



Clinical-educational system for the comprehensive care of chronic kidney disease patients undergoing hemodialysis

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ABSTRACT

Introduction: chronic kidney disease in patients undergoing hemodialysis represents a clinical and educational challenge due to the complexity of treatment and the need for sustained self-care. In Cuba, there are still shortcomings in structured health education systems that integrate pedagogical and clinical components.

Objective: to design a clinical-educational system that contributes to the comprehensive care of patients with chronic kidney disease undergoing hemodialysis.

Methods: a technological development research study of descriptive type was conducted following this sequence: 1) general description of the clinical-educational system; 2) general objective and specific objectives; 3) system components; 4) methodological structure; 5) temporal and operational articulation; and 6) teaching methodology. Theoretical and empirical level methods were used. The research was carried out in accordance with the principles of medical ethics and was approved by an institutional Scientific Council.

Results: a clinical-educational system was developed for the comprehensive care of chronic kidney disease patients undergoing hemodialysis. The system was structured around five components: instructional, motivational, behavioral, communicative, and evaluative; organized into sequential and interconnected educational modules that combine dialogued exposition, practical demonstration, and participatory reflection.

Conclusions: the implementation of the system will improve health literacy, therapeutic adherence, and patient self-management, demonstrating a reduction in complications and greater satisfaction with treatment.

Keywords: Health communication; Renal Insufficiency, Chronic; Renal Dialysis; Primary Health Care.

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INTRODUCTION

Chronic Kidney Disease (CKD) currently constitutes one of the main health challenges worldwide due to its high prevalence, silent progression, impact on patients' quality of life, and the high cost of renal replacement therapies, such as hemodialysis and transplantation. It is a disease with a profound social and educational component, as it obliges the patient to modify lifestyle habits, understand complex processes related to metabolism, manage their own medication and diets, and take active responsibility for their treatment to ensure survival.⁽¹⁾

The first attempts to replace renal function date back to the early 20th century, when the first rudimentary dialysis machines were developed. In 1943, Willem Kolff built the first functional artificial kidney, which successfully dialyzed patients with acute renal failure.⁽²⁾ From the 1960s onward, with the development of cellulose membranes, controlled anticoagulation with heparin, and permanent vascular access systems (internal arteriovenous fistula described by Cimino and Brescia in 1966), hemodialysis began to be used systematically in end-stage chronic renal failure.⁽³⁾ Since then, technology has evolved significantly: high-permeability filters, digital monitors, and adjustable ultrafiltration systems have allowed safer and more prolonged treatments over time. However, this technical advancement has not entirely resolved the human and educational component of the disease.⁽⁴⁾

The World Health Organization (WHO) defines Chronic Kidney Disease as the presence of structural or functional kidney abnormalities for more than three months, with health implications, expressed by a glomerular filtration rate less than 60 mL/min/1.73 m² or markers of kidney damage such as proteinuria, abnormalities in urinary sediment, or abnormalities in imaging studies.⁽⁵⁾ In its stage V or end stage, the kidney loses more than 85-90 % of its function, and it becomes necessary to resort to renal replacement therapies: hemodialysis, peritoneal dialysis, or transplantation. Hemodialysis consists of an extracorporeal process where blood is filtered through a semipermeable membrane to eliminate toxins, excess fluids, and correct acid-base and electrolyte alterations.⁽⁶⁾ This procedure, which must be performed two to three times per week, for three to four hours per session, subjects the patient to total dependence on technology to live and requires active participation in self-care between sessions.

In epidemiological terms, CKD affects between 9-13 % of the world population. It is estimated that in 2017 there were more than 850 million people with kidney disease in different stages, a figure that continues to increase due to population aging, the increase in chronic diseases such as type 2 diabetes mellitus and arterial hypertension, and environmental factors associated with lifestyle.⁽⁷⁾ In 2019, CKD was the 10th leading cause of death globally; projections from the Global Burden of Disease estimate that by 2040 it could become the fifth leading cause of mortality.⁽⁸⁾ In 2023, more than 3.4 million people were receiving renal replacement therapy through hemodialysis, peritoneal dialysis, or transplantation, and it is estimated that around 7 million would require dialysis or transplantation but do not have access to these therapies, particularly in low-income countries.⁽⁹⁾

Latin America represents one of the regions with the greatest inequality in access to dialytic therapies. While in countries such as Argentina, Chile, Uruguay, or Cuba dialytic treatment is financed by public health systems, in other nations such as Guatemala, Honduras, or Haiti, less than 20 % of patients who require it have access to it.⁽¹⁰⁾ The Latin American Society of Nephrology and Hypertension (SLANH) reported that in 2021 there were 240,000 patients on renal replacement therapy in Latin America, with a prevalence of 861 patients per million inhabitants; 90 % of them on hemodialysis.⁽¹¹⁾ At the same time, the prevalence rate continues to increase annually, close to 4-5 %, associated with population aging and the increase in diabetes mellitus and obesity.⁽¹²⁾ However, beyond access to dialysis machines, serious deficiencies persist in patient education.⁽¹³⁾ This generates frequent hospitalizations, cardiovascular mortality, infectious complications, and emotional suffering both in the patient and their family.

In Cuba, chronic kidney disease has shown a sustained increase during the last decades, related to population aging and the increase in chronic non-communicable diseases, especially arterial hypertension and diabetes mellitus. It has been estimated that around 9 to 10 % of the adult population presents some degree of kidney function deterioration, although the real figure could be higher due to underdiagnosis in early stages.⁽¹⁴⁾ Reports from the Ministry of Public Health indicate that in the period between 2010 and 2020, the prevalence of patients on dialytic treatment increased from 149 patients per million inhabitants (pmh) to more than 230 pmh.⁽¹⁵⁾

During the years 2021 to 2023, the figures continued to increase, with an estimated prevalence of between 280 and 300 pmh, of which 90 % receive hemodialysis in hospital units.⁽¹⁶⁾ Although the national system guarantees free access to therapy, limitations persist in technological resources, stability in the supply of inputs, availability of specialized nursing, and, above all, the absence of systematic health education programs aimed at renal patients and their families.

Various international studies support the positive influence of educational interventions on therapeutic adherence and the reduction of morbidity in renal patients.^(17,18,19) However, in the Cuban scenario, formal health education programs in hemodialysis are limited, discontinuous, and with little theoretical systematization, which hinders the sustained acquisition of self-care habits. All this reveals an essential problem: the absence of a systematic, scientific clinical-educational system adapted to the context of the chronic kidney disease patient on hemodialysis. Thus, the general objective of this research is to design a clinical-educational system that contributes to the comprehensive care of chronic kidney disease patients undergoing hemodialysis.

METHODS

A technological development research study was conducted, with a descriptive design and applied approach, oriented toward the creation of a clinical-educational system for the comprehensive care of chronic kidney disease patients undergoing hemodialysis.

The research was structured in a methodological sequence organized in six stages:

1. General description of the clinical-educational system, including its theoretical and practical foundation.
2. Definition of the general objective and specific objectives, which guided the investigative process.

3. Identification and characterization of system components, both clinical and educational.
4. Design of the methodological structure, which integrated conceptual and operational elements.
5. Temporal and operational articulation, establishing phases, timeline, and necessary resources.
6. Teaching methodology, with pedagogical strategies adapted to the context of primary health care.

Methods employed

Theoretical level

- Historical-logical: allowed delving into the background of the topic and current trends, establishing the evolution of the process and the object of research.
- Analysis and synthesis: used to decompose the object of study, identify its essential elements, and reconstruct information from the bibliographic review and expert consultation.
- Induction and deduction: facilitated the transition from the general to the particular and vice versa, enabling the elaboration of generalizations about the object of study and the validation of theoretical and methodological references.

Empirical level

- Observation: applied to follow the development of the object of research in its real context.
- Documentary analysis: allowed the systematic collection of relevant information, both from bibliographic sources and institutional documents.

Ethical considerations

The research was conducted in accordance with the principles of medical ethics, guaranteeing the protection of patients and respect for the confidentiality of information. The study was approved by the corresponding institutional Scientific Council and was based on scientific evidence-based information.

RESULTS

The investigative process allowed the construction of a clinical-educational system oriented toward the comprehensive care of patients with chronic kidney disease undergoing hemodialysis, conceived as an innovative tool that articulates clinical practice with therapeutic education. The findings show that the integration of pedagogical, clinical, and organizational methods favors the formation of self-care competencies in patients, while strengthening the active participation of the family and the interdisciplinary team. The proposal is based on principles of comprehensiveness, flexibility, and continuous evaluation, which guarantee its applicability in the context of Primary Health Care and its relevance for the promotion of healthy lifestyles and the prevention of complications associated with dialytic treatment.

General description of the clinical-educational system

It is defined as a structured set of planned actions, relationships, and pedagogical, clinical, and organizational resources that integrate medical care and health education of the chronic kidney disease patient undergoing hemodialysis, with the purpose of optimizing comprehensive care. This design is based on pedagogical principles and health promotion applied to the field of nephrology and therapeutic education.

Among its fundamental characteristics are:

- Comprehensiveness: combines clinical, educational, and psychosocial dimensions.
- Flexibility: adapts to the cultural and cognitive level of the patient.
- Active participation: promotes bidirectional interaction patient-team-family.
- Continuous evaluation: includes clinical, biochemical, and learning indicators.

The system is based on the self-care approach as a formative process.^(20,21) It is assumed that education cannot be limited to the transmission of information, but must imply the conscious transformation of attitudes toward treatment.

General objective

To develop a comprehensive clinical-educational system that contributes to improving the knowledge, attitudes, and self-care practices of patients with CKD undergoing hemodialysis, through a continuous, participatory, and contextualized formative process, directed by the interdisciplinary team of the service.

Specific objectives

- Strengthen knowledge about renal physiology, principles of dialytic treatment, diet, and management of vascular access.
- Increase adherence to medication and to dietary and fluid regimens.
- Decrease the incidence of intradialytic complications and associated biochemical alterations.
- Favor the active participation of the patient and their family in decision-making about their health.
- Promote better quality of life and emotional balance in patients on prolonged treatment.

System Components

The clinical-educational system designed for the comprehensive care of the chronic kidney disease patient undergoing hemodialysis is structured based on five functional components that guide, dynamize, and sustain the educational process within the service. These components: instructional, motivational, behavioral, communicative, and evaluative (Table 1), do not act in isolation, but are integrated synergistically to generate a continuous, participatory formative process adapted to the clinical, psychological, and sociocultural characteristics of patients.

Table 1. Components of the clinical-educational system.

System Component	Clinical Aspects	Educational Aspects
Instructional	Information about chronic kidney disease, functioning of hemodialysis, medication management, control of clinical and biochemical parameters, and prevention of complications associated with treatment.	Development of knowledge about the disease and treatment through educational activities, individual and group guidance, use of didactic materials, and pedagogical strategies that facilitate patient understanding.
Motivational	Importance of therapeutic adherence, compliance with hemodialysis sessions, and following medical and pharmacological indications to maintain clinical stability.	Strategies to strengthen patient motivation, promotion of commitment to treatment, psychological support, positive reinforcement, and active participation in the care process.
Behavioral	Compliance with prescribed diet, fluid restriction, control of interdialytic weight, care of vascular access, and early identification of signs and symptoms of complications.	Training in self-care skills, training in healthy behaviors, guidance for adopting appropriate lifestyle habits, and strengthening patient responsibility in managing their health.
Communicative	Exchange of clinical information between the patient and the health team, communication of symptoms, doubts, or difficulties related to treatment, and follow-up of health status.	Establishment of bidirectional educational communication that facilitates understanding of medical guidance, promotes trust, and stimulates active patient participation in their learning process.
Evaluative	Follow-up of clinical and biochemical indicators, assessment of patient evolution, control of therapeutic adherence, and detection of complications.	Evaluation of the level of acquired knowledge, assessment of changes in self-care behaviors, feedback of the educational process, and adjustment of formative strategies.
Source: own elaboration.		

Methodological structure

The system is organized in sequential and articulated educational modules (Table 2), developed within the hemodialysis unit, with individual and group sessions. Each module combines dialogued exposition, practical demonstration, and participatory reflection.

Table 2. Educational modules.

Module	Central Theme	Estimated Duration	Educational Strategy
I	Knowing my kidneys and the function of dialysis	2 weeks	Talks, infographics, video-debate.
II	Healthy renal diet	3 weeks	Demonstrative workshop with nutritionist.
III	Control of water and fluids	2 weeks	Educational talk and demonstration of weight measurement.
IV	Care of vascular access	2 weeks	Demonstrations and supervised practice.
V	Medications and adherence	2 weeks	Group dynamics and guided discussion.
VI	Emotional coping and quality of life	3 weeks	Participatory psychoeducational sessions.
VII	Evaluation and reinforcement of learning	1 week	Survey, feedback, and individual plan.

Source: Own elaboration.

Each module is developed through a dialogic approach, where the patient becomes the protagonist of learning. Audiovisual materials, simplified guides, and everyday examples are used, adjusted to the level of understanding of the population.

Temporal and operational articulation

- The complete cycle lasts 15 weeks (sum of modular durations), with the possibility of repeating critical modules according to evaluation.
- Group sessions are preferably scheduled during or immediately after the dialysis session and avoid interfering with clinical procedures.
- Each module contains reinforcement actions in subsequent sessions (micro-reinforcements of 5–10 min) and registration in an educational record.
- The System Coordinator supervises modular execution, controls methodological quality, and consolidates indicators quarterly.

Teaching methodology

The teaching methodology of the clinical-educational system is based on a dialogic and participatory perspective, combining principles of popular education,⁽²²⁾ with meaningful learning. Both approaches recognize the patient as an active subject of their own learning process, with a background of experiences, knowledge, and perceptions that constitute the starting point for the collective construction of knowledge.

From the Freirean vision, education is not conceived as vertical transmission of information, but as a horizontal encounter where dialogue, problematization, and critical reflection allow the patient to reorganize their understanding of the disease and consciously participate in their self-care. Meaningful learning, for its part, ensures that content is not presented in an isolated or decontextualized manner, but linked to the experiences, difficulties, and motivations of the chronic kidney disease patient undergoing hemodialysis.

This methodological approach allows integrating the five components of the system (instructional, motivational, behavioral, communicative, and evaluative), articulating in strategies that foster participation, deep understanding, development of practical skills, and personal commitment.

Below, the main teaching forms used are described.

- Educational conversations in small groups.
- Practical demonstrations of vascular access manipulation.
- Experiential workshops on diet and fluid control.
- Life stories and testimonials to strengthen motivation.
- Individualized reinforcement during and after each dialysis session.

DISCUSSION

The analysis of the results of this research allows highlighting that the designed clinical-educational system responds to a concrete need in the Cuban context: the absence of structured health education programs for patients on hemodialysis. The proposal integrates clinical, pedagogical, and psychosocial dimensions, which coincides with international evidence that underlines the importance of therapeutic education in improving adherence and reducing complications.⁽²³⁾ Lopez-Vargas et al.,⁽²⁴⁾ demonstrated in their systematic review that educational interventions in dialysis significantly increase health literacy and self-management, findings that are reflected in the specific objectives of the present system.

In comparison with international experiences, the Cuban system is distinguished by its dialogic and participatory approach, inspired by Freirean pedagogy. This aspect brings it closer to models of popular education applied to health, which have shown efficacy in populations with low cultural level or with barriers to access to information. Payton et al.,⁽²⁵⁾ highlight that education in home dialysis based on patient-team interaction favors autonomy and reduces hospitalizations, which is related to the strategy of sequential modules and periodic reinforcements described in the article.

The motivational component of the system, focused on reinforcing the patient's commitment to their treatment, aligns with the study by Zhang et al.,⁽²⁶⁾ who evidenced that psychological support and motivation are determining factors in the quality of life of dialyzed patients. The inclusion of participatory psychoeducational sessions in module VI constitutes an innovative contribution, as it integrates the emotional dimension into the educational process, an aspect that is usually absent in traditional clinical training programs.

Likewise, the behavioral component, oriented toward the formation of practical skills for self-care, coincides with the recommendations of MacLaughlin et al.,⁽²⁷⁾ who emphasizes the need to train patients in behaviors related to diet and fluid control to decrease intradialytic complications. The Cuban system incorporates demonstrative workshops and supervised practices, which strengthens the transfer of knowledge to daily life and favors the sustainability of healthy habits.

The comparative analysis also reveals that the communicative dimension of the system, based on bidirectional patient-team interaction, responds to the recommendations of Kidney Disease: Improving Global Outcomes (KDIGO),⁽²⁸⁾ which underlines the importance of effective communication to guarantee therapeutic adherence and early detection of complications. The strategy of conversations and testimonials included in the system reinforces trust and active patient participation, which constitutes a differentiating element compared to more vertical models of health education.^(29,30)

Finally, the evaluative component, which integrates clinical and learning indicators, provides a framework for continuous monitoring that allows adjusting formative strategies. This aspect is related to WHO recommendations,⁽¹⁾ on the need to evaluate the effectiveness of educational interventions in prolonged therapies. Together, the designed clinical-educational system not only responds to the shortcomings of the Cuban context, but is articulated with international best practices, offering a comprehensive model that can serve as a reference for other countries with similar limitations in health education for chronic kidney disease patients.

CONCLUSION

The clinical-educational system designed, contextualized in hemodialysis, contributes to humanizing care, reducing complications, and strengthening the autonomy of the chronic kidney disease patient. Its systematic implementation will allow consolidating the integration between clinical practice and pedagogy, in coherence with the principles of the Cuban national health system. With its application, health literacy, therapeutic adherence, and patient self-management will improve, demonstrating a reduction in complications and greater satisfaction with treatment.

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