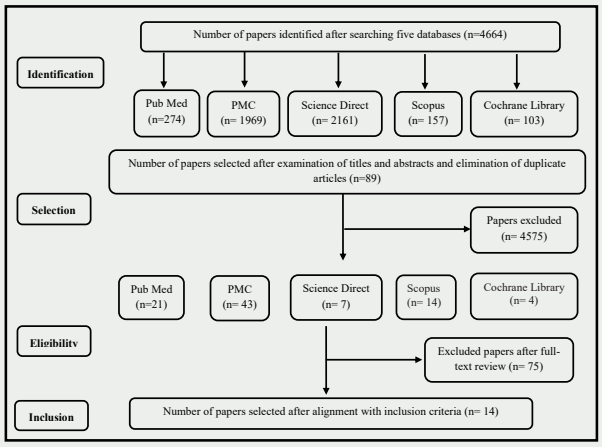


**Figure 1**. Study selection chart.

## Results

Several types of studies were included, principally meta-analyses, systematic reviews, cohort studies, retrospective, empirical and other perspectives on interventions to improve quality of care and outcomes for patients in hemodialysis environments (Table 2).

## Discussion

We conducted a systematic review to determine the impact of quality improvement interventions on decreasing infection rates and their importance for infection prevention in hemodialysis settings. Fourteen studies were included, comprising both quantitative and qualitative information, describing quality improvement practices, approaches and methods for the management, and prevention, of infections in hemodialysis units. These efforts aim to deliver high-quality healthcare services and improve patient safety through proactive and preventive infection control approaches.

CQI processes, as seen in Australia and New Zealand, have significantly improved peritonitis outcomes by integrating expert recommendations and financial incentives. State approval of this process has led to a significant improvement in peritonitis outcomes, attributed to the successful implementation of continuous quality improvement initiatives. These initiatives mainly involved the development of peritonitis-specific key performance indicators (KPIs), the provision of financial incentives to achieve KPIs and local quality improvement protocols tailored to address clinical challenges (16), In similar circumstances, Yu and al conducted a 6-year retrospective analysis with a test and control cohort. Their results indicated that CQI interventions demonstrated a beneficial effect on improving clinical outcomes, such as reducing the incidence of peritonitis and increasing survival rates in people on dialysis (22).

The implementation of uniform standards in hemodialysis centers is essential to mitigate infections and limit their spread among people undergoing dialysis. (20). Adherence to CDC core interventions and KDIGO guidelines has been shown to improve patient outcomes, reduce infection-related morbidity, and achieve zero preventable infections when implemented collaboratively by healthcare teams(17-19).

Three systematic reviews, comprising a total of 56 articles, examined the effectiveness of quality improvement interventions in preventing catheter-associated infections, outside intensive care units, in hemodialysis centers and in non-dialyzed chronic kidney disease patients. The consensus from these reviews indicated that the implementation of quality improvement measures was effective in preventing catheter-related infections (9), reducing the incidence of dialysis (13) and improving safety in hemodialysis facilities, subject to the successful implementation of quality practices (15).

However, the effectiveness of these multidimensional quality improvement interventions is considered to be of inferior quality, mainly due to insufficient empirical evidence, small sample sizes and relatively short study periods, as well as significant discrepancies in the assessment of risk of bias. As a result, the generalizability of results is limited, underlining the need for future research initiatives characterized by greater empirical rigor.

A meta-analysis of 43 studies involving 584 intensive care units further confirmed the efficacy of quality improvement interventions on the prevention of central line bloodstream infections in intensive care units expressed by a favorable change in slope and infection levels ranging from 3 to 24 months post-intervention. This mainly involved the implementation of care bundles or checklists alongside other quality improvement interventions (21).

Three papers (14,23,24), have highlighted that the increasing number of hemodialysis patients in a context of limited resources has prompted the search for innovative and sustainable approaches to provide high-quality care, improve patient safety and mitigate unforeseen events in various hospital units. These mainly involve the use of process mapping techniques, the creation of balanced scorecards, the application of ¨Lean management¨ principles (14), which is a managerial approach that aims to simplify processes by reducing non-value-added time, causes of non-quality and complexity, while improving the quality and productivity of dialysis facilities.

Chen and al, explored an alternative approach and concluded that it was possible to improve quality of care and reduce infection and irregular event rates by incorporating the PDCA (Plan-Do-Check-Act) cycle of risk factor management into care processes (23). In addition, the use of FMECA is crucial to improving patient safety in hemodialysis, leading to a reduction in the incidence of complications and adverse events often linked to infections (24).

Metcalf and al highlighted an additional pragmatic consideration for improving healthcare quality through a study of 101 hospital units in the USA. They determined that in healthcare settings, the interpersonal dimension of quality, exemplified by the empowerment of staff members, is a crucial factor for true quality improvement in hospital units. This empowerment requires organizational support, training of healthcare providers, promotion of decentralized decision-making and improved communication for better results (24).

**Table 2.** Studies included in the review

| Reference | Methodology | Summary of results | Effect measurement | Limitations | Risk of bias assessment according to ROBIS(*) or JBI(**) Tools |
|---|---|---|---|---|---|
| (8)<br>(Lazarus and *al.*, 2023) | Systematic review including 21 studies (2 randomized cluster trials, 3 time-series analyses and 16 before-and-after studies) | Quality improvement initiatives have proven effective in preventing catheter-associated infections outside intensive care units, with positive outcomes; | More than 90% of selected studies showed a favorable effect of multidimensional quality improvement interventions on the incidence of bloodstream infections related to vascular access. | Limited high-quality evidence from the studies that were included.<br>More research is needed to confirm and generalize these results. | Moderate (*) |
| (12)<br>(Silver and *al.*, 2017) | Systematic review of 15 randomized and cluster randomized trials (n = 3298 patients) and six cluster randomized trials (n = 30042 patients) | Quality improvement interventions in CKD patients not requiring dialysis had positive effects on reducing the incidence of dialysis and LDL cholesterol concentrations, and on the likelihood of patients receiving renin-angiotensin-aldosterone system inhibitors.<br>The main interventions were patient self-management and education, training of healthcare staff, auditing and feedback, and the use of electronic patient registers. | Significant reduction in the incidence of dialysis (RR, 0.85; 95% CI, 0.74 to 0.97; $Je^2$=0%), and in LDL cholesterol concentrations (MD, -17.6 mg/dl; 95% CI, -28.7 to -6.5; $Je^2$=75%). | Quality improvement strategies were of limited effectiveness. The authors were unable to include data from seven CKD subgroup studies due to small patient numbers. The gaps in the literature affected the generalizability of the results | Moderate (*) |
| (13)<br>(Hingwala and *al.*, 2015) | Review article | The creation of balanced scorecards, the use of process mapping techniques and the application of LEAN management principles can easily improve hemodialysis care in a context of increasing patient numbers and reduced operating resources. | These tools have been adopted to improve the quality and efficiency of care in hemodialysis units. Controlling processes has helped to reduce costs and improve patient satisfaction with fewer resources. | The difficulties of maintaining quality while increasing the number of patients limits the application of these tools and methods. | Low (**) |
| (14)<br>(Albreiki and *al.*, 2023) | Systematic review including 17 papers from six countries between 2010 and 2020. | The successful application of quality practices including training nurses on the technologies used in hemodialysis treatment, adopting proactive risk identification tools to prevent infections, root cause analysis in error assessment, implementation of the hemodialysis checklist to reduce adverse events, effective communication and mutual trust between employee and administration improve the safety culture and prevent infections in hemodialysis environments. | Applying these strategies prevents infections in hemodialysis units and enhances patient safety | Limited empirical evidence exists regarding the actual impact on long-term patient outcomes.<br>Some studies have used small samples, which may affect the validity of the conclusions. | Moderate (*) |
| (15)<br>(Nataatmadja and *al.*, 2016) | The data were collected from the ANZDATA registry between 2005 and 2014 | In Australia and New Zealand, the implementation of continuous quality improvement (CQI) processes based on expert advice at local and national levels has led to a sustainable reduction in peritonitis rates | A decrease in peritonitis frequencies of approximately one-third was documented over a span of five years (2009-2014). The variation in peritonitis rates between centers was reduced by roughly fifty-four percent (54%) during the corresponding duration. | Wide variability in compliance with guideline recommendations<br>Definitions used to count infections were inconsistent | Moderate (**) |
| (16)<br>(Fisher and *al.*, 2020) | | The CDC (Centers for Disease Control and Prevention) recommendations for the prevention of bloodstream infections are the gold standard for catheter-based care in hemodialysis, and have proven effective in reducing catheter-associated bloodstream infection.<br>However, non-compliance with aseptic techniques can still contribute to infection rates, indicating that new prophylactic therapies are essential to control infectious risks. | A reduction of 20% to 50% in bloodstream infection rates and sepsis-related hospitalizations has been documented. | This study does not examine in depth the feasibility of widespread adoption, nor the constraints of implementing new prophylactic therapies in hemodialysis centers, beyond CDC's core interventions. | Low (**) |
| (17)<br>(Drozdz and *al.*, 2021) | Prospective multicenter study including patients (n = 3462) treated at 56 DaVita dialysis centers in Poland and Portugal | This study indicates that using medical protocols in line with KDIGO (kidney Disease: Improving Global Outcomes) guidelines ensures significant improvements in quality of care, which may correspond to better patient outcomes | Significant improvements in the quality of care provided to hemodialysis patients, including improved dialysis adequacy, increased serum albumin, better control of anemia and increased use of the arteriovenous fistula. | The study did not explore the long-term sustainability of these improvements beyond the 6-month period, indicating a potential limitation in assessing the sustainability of interventions | Moderate (**) |
| (18)<br>(Vijayan & Boyce, 2018) | Narrative review | Infection acquisition in hemodialysis facilities is often due to suboptimal infection control practices<br>100% use of recommended infection control guidelines is essential to prevent infections in this vulnerable population.<br>Adherence to CDC infection control practice guidelines by nephrologists, in collaboration with administration and nursing staff, can lead to zero preventable infections and reduce infection-related morbidity and mortality | A significant reduction in vascular access-related bloodstream infections and an improvement in infection control practices have been documented. | The feasibility of the proposed strategies has not been tested.<br>The generalizability of the results is limited only to hemodialysis environments. | Low (**) |

**Table 2.** Studies included in the review

| Reference | Methodology | Summary of results | Effect measurement | Limitations | Risk of bias assessment according to ROBIS(*) or JBI(**) Tools |
|---|---|---|---|---|---|
| (19)<br>(Sola and *al.*, 2020) | Retrospective qualitative-analytical study | Analysis of the guidelines established in high-income countries over the last 30 years has helped define minimum and optimum safety and quality standards for dialysis care. The implementation of these standardized norms in hemodialysis facilities is essential to reduce infections. Monitoring infection rates and adhering to universal precautions can prevent their spread.<br>By monitoring infection rates and adhering to universal precautions, we can prevent their spread. | The increased respect for evidence-based guidelines results in safer and more efficient dialysis practices, and contributes to improving the total quality of care and patient safety. | The paper does not address specific details regarding the challenges of implementing, monitoring and maintaining universal standards for dialysis care in low- and middle-income countries. | Moderate (**) |
| (20)<br>(Perl and *al.*, 2014) | Meta-analysis of 43 studies in 584 intensive care units Including before-and-after, interrupted time-series and controlled before-and-after studies, ranging from nine to 180 months in duration | The results indicated a decrease in central line-associated bloodstream infection (CLABSI) rates in intensive care units with quality improvement interventions in 41 before-and-after studies.<br>Among the most effective interventions to reduce infection rates were the implementation of care bundles, adherence to infection control practices, implementation of mandatory reporting laws on CLABSI to improve infection control practices alongside other clinical interventions. | By focusing on evidence-based quality improvement initiatives, healthcare providers can optimize the quality of care, minimize patient morbidity, shorten hospital stays and improve the overall quality of healthcare services. | The variation in the effectiveness of quality improvement interventions limits the generalizability of results.<br>No details of interventions, which may have an impact on the overall evaluation of interventions | Low (*) |
| (21)<br>(Yu and *al.*, 2014) | Retrospective study over 6 years | The impact of continuous quality improvement (CQI) initiatives on clinical outcomes was assessed by comparing data from a control group (July 1, 2005 to June 30, 2008) with data from a CQI group (July 1, 2008 to June 30, 2011).<br>The peritonitis rate was significantly lower in the CQI group than in the control group, and patient survival was significantly higher in this group. | A significant reduction in peritonitis in the CQI group, from 1 episode in 22.86 patient-months to 1 episode in 77.25 patient-months.<br>A significant improvement in patient survival at 1, 2 and 3 years in the CQI group (97.3%, 96.3% and 96.3%) compared with the control group (92.6%, 82.4% and 67.3%) ($p < 0.001$). | The research focused on a single center, which could limit the generalizability of results to other contexts. | Moderate (**) |
| (22)<br>(Chen and *al.*, 2022) | A comparative study involving a conventional group of 150 patients and a research group (150 patients), between November 2020 and June 2021 in a hospital in China. | A comparative study was conducted to evaluate the effect of applying plan-do-check-action (PDCA) cycle management combined with risk factor management on reducing infection rates in the operating room.<br>PDCA cycle management, combined with risk factor monitoring, can reduce incisional infection rates and the incidence of irregular events, improve qualified disinfection rates and improve the quality of nursing care. | In the conventional and research groups respectively, a significant improvement was observed in the detection rate of pathogenic bacteria (16.66% vs. 5.33%), the rate of infection by incision (11.33% vs. 4.00%), the rate of qualified disinfection of staff hands (25.33% vs. 94.00), and the rate of occurrence of irregular events (9.37% vs. 3.38%) ($p<0.05$). | The monocentric nature and short duration of the study limit the observation of long-term effects and variations, as well as the generalization of outcomes. | Moderate (**) |
| (23)<br>(Arenas Jiménez and *al.*, 2017) | A retrospective study analysing records of 1303 hemodialysis sessions (97 patients) over a one-month period (Spain, 2015). | Implementation of the Failure Mode Effect Criticality Analysis (FMECA) system helps to improve patient safety during hemodialysis sessions, reducing the occurrence of complications and adverse effects, often linked to infections. | Improvement of patient safety through failure identification, risk management and prevention of future errors during hemodialysis operations. | The lack of real-time monitoring and feedback mechanisms within the FMECA system could limit its ability to provide immediate alerts during hemodialysis sessions, which could hamper rapid responses to emerging failures. | Moderate(**) |
| (24)<br>(Metcalf and *al.*, 2018) | Empirical study analysing data collected via validated managers' and clinicians' surveys from 101 hospital units in the U.S. | While quality practices are important, employee empowerment has been identified as an essential element for true quality improvement in hospital units.<br>In healthcare institutions, the social aspect of quality management, exemplified by empowering employees through (i) organizational support (ii) educating care providers (iii) encouraging decentralized decision-making (iv) overcoming communication barriers, was found to be essential for improving outcomes. | An improvement in clinical outcomes for patients and promotion of compliance with standards have been demonstrated by the implementation of healthcare programs such as "Assess and Treat", which focus on the application of care protocols and employee empowerment. | The sample size (n=168) is relatively small and could affect the generalizability of the results.<br>The cross-sectional view of the data makes it difficult to understand the long-term effects of empowerment and quality programs on hospital unit outcomes. | Hight (**) |

The interventions identified in these studies concern various aspects. These include (i) changes to the healthcare system, through case management, team restructuring, and the use of electronic patient registers (13), (ii) education and training of healthcare professionals and patients (13,15), (iii) process improvement through the creation of balanced scorecards, the use of process mapping techniques and the application of LEAN management principles (14), (iv) infection prevention and patient safety through the use of proactive risk identification tools , root cause analysis for error assessment, use of the hemodialysis checklist to reduce adverse events, and effective communication and mutual trust between staff and management to improve the safety culture (15), (v) implementation of Key Performance Indicators (16), (vi) management of the PDCA cycle combined with risk factor management (23), and (vii) analysis of failure modes and their effects and criticality (24).

These interventions are foundational but lack comprehensive coverage of total quality management. Limited evidence on their long-term effectiveness may hinder widespread adoption

Implementing continuous quality improvement (CQI) initiatives in hemodialysis units requires a comprehensive approach that integrates proven improvement practices, relevant quality methodologies and tools, and current quality standards.

This systematic review confirms the positive impact of CQI initiatives on the reduction of hemodialysis-associated infections. However, geographical, economic and structural differences between healthcare systems significantly influence the implementation and sustainability of these interventions. The reviewed studies from different contexts (Australia, China, USA, New Zealand) reveal different challenges depending on the local context. In China, for example, the introduction of peritoneal dialysis has historically been hampered by unfavorable reimbursement policies and a lack of infrastructure, necessitating low-cost improvement interventions (21). Conversely, in centralized systems such as Australia, standardized national programs supported by key performance indicators and financial incentives have homogenized practices (15).

The structure of health care systems also plays a key role. Centralized models, such as Australia, facilitate the integration of CQI initiatives through national data registries, while decentralized systems, such as the US, rely on local initiatives, leading to heterogeneous results. Funding mechanisms have a direct impact on sustainability: while Australia uses bonuses linked to key indicators, China has had to resort to alternative solutions (free training, intensive monitoring) due to budgetary constraints. The sustainability of CQI programs is highly dependent on their integration into clinical workflows. The Australian example, where monthly meetings embed CQI into the routine, contrasts with the challenges faced in under-resourced centers, where simplified protocols (e.g., visual checklists) are more appropriate.

In addition, leadership support is essential to sustaining CQI efforts, including allocating resources, recognizing and rewarding staff contributions, and promoting the importance of continuous improvement.

However, CQI program implementation faces challenges such as high costs for infrastructure and training, insufficient staff expertise in quality improvement principles, and organizational barriers like resistance to change or poor communication

Finally, explicit recognition of systemic inequities is essential to ensure effective implementation of CQI initiatives. A comprehensive strategy that combines international standards and contextual adaptations, involves staff in planning, and fosters transparent communication is critical to ensuring equitable and sustainable hemodialysis care beyond short-term outcomes.

## Conclusion

Hemodialysis, the main modality of renal replacement therapy, is a specialty with a high risk of infection, mainly attributed to the vulnerability of patients and the need for invasive procedures for vascular access. Moreover, the periodic nature of this procedure contributes to a significant incidence of infections, thus constituting a major public health problem.

In this review, we have tried to identify what exists in terms of quality in hemodialysis settings, and to illustrate the main quality improvement interventions by identifying their impact on infection prevention, quality of care and patient safety.

Several quality methods were recognized as relevant to reducing infections and improving patient outcomes and safety, including the adoption of the PDCA cycle associated with risk factor management, the use of the Failure Mode, Effects and Criticality Analysis (FMEA) system, the application of LEAN management principles, and rigorous adherence to the guidelines set out by the CDC and KDIGO . The goal of zero preventable infections can be achieved by reducing morbidity and mortality in hemodialysis settings through 100% application of these guidelines.

Nevertheless, the quality improvement interventions studied are elementary and not exhaustive, with limited long-term effectiveness. A comprehensive management initiative must therefore bring together successful improvement practices, relevant methodologies and current quality standards to establish an integral management system based on the principles of quality control, quality assurance and continuous improvement.

Future research efforts could draw valuable information from this review by exploring total quality management in hemodialysis centers while ensuring optimal risk management, process control, and long-term continuous improvement.

## References


1. A. K. Bello and al., « Epidemiology of hemodialysis outcomes », Nat Rev Nephrol, vol. 18, no 6, p. 378-395, 2022, doi: 10.1038/s41581-022-00542-7.
2. H. N. Murdeshwar and F. Anjum, « Hemodialysis », in StatPearls, Treasure Island (FL): StatPearls Publishing, 2024. Consulté le: 29 février 2024. [En ligne]. Disponible sur: http://www.ncbi.nlm.nih.gov/books/NBK563296/
3. É. Laprugne-Garcia and S. Gardes, « [The infection risk assessment visit in hemodialysis, a new tool] », Soins, vol. 62, no 813, p. 17-19, mars 2017, doi: 10.1016/j.soin.2017.01.003.
4. S. El Marnissi and al., « Analyse du risque infectieux autour du patient dans l'unité d'hémodialyse de l'hôpital Ibn Sina de Rabat par application de la méthode d'analyse des modes de défaillance, de leurs effets et de leur criticité », Néphrologie & Thérapeutique, vol. 16, no 2, p. 105-117, mars 2020, doi: 10.1016/j.nephro.2019.09.005.
5. D. B. Nguyen, M. J. Arduino, and P. R. Patel, « Hemodialysis-Associated Infections », in Chronic Kidney Disease, Dialysis, and Transplantation (Fourth Edition), J. Himmelfarb and T. A. Ikizler, Éd., Philadelphia: Elsevier, 2019, p. 389-410.e8. doi: 10.1016/B978-0-323-52978-5.00025-2.
6. S. Beaudreuil, H. Hebibi, B. Charpentier, and A. Durrbachr, « Les infections graves chez les patients en dialyse péritonéale et en hémodialyse chronique conventionnelle : péritonites et infections de la voie d'abord vasculaire », Réanimation, vol. 17, no 3, p. 233-241, mai 2008, doi: 10.1016/j.reaurg.2008.01.014.
7. J.-É. Bazin, « Tomorrow's hospital management », Oxymag, vol. 34, no 181, p. 15-17, 2021, doi: 10.1016/j.oxy.2021.09.005.
8. B. Lazarus, E. Bongetti, J. Ling, M. Gallagher, S. Kotwal, and K. R. Polkinghorne, « Multifaceted Quality Improvement Interventions to Prevent Hemodialysis Catheter-Related Bloodstream Infections: A Systematic Review », Am J Kidney Dis, vol. 82, no 4, p. 429-442.e1, oct. 2023, doi: 10.1053/j.ajkd.2023.02.006.
9. J. Z. Breyer and al., « Hospital quality indicators: a systematic review », International Journal of Health Care Quality Assurance, vol. 32, no 2, p. 474-487, janv. 2019, doi: 10.1108/IJHCQA-04-2018-0091.
10. H. Lazareth and al., « Quality indicators in hemodialysis: A 5-year experience of national campaigns in France », Seminars in Dialysis, vol. 35, no 6, p. 511-521, 2022, doi: 10.1111/sdi.13095.
11. S. Grangé, M. Hanoy, F. Le Roy, D. Guerrot, and M. Godin, « Monitoring of hemodialysis quality-of-care indicators: why is it important? », BMC Nephrol, vol. 14, p. 109, mai 2013, doi: 10.1186/1471-2369-14-109.
12. S. A. Silver and al., « Effectiveness of Quality Improvement Strategies for the Management of CKD », Clin J Am Soc Nephrol, vol. 12, no 10, p. 1601-1614, oct. 2017, doi: 10.2215/CJN.02490317.
13. J. Hingwala, N. Tangri, C. Rigatto, and P. Komenda, « Improving the quality and efficiency of conventional in-center hemodialysis », Semin Dial, vol. 28, no 2, p. 169-175, 2015, doi: 10.1111/sdi.12347.
14. S. Albreiki and al., « A Systematic Literature Review of Safety Culture in Hemodialysis Settings », J Multidiscip Healthc, vol. 16, p. 1011-1022, 2023, doi: 10.2147/JMDH.S407409.
15. M. Nataatmadja, Y. Cho, and D. W. Johnson, « Continuous Quality Improvement Initiatives to Sustainably Reduce Peritoneal Dialysis-Related Infections in Australia and New Zealand », Perit Dial Int, vol. 36, no 5, p. 472-477, sept. 2016, doi: 10.3747/pdi.2016.00114.
16. M. Fisher, L. Golestaneh, M. Allon, K. Abreo, and M. H. Mokrzycki, « Prevention of Bloodstream Infections in Patients Undergoing Hemodialysis », Clin J Am Soc Nephrol, vol. 15, no 1, p. 132-151, janv. 2020, doi: 10.2215/CJN.06820619.
17. M. Drozdz and al., « Improvements in six aspects of quality of care of incident hemodialysis patients – a real-world experience », BMC Nephrol, vol. 22, p. 333, oct. 2021, doi: 10.1186/s12882-021-02529-1.
18. A. Vijayan and J. M. Boyce, « 100% Use of Infection Control Procedures in Hemodialysis Facilities », Clin J Am Soc Nephrol, vol. 13, no 4, p. 671-673, avr. 2018, doi: 10.2215/CJN.11341017.
19. L. Sola and al., « Development of a framework for minimum and optimal safety and quality standards for hemodialysis and peritoneal dialysis », Kidney Int Suppl (2011), vol. 10, no 1, p. e55-e62, mars 2020, doi: 10.1016/j.kisu.2019.11.009.
20. T. M. Perl, K. Blot, J. Bergs, D. Vogelaers, S. Blot, and D. Vandijck, « Prevention of Central Line–Associated Bloodstream Infections Through Quality Improvement Interventions: A Systematic Review and Meta-analysis », Clin Infect Dis, vol. 59, no 1, p. 96-105, juill. 2014, doi: 10.1093/cid/ciu239.
21. Y. Yu and al., « Impact of Continuous Quality Improvement Initiatives on Clinical Outcomes in Peritoneal Dialysis », Perit Dial Int, vol. 34, no Suppl 2, p. S43-S48, juin 2014, doi: 10.3747/pdi.2013.00123.
22. H. Chen, P. Wang, and Q. Ji, « Analysis of the Application Effect of PDCA Cycle Management Combined With Risk Factor Management Nursing for Reducing Infection Rate in Operating Room », Front Surg, vol. 9, p. 837014, mars 2022, doi: 10.3389/fsurg.2022.837014.
23. M. D. Arenas Jiménez, G. Ferre, and F. Álvarez-Ude, « Estrategias para aumentar la seguridad del paciente en hemodiálisis: Aplicación del sistema de análisis modal de fallos y efectos (sistema AMFE) », Nefrología, vol. 37, no 6, p. 608-621, nov. 2017, doi: 10.1016/j.nefro.2017.04.007.
24. A. Y. Metcalf, M. Habermann, T. D. Fry, and J. K. Stoller, « The impact of quality practices and employee empowerment in the performance of hospital units », International Journal of Production Research, vol. 56, no 18, p. 5997-6014, 2018, doi: 10.1080/00207543.2018.1475763.