Exploring Educational and Training Skills of Nephrology Nurses: Scoping Review

In depth review

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ABSTRACT

Background. Chronic kidney disease poses global health risks, requiring specialized nursing skills and ongoing professional development. The objective of this review was to identify postgraduate nurse education programs in nephrology and dialysis.

Design. A scoping review following the framework given by Arksey and O'Malley was conducted using five databases: Medline, Scopus, Cochrane Library, ASSIA and CINAHL. The research was supplemented by consulting gray literature. Screening of articles, data extraction and quality appraisal were independently performed by two authors. The included articles examined the modalities of skills acquisition by nephrology and dialysis nurses. Critical appraisal was conducted using JBI critical appraisal tools.

Results. Out of 8789 records identified, 20 were included in this review. Analysis of the data indicated that nephrology and dialysis nurses acquire their skills through both structured training pathways and professional experience. This review identified a lack of standardized training pathways in this field, resulting in global heterogeneity in training programs. Educational interventions typically comprised theoretical and practical components, often delivered through a combination of teaching methods. Additionally, professional training was found to be essential for skill acquisition, with variations in reliance on mentorship, individual study, and direct experience.

Conclusion. Despite the heterogeneity of existing training courses, this study outlines existing knowledge, laying the foundations for a review and standardization of training courses and underlining the need for a clear definition of nephrology and dialysis nurses' skills for curriculum development.

KEYWORDS: Competencies, Nephrology Nurse, Scoping Review, Postgraduate Nurse Education, Training

Introduction

Chronic Kidney Disease (CKD) has emerged as a globally growing health issue, significantly impacting the well-being and lives of individuals [1]. Research indicates a strong association between CKD and a heightened risk of severe cardiovascular issues, progression of renal damage, and increased mortality [2]. Acknowledged as the sixteenth leading cause of years of life lost worldwide, CKD has evolved into an epidemic, with predictions of further escalation. In 2015 alone, it led to millions of years of disability, a significant reduction in life expectancy, and millions of deaths across 195 nations [3, 4]. The Global, Regional, And National Chronic Kidney Disease Collaboration (GBD) emphasizes the importance of a comprehensive approach in CKD management, highlighting the need for increased public awareness, targeted education, and effective preventive strategies [5]. Given the CKD prevalence, its impact on daily life, and healthcare costs, adopting a multidisciplinary approach is crucial [6]. A substantial investment in human and financial resources is essential to address the complexity of the disease.

Kampmann et al. [7] underscore that CKD poses a critical challenge to global health, requiring coordinated actions at individual, community, and institutional levels to raise awareness, prevent disease progression, and enhance clinical outcomes. In the realm of nephrology and dialysis, successfully managing CKD patients demands a multidisciplinary team, with nursing expertise playing a central role [8]. Collaboration among healthcare professionals becomes paramount to address the escalating complexities of care, each contributing unique perspectives on patient needs [9]. This cutting-edge approach allows for a comprehensive handling of diverse facets of patient needs, leveraging various professional competencies [10].

Nursing competence, defined as the ability to effectively manifest personal qualities, professional attitudes, ethical values, knowledge, and skills, is crucial for ensuring high-quality nursing care and enhancing the overall patient experience [10, 11]. In nephrology and dialysis, it's not just about mastering technical knowledge to tackle CKD complexity but also providing empathetic and personalized support [11]. Specialized nephrology nurses must possess in-depth training and high-level skills to manage the myriad challenges of patients, including a wide range of comorbidities. The care of CKD extends beyond the physical aspect, involving psychosocial elements where the nurse's role becomes crucial [12]. Advanced practice nurses, in line with the International Council Nurses (ICN) directives, emerge as essential figures to ensure high-quality care and efficient management of healthcare costs [13]. Specializing professional competencies are crucial for improving care and reducing healthcare costs [14]. The American Nurses Association (ANA) defines Continuous Professional Development (CPD) as an ongoing process of nurses' active participation in learning activities, vital for enhancing nurses' continuous competence, improving professional practice, and supporting the achievement of their professional goals. Additionally, continuous scientific and technological progress, coupled with increasing healthcare system demands, makes CPD a legal and professional obligation for nurses [15]. Promoting CPD in the clinical setting is crucial, yielding tangible benefits for patients, professionals, and organizations. With a positive impact on the quality of care, a reduced likelihood of patient mortality, and increased motivation and professional satisfaction among nurses, investing in CPD is a winning step [16, 17].

Scoping Review Objectives

The objective of this scoping review is to identify postgraduate nurse education programs in nephrology and dialysis by reviewing and synthesizing literature on both academic and professional training programmes, including those conducted in clinical settings.

Methods

Protocol and Registration

This scoping review was conducted in accordance with a protocol that had been prospectively registered on the Open Science Framework and is available at: https://doi.org/10.17605/OSF.IO/DG7F6. In developing the literature review, we followed the framework given by Arksey and O'Malley [18], which included the updated approach approved by the Joanna Briggs Institute (JBI) [19]. To improve the study's methodological rigor, we used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) [20]. This comprehensive technique establishes a solid platform for comprehensively mapping the available literature and assuring transparency in reporting of scoping review results.

Formulation of Research Question

The PICO framework [21] led the development of the research question, which consists of four components: Patient or Problem (P), Intervention or Exposure (I), Comparison Intervention or Exposure (C), if applicable, and Clinical Outcome of Interest (O). This scoping review seeks to answer the question: "how do nephrology and dialysis nurses acquire their competencies?". This evaluation focused on three components of the PICO technique, including the use of a PIO. In fact, the comparison element "C" is not necessary in the formulation of the question, as the objective of the study is to investigate the evidence for all alternatives to the intervention of interest, rather than conducting a specific comparison.

Based on the aforementioned methodology, the following elements were taken into consideration: P: nephrology nurse; I: Identification of research studies that describe the training/education pathway of the nephrology nurse in accordance with the international guidelines of reference Scientific Societies; O: define the methodologies and tools used in the education and training of the nephrologist nurse.

Eligibility Criteria

Following Arksey and O'Malley's approach [18], this review employed strict eligibility criteria in accordance with accepted methodology [19, 20]. The inclusion criteria were refined by an initial search of databases like PubMed/Medline and Google Scholar. The goal of this iterative procedure was to guarantee review accuracy and boost confidence in the literature. The inclusion criteria for this study encompass primary studies conducted in English, Italian, Spanish, or German languages. These studies focus on investigating the education and training pathway of nephrology and dialysis nurses, exploring educational tools in nephrology nurse training. All relevant studies were included in the search without temporal restrictions. The decision to adopt such flexibility stems from the desire to comprehensively explore the topic of interest and the lack of reviews that could limit the search to studies conducted subsequently. Conversely, studies not available in full text, as well as books, chapters, congress contributions, and research that do not analyze the figure of the nephrology nurse education pathway or training, were excluded.

Search Strategy

The JBI framework [19, 20] was followed in conducting a systematic literature search to find possibly relevant records. The Cochrane Central Register of Controlled Trials (CENTRAL), PubMed (Medline), CINAHL (Cumulative Index to Nursing and Allied Health Literature), Scopus and ASSIA (Applied Social Sciences Index & Abstracts) were among the databases that were included in the search. The period of the investigation was December 2023–January 2024. All records deemed possibly relevant were loaded into the EndNote 20 program, (which may be accessed at https://endnote.com/). By hand-removing duplicate entries, the literature corpus was accurately compiled for further study.

For conducting this review, the search strategy involved transforming the research topic into keywords and possible synonyms and variations thereof, followed by the identification of corresponding thesaurus terms, including MESH terms, in the databases. The terms "nurs*", "nephrology", "education*" and "training" were picked in accordance with the study's predetermined qualifying requirements. These search terms were customized for each specific database that was visited. The keywords were then appropriately combined using Boolean operators.

Google Scholar was searched to get any additional records from the grey literature, ensuring a complete study of the accessible material and giving the scoping review more depth and inclusivity. Furthermore, in accordance with the technique [19, 20], we intended to review the full-text records that were acquired and their references and citations. This thorough method demonstrates the iterative nature of the scoping process and strengthens the study's rigor. To ensure openness and repeatability, the detailed search strings used in this study are included in Supplementary File 1 (available upon request).

Selection of Evidence Sources

The evidence sources were chosen in accordance with the JBI methodology and the Arksey and O'Malley framework [18–20], resulting in a systematic and thorough approach. This technique was divided into two steps, each done separately by two researchers (GA and GF). Conflicts were handled with the assistance of a third author (SM), who was not actively involved in the screening process. In the first step, which focused on titles and abstracts, papers about non-nephrology nurses or studies that did not meet inclusion requirements were eliminated. Lack of clarification regarding population, intervention, or outcome resulted in exclusion owing to uncertainty.

By effectively removing articles that were not relevant, this step reduced the amount of time needed to fully study the texts. As we moved on to the next screening phase, we used a variety of methods, such as the specialized EndNote function, online searches, and journal access, to retrieve the complete texts of records that were found in the title and abstract screening. Next, in order to find more relevant records, a thorough examination of the entire texts' references and citations was carried out. The final full-text article screening for eligibility was conducted using predetermined inclusion and exclusion criteria. This involved eliminating publications that did not meet the scoping review's objectives and incorrectly classed as books, chapters, or submissions to congress.

Evaluation of risk of bias and methodological quality of studies

Two researchers (LG and DG) independently evaluated the included publications' methodological quality and risk of bias using the JBI checklists and the JBI framework's approach [19, 22]. An unbiased third-party reviewer (MS) arbitrated any disputes. A prior meta-analysis [23] was used to identify high-quality studies. The study defined high quality as defined by a JBI score of greater than 70%, medium quality as defined by a score between 50% and 69,99%, and low quality as defined by a score less than 50% (Supplementary File 1, available upon request).

Data Charting Process

A data-charting form was created using the JBI scoping review approach [20–24] to facilitate data extraction for answering research questions and meeting scoping review goals. EndNote was used for both design and data extraction. Two researchers (MS and SC) independently carried out the process to guarantee a solid and objective methodology. In order to improve accuracy and dependability, any discrepancies or uncertainties in the retrieved data were extensively addressed with a third author (SM) until an agreement was reached.

Stakeholders Consultation

Following the framework proposed by Arksey and O'Malley [18] and Hollman et al. [25], we implemented a systematic approach divided into clear phases to conduct a stakeholder consultation aimed at enriching and validating the skills of nephrology and dialysis nurses. Initially, we clearly defined the objectives of the project and formulated the desired outcomes, identifying stakeholders through consultation with the Italian Society of Nephrology Nurses (SIAN).

In the first phase, we used the results obtained from this scoping review to develop a specific survey via a Google Form, ensuring compliance with data privacy regulations (Supplementary File 2, available upon request). We defined what data would be needed, who would have access to it, and how this information would be managed, addressing concerns about intellectual property and data disclosure. SIAN registered nurses from different groups within the company were identified as stakeholders for the survey administration and subsequently representatives of the different research groups were identified as key stakeholders for the discussion phase of the survey results.

In the second phase, we developed a detailed engagement plan, defining useful tools to reach stakeholders and establishing the optimal frequency for interactions. The selection and testing of the tools were carried out with particular attention to GDPR compliance. Once the survey was administered and feedback was obtained, statistical analysis of the responses guided any changes to the engagement plan, ensuring effective communication and adaptation to stakeholder needs.

In the final phase, after analyzing the survey data, we organized a two-hour meeting with representatives of the various groups in order to present and discuss the survey results and collaboratively outline a future development framework relating to educational and training skills. Authorization for conducting the survey was requested from SIAN Advisory Board with approval number NEP.01.24.v2.

Data Extraction, Synthesis and Analysis

The extracted data included many factors such as authors, year, country, study design sample, setting, evaluation tools, objective, nursing skills/results, and quality/risk of bias. The data gathering was rigorously planned to correspond with the research goals. The outcomes of this study were classified based on the review goals, using the narrative technique provided by Arksey and O'Malley [18]. Furthermore, the findings were grouped into particular tables, graphs, and figures to improve clarity and awareness. The data were analyzed using descriptive statistical methods, including mean, standard deviation, frequency, and percentages.

Results

Selection of sources of evidence

Our search strategy identified a total of 8772 records. After removing duplicates (n = 2927) and screening title and abstract (n = 5862), we assessed 123 studies for eligibility. Of these, 67 were judged as not coherent. A total of 20 records were included in this study (Figure 1).
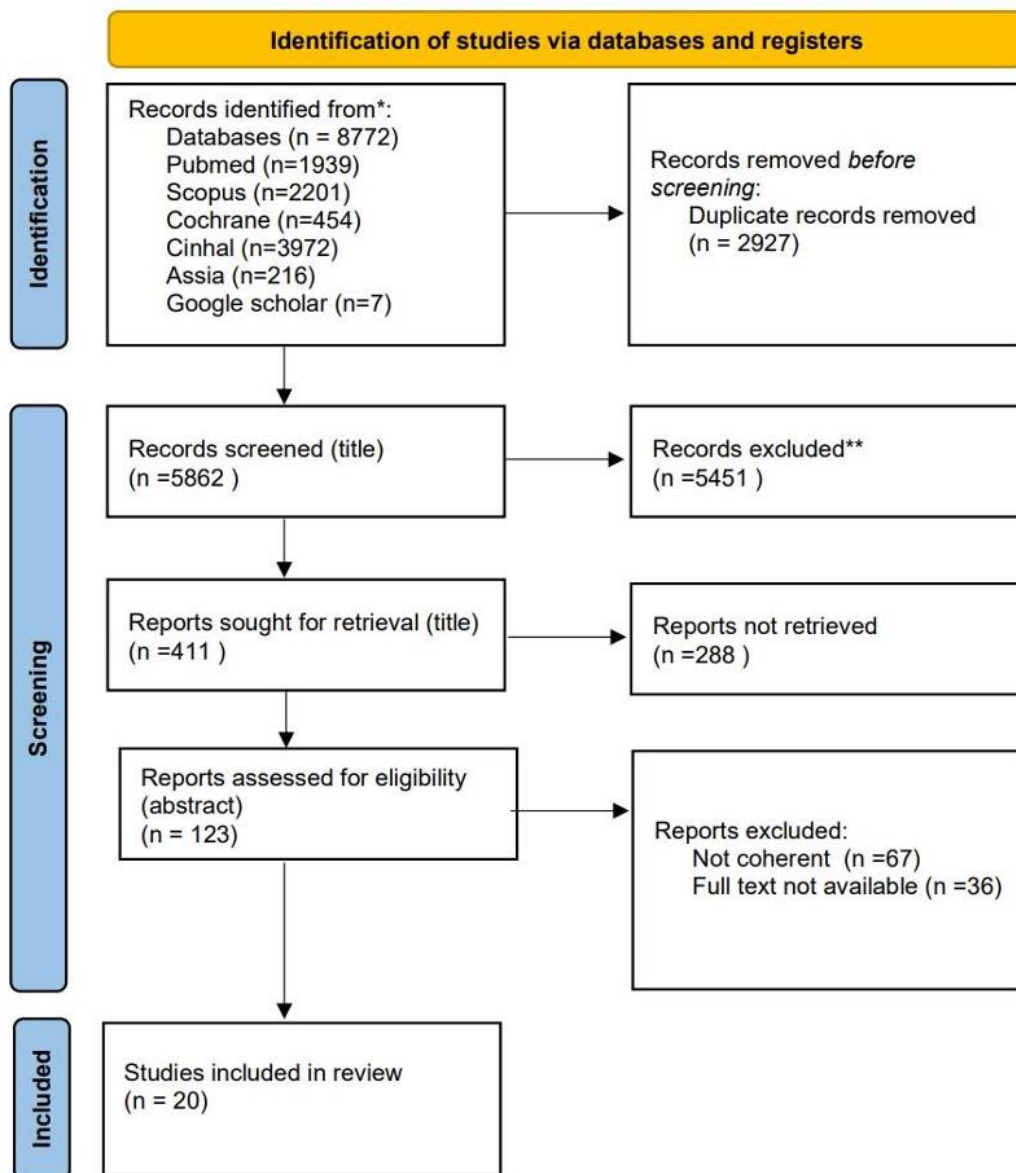
Figure 1. PRISMA ScR Flowchart.

General characteristics of sources of evidence

The literature review included a total of 20 articles, of which ten were conducted in Europe, two in Turkey, two in America, three in Asia, two in Australia and one in Africa. A relative majority of records included resulted from ten expert opinions or consensus. Six studies were cross-sectional studies, one was a qualitative study, one was a Randomized Controlled Trial (RCT), one was a quasi-experimental study, and finally one was a case study.

Most of articles in this review considered national or international healthcare/educational settings, six articles reported the local implementation of interventions or educational strategies concerning nephrology and two articles reported other types of local studies. A summary and detailed outline of the studies are provided in Table 1.

Author / Year / Country / Study Design	Setting	Learning Objective	Competencies/ Variables evaluated	Training / Education / Results	Education / Study Methodology	Quality / Bias
Meng et al., 2023, Singapore, Cross Sectional Study	Two tertiary hospitals: -four dialysis units -two community dialysis centres	Evaluate Dialysis Nurse knowledge of vascular access	Management of dialysis vascular access	Participants specialized training: -advance diploma in nephrology and urology, -advance nephrology course conducted in the hospital, -post-basic renal training from overseas and renal foundation program intensive care nursing. Dialysis access training: -job training (88.6%) -simulated training (34.3%) -online resource (30.0%)	KAP-SE instrument	+++/ High
Andreoli, 2022, Italy, Cross-Sectional Study	Nephrology, dialysis and kidney transplant hospitals	Investigate the training/critical issues of the nephrology nurse	-Acquisition of skills through direct experience in the field (a) -Transmission of knowledge by more experienced colleagues (b) -Self-study – Hospital training (c) – Specialization course in nephrology and dialysis (d) -Specialization course in intensive care (e)	Participants skill level: a=34.7% b=30% c=7,7% d=1.2% e=0.4%	Survey	+++/ High
Colobong Smith, 2022, United States, Expert Opinion	Acute and Critical Care Settings	Integrate nephrology nursing in Acute and Critical Care Nursing	-Hemodialysis -CKD Nutrition -Renal Case Manager -AKI -CKD medications -Vascular Access -HD Complications -Therapeutic Plasma Exchange	Training program includes: -8-hour didactic days/ minimum of 64 hours performing HD with a preceptor. -Generally, HD orientation is a 10-day process over three to four weeks	HD training program	+++/ High
Hurst, 2019, United Kingdom, Expert Opinion	UK nursing education system	Association of Nephrology Nursing's activities update	-CKD -ESRD	E-Learning Package with blended learning for all nurses who work in Kidney care.	E-Learning Course	++ / Medium
Jenkins, 2019, United Kingdom, Expert Opinion	UK nursing education system	Develop a minimum standard national qualification for nurses working in renal care.	-Theoretical knowledge (CKD general) -Practical skills.	N.R	E-Learning Course	++ / Medium
Bennet, 2019, United States, Expert Opinion	International Society of Nephrology Nurse Working Group	Develop a specialized nephrology nurse training and education in LLMICs	Development of: -Training needs assessment program -Training packages for nurses	-ISN Academy online learning platform (nephrology nursing core/advanced skill)	E-Learning Course	+++/ High
Dainton, 2018, United Kingdom, Expert Opinion	UK Healthcare System	Describes the need for a nationally recognized training program for nephrology nurses	-CKD (general) -ESRD	No national standards or accreditations Format / content of courses varies greatly.	Training course (CKD General), Academic courses (CKD General)	+/ Low
Georgieva & Dobrilova, 2018, Bulgaria, Cross Sectional Study	Bulgaria Healthcare System	Assess the need for nephrology nurses to acquire core and advanced knowledge and skills	Need for additional training (a) Training received from a more experienced nurse (b) Training received by a senior nurse (c) Completion of a basic preliminary course (d) Special training deemed necessary for dialysis (e)	a=100% b=66.7% c=21.8% d=2.6% e=98.7% f=29.3% g=24.4% h=16.7%	Survey	+++/ High

			Preference for postgraduate training courses (f) Request for inclusion of university education (g) Preference for specialization as a form of training (h)			
Topbas et al., 2018, Turkey, RCT	University course	Investigate the effects of different education methods in PD application training	– Psychomotor skills -Self-efficacy of nursing students.	Pre-post test scores: -Psychomotor skills: higher results in the experimental group -Self-efficacy: No difference was found	IG=clinical simulation CG=face to face lesson	+++/ High
Yousef et al., 2019, Egypt, Quasi experimental Study	Children renal dialysis unit	Prevention and control of infections in children (HD)	Prevention and control of infections in children (HD)	Training: – Freedom in choosing the duration of the educational program. – Nine teaching sessions. – Personalized feedback. – Educational brochure provided to each nurse Results: -The training has significantly improved nursing practice, -Better adoption of preventive procedure – 68.7% of nurses demonstrated adequate practical competence.	Educational nursing program structured on the skills of the staff previously assessed through survey.	+++/ High
Thaiyuenwong et al., 2011, Thailand, Cross Sectional Study	Thailand Healthcare System	Enhance national training of peritoneal dialysis nurses in Thailand	– Core knowledge: RRT – CKD – PD -Assessment skills and early detection of complications -Safety and quality skills -Advanced health assessment and clinical judgment.	PD training course (4 month): -Theory: 173 hours (PD) -Practice: 300 hours of advanced skill development -Program integrated with psychological support, stress and emotional problems.	PD training course	++ / Medium
De Pietro, 2010, Italy, Expert Opinion	Italian Healthcare System	Describe the process of professionalisation that nurses are experiencing.	-Vascular access management -Patient education -Anemia management	-Advanced postgraduate course in Nephrology and Dialysis; -Advanced postgraduate course in assistance in critical areas; -From 3 to 6 months of field training (with the possible presence of a tutor).	-Academic postgraduate course -Field training course	+++/ High
Douglas & Bonner, 2010, Australia, Delphi Study	Australia healthcare system	Develop recommendations for Australian Nurse Practitioner for advanced practice in nephrology settings.	-Role and area of competence of the NNP -Clinical education, learning strategies to support NNP -Results of NNP clinical training.	N.R	Consensus statement	+++/ High
Bridger, 2007, United Kingdom, Case Study	University course	Exploring the learning experience of a group of NNPs	CKD / ERSD core and advanced skill	The training program included one academic year of study, with a 50:50 split of theory and clinical practice, followed by a six-month clinical internship.	NNP nursing training program	++ / Medium
McCann & Sedgewick, 2005, Ireland, Expert Opinion	Europen nursing education system	Identification of post-basic skills and training of the nephrology nurse	-Fundamental Aspects; -Psychological aspects -CKD -ERSD -AKI -Special therapies -Pediatric care.	-Each module contains topic areas that have specific learning outcomes -Academic training -Practical training	European Post-Basic Core Curriculum (PBCC) 2nd edition for nephrology nursing.	+++/ High
Bonner & Greenwood, 2006, Australia, Qualitative study	Nephrology and renal unit	-Understand the characteristics of nephrology nursing competence and the process through which it was acquired	CKD/ESRD post-training skills acquisition competencies: -Knowledge -Experience	Three-stage skill acquisition process, identified in stages: -non-expert, -non-expert with experience	Grounded Theory	+++/ High

			-Practical ability -Concentration	-expert.		
		-Explain how the practice of experienced nephrology nurses differed from that of non-expert nephrology nurses.				
Poh-Choo & Zaki, 2003, Malaysia, Cross Sectional Study	Malaysia healthcare system	Describe CKD, RRT and PD nursing training program of the Ministry of Health of Malaysia	-HD -PD	– HD courses: 8 weeks of theoretical training on CKD and RRT, followed by 16 weeks of practical experience, mainly in hemodialysis. – PD course: Nurses without a post-basic renal nursing certificate need 4 weeks of training; those with the certificate require 2 weeks.	-Post-Basic Renal Nursing Course Curriculum -PD Training:	+++/ High
Fuchs & Thomas, 2003, United Kingdom, Experts Opinion	Europen nursing education system	Describe Basic Core Curriculum of nephrology nursing, profile, education programmes	-CKD -RRT -Transplantation. -Psychological aspects of CKD	Variety of European training programs: -lectures, group work, case studies, visits to nephrology departments and renal units – variety in learning hours -in some countries practical experience is not mandatory	Survey	++ / Medium
Hurst, 2003, United Kingdom, Experts Opinion	UK university nurse course	Develop and implement a university accredited renal nursing course delivered by distance learning	Transversal skills acquired through the e-learning methodology: -Computing skills -Professional confidence -Interprofessional communication skills -Using of software and accessing web-based resources	Technologies employed: -The use of video clips -Animation -Self-assessment questionnaires and quizzes -Chat rooms -Links to other web sites -Use of self-learning packages freely available on the web, and via the learning resources centre of the university	E-Learning Course	+++/ High
Gelmez et al., 2002, Turkey, Cross-Sectional Study	Turkey healthcare system	Integrate education on nurses knowledge in renal units	-CKD -ESRD -Vascular access	Training course to prepare for the Nephrology Nurse certificate* -Two-day training program, aimed at 30 nurses -Discussion and intervention groups supported by posters	Educational program organized by dialysis center	+++/ High

Table 1. General Characteristics of the Studies Included.

Critical appraisal of sources of evidence

Most studies included demonstrated high methodological quality and a low risk of bias (n = 14; 70%), five studies demonstrated medium quality (n = 5; 25%), and one study low quality (n = 1; 5%) consistent with the criteria outlined in a prior meta-analysis by [23], where studies with a JBI score mean ≥70% were deemed of high quality. The quality assessment of the included studies is detailed in Table S2-S7.

Educational Training in Nephrology and Dialysis

Competence acquisition is a core element of nursing practice. The training of nephrology and dialysis nurses involves acquiring specialized skills that distinguish their professional actions. However, various studies indicate that the training of nephrology nurses often occurs through undefined and non-standardized pathways [26, 27], although indications and activities of some scientific societies seem to lean towards creating widely shared curricula at the national or international level [28–31]. Several articles [32–42] have reported the existence of various types of training courses for acquiring

specific nephrology-related competencies. However, there is no homogeneity in structure, study programs, and duration, ranging from a few weeks to a year for enabling training courses. Except for some studies reporting national training programs in the specific area of Peritoneal Dialysis [26, 27] or providing opinions/guidelines to a European international audience [30, 31], the remaining authors addressing the implementation of training programs have done so at the local level [33, 34, 36, 38–41]. This reflects an internationally manifest heterogeneity in post-basic training pathways for nephrology nurses. Training is provided by both basic and post-basic university courses and local healthcare entities. Within the analyzed training programs in various studies, there is also observed heterogeneity in educational content (Table 2). Except for the training pathway implemented in a study by Yousef et al. [41], focused on knowledge assessment, all included studies alternate educational interventions based on both theoretical training and practical or laboratory training. Additionally, it is useful to note that in this field, theoretical components are sometimes offered in e-learning mode [28, 30, 31], and practical aspects are also taught through Simulation Activities [40].

On-the-job training in Nephrology and Dialysis

On-the-job training for nephrology nurses has been the subject of investigation and evaluation in two European studies [32, 37], uncovering partially contrasting results. While Georgieva and Dobrilova [37] reported that 88% of the study sample acquired competencies through mentorship from a colleague or experienced nurse, the study by Andreoli [32] found a significantly lower percentage (30%). Similarly, this study reported that 24.5% of the sample acquired competencies through individual study, a percentage that drastically drops to 6.4% in the Bulgarian study. It is interesting to note that in the Italian study [32], 34.7% of nurses declared that direct field experience played a fundamental role in acquiring competencies in this field, while this option was not considered in the other study. Building on the previously mentioned Italian study, the study by Bonner and Greenwood [43] investigated the competency acquisition process in nursing practice using Grounded Theory methodology, highlighting a three-phase competency acquisition process identified as phases of non-experience, inexperience, and experience, each characterized by four changing features: knowledge, experience, skills, and concentration.

Stakeholder Agreement and Assessment of Educational and Training skills

Sample Characteristics

The study involved a sample of Italian nursing stakeholders, primarily engaged in clinical-care activities, with 89% of respondents indicating patient care as their primary responsibility. The remaining were involved in coordination/management (9%), education (1%) or research (1%). These stakeholders were mostly employed in hemodialysis settings (79%), followed by peritoneal dialysis (10%), nephrology units (10%), and nephrology in community settings (1%). Despite 80% not having pursued post-basic academic courses in nephrology, there was a strong interest in further education, with 70% expressing a decisive desire for additional training in this area, 22% showing moderate interest, and 8% being uncertain or not interested. The gender distribution among the stakeholders was predominantly female (73%), and their educational qualifications varied, with 34% holding a first-level master's degree, 32% a bachelor's degree, 27% a diploma in nursing, 5% a master's degree, 2% a second-level master's degree, and none with a doctoral degree. The average professional experience among the participants was 14 years, with a standard deviation of 10 years.

| Author(s), year | Educational Focus | Length, Content | Graduation | | Teaching Mode | |
			PRE	POST	Classical	Online
Bridger, 2007	Nephrology Nursing (General)	1 Year with 50:50 ratio between theory and practice.		X	X	
Colobong Smith, 2022	Nephrology Nursing in acute care settings	HD TRAINING PROGRAM: 2 days of 8 hours of didactic and a minimun of 64 hours performing HD with a preceptor		X	X	
		PD & CKRT TRAINING PROGRAM: 6 hours of training (each) plus unspecified hours observing an experienced nephrology RN + unspecified direct experience with support of experienced nephrology RN		X	X	
Douglas & Bonner, 2010	Nephrology Nursing (General)	2 Years; the nephrology nursing education is part of the local Nurse Practitioner Master's Degree		X	X	
Fuchs & Thomas,2003	Nephrology nursing basic core curriculum	From 10 to 16 hours; the european basic core curriculum for nephrology nursing should be adopted in the Bachelor level studies	X		X	
Gelmez et al. 2002	Nurses' knowledge of hemodialysis vascular access	Authors report 3 days of educational intervention but it's unclear how many hours or learning were		X	X	
Hurst, 2003	Nephrology Nursing (General)	Not reported		X		X
Jenkins, 2019	Nephrology Nursing (General)	Not reported		X		X
McCann & Sedgewick, 2005	Nephrology Nursing Post basic core curriculum	Can vary from 6 weeks full-time study to 2 years part time study		X	X	
Poh-Choo & Zaki, 2003	Post Basic Renal Nursing Course	6 months: 8 weeks of intensive lectures, seminars, and workshops on the theory of renal diseases and RRT, PLUS 16 weeks of practical experience		X	X	
	Peritoneal Dialysis (General)	4 weeks (176 hours) with 48 hours allocated to knowledge acquisition and 128 hours of skill acquisition		X	X	
Thaiyuenwong et al., 2011	Peritoneal Dialysis (General)	4 months with 173-hour integrated healthcare knowledge and 300-hour skill development with actual practices		X	X	
Yousef et al., 2019	Hemodialysis (infection control measures)	9 hours educative intervention		X	X	

Table 2. Educational programs relating to nephrology nursing.
Legend. HD = Hemodialysis; PD = Peritoneal Dialysis; CKRT = Continuous Kidney Replacement Therapy; RN = Registered Nurse; RRT = Renal Replacement Therapy.
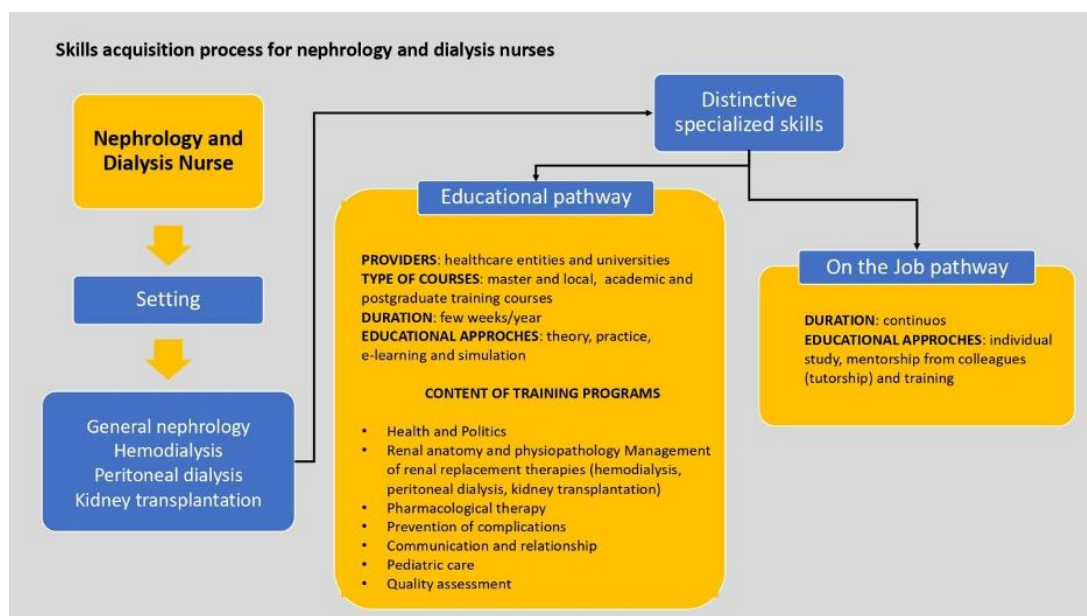

Figure 2. Skills acquisition process for nephrology and dialysis nurses.

Assessment of Educational and Training skills

A comprehensive evaluation of competencies in nephrology and dialysis was conducted using a specially developed questionnaire based on the results of this scoping review. This review identified

six key domains for the training of nephrology and dialysis nurses, which included elements of health policy [27], renal anatomy and pathophysiology [27, 44], management of renal replacement therapies [27, 34, 44], pharmacotherapy [34], and complication prevention [27, 34, 44]. Additional aspects such as relational skills, pediatric care, and quality monitoring completed the assessment framework [36, 41, 45]. The questionnaire was structured into 10 domains of competencies, corresponding to ten questions, utilizing a 5-point Likert scale where one indicated "none" and five indicated "excellent". The domains included: theoretical knowledge of nephrology specialties; knowledge of specialist medications for chronic kidney disease; knowledge of nutritional management for chronic kidney disease; technical-specialist skills in hemodialysis; technical-specialist skills in peritoneal dialysis; technical-specialist skills in kidney transplantation; communication skills; patient health education abilities; competencies in humanistic care; and research capabilities (Table 3). This evaluation aimed to identify and analyze in detail both the established competencies and the areas requiring further training among nurses specialized in nephrology and dialysis. Through a systematic analysis of the questionnaire responses, the goal was to delineate a comprehensive profile of the current capabilities of healthcare providers in the context of renal care. This approach enabled the identification of key competencies needing further development and the recognition of specific educational gaps, thereby providing a solid foundation for the planning of targeted educational programs and continuous improvement interventions in the quality of care provided to patients with renal diseases. Following the administration of the questionnaire to the nurses enrolled in SIAN, the stakeholder consultation continued with representatives from various research groups, including the institutional board, the scientific committee, the hemodialysis group, the peritoneal dialysis group, the renal palliative care group, the chronic kidney disease nutrition group, and the kidney transplant group of SIAN. This consultation led to unanimous responses across all groups, identifying a critical need to incorporate the identified competency domains into the undergraduate and postgraduate nephrology and dialysis curricula for nursing education. Furthermore, further considerations emerged related to the fact that these areas, explored and identified during the initial phase of the consultation, are essential to improve the training and preparation of nurses in the field of nephrology and dialysis.

Skills Investigated	None	Low	Medium	High	Excellent
	n (%)	n (%)	n (%)	n (%)	n (%)
Theoretical knowledge of nephrology specialties	46 (15)	48 (16)	61 (20)	87 (29)	58 (19)
Knowledge of specialist medications for chronic kidney disease	21 (7)	77 (26)	132 (44)	61 (20)	9 (4)
Knowledge of nutritional management for chronic kidney disease	16 (5)	50 (17)	117 (39)	90 (30)	27 (9)
Hemodialysis: techinal-specialist skills	127 (42)	54 (18)	48 (16)	43 (14)	28 (9)
Peritoneal dialysis: techinal-specialist skills	131 (44)	68 (23)	64 (21)	31 (10)	6 (2)
Kidney transplantation: techinal-specialist skills	0	8 (3)	69 (23)	146 (49)	77 (26)
Communication skills	30 (10)	53 (18)	98 (33)	72 (24)	47 (16)
Patient health education abilities	35 (12)	62 (21)	106 (36)	75 (25)	22 (7)
Competencies in humanistic care	1 (0.2)	11 (4)	71 (23.4)	133 (44.4)	84 (28)
Research capabilities	35 (12)	86 (29)	113 (38)	48 (16)	18 (6)

Table 3. Stakeholder consultation.

Discussion

This review synthesized the available literature on the skills acquisition pathways of nephrology and dialysis nurses worldwide, examining both academic pathways [29, 33, 38] and field experience pathways [32, 34, 37] (Figure 2). A recent conceptual inquiry emphasized that the development of personal, social, and professional skills should occur both during studies and within the workplace context [46]. Our study indicates that the educational pathway is a crucial method for developing

competencies in nephrology and dialysis nurses [26–28]. Supporting this, several studies suggest that the acquisition of specialized skills should involve dedicated academic courses, such as university courses, master's programs, or postgraduate training [47–49]. Mrayyan et al. [50] argue that educational preparation should precede the development and maintenance of clinical competence. The findings from various studies highlight significant variability in the training pathways for nephrology and dialysis nurses. While some studies [26, 27] report undefined and non-standardized training pathways, others [27–30] show attempts at national and international standardization. This heterogeneity represents a significant obstacle to creating a unified curriculum, which seems essential for ensuring high-quality fundational knowledge and competencies for nephrology nurses [29–31, 44]. The lack of uniformity concerns not only the actual availability of courses but also extends to the duration, structure, and content of training programs. The duration of training courses varies considerably, ranging from a few weeks to a year [32–41]. This diversity affects the depth and breadth of acquired competencies and raises questions about the consistency of educational outcomes. Analysis of training programs reveals significant variation in educational content, with some programs emphasizing theoretical training and others integrating substantial practical or laboratory training [41]. The analysis of nephrology and dialysis training programs reveals a rich and varied landscape of educational content, including elements of health policy [27], renal anatomy and pathophysiology [11, 27], management of renal replacement therapies [27, 34, 44], pharmacotherapy [34], and complication prevention [27, 34, 44]. Relational aspects, pediatric care, and quality monitoring complete the picture [36, 41, 45]. The theoretical knowledge acquired through educational program content represents, according to Almarwani and Alzahrani [51], a key factor in the competence acquisition process for professionals. This is consistent with the stakeholders' consultation. When the stakeholders convened, their discussions focused on various specialized competencies. These included theoretical knowledge in nephrology, expertise in medications for chronic kidney disease, nutritional management strategies, and technical skills in hemodialysis, peritoneal dialysis, and kidney transplantation. Additionally, they emphasized the importance of communication skills, patient health education, humanistic care competencies, and research capabilities. The variety of content identified in our study demonstrates a holistic approach to nephrology nursing education, reflecting the holistic nature of care for patients with kidney disease, as highlighted by Clementi et al. [52]. However, the lack of uniformity in training content underscores the need for greater standardization. A nationally or internationally standardized curriculum could enhance the quality of training, ensuring that all nephrology nurses acquire a common set of core competencies, regardless of their training location. As asserted in the recent study by Wu et al. [53], implementing a standardized curriculum could be a prerequisite for overall improvement in nursing competencies. The heterogeneity also pertains to training providers; we identified both local courses organized by healthcare entities and supra-local university programs. For instance, Billo de Oliveira et al. [54] report the case of Brazil, where nurses acquire the title of nephrology specialist through a national certification process. In contrast, Morocco lacks specialized training in nephrology nursing [55]. This lack of standardization in training offerings is also reflected in diverse educational approaches, including theory, practice, e-learning, and simulation [28, 30, 31, 40]. According to a recent study, the absence of explicit standards for national and international training could push nephrology and dialysis services to develop staff training programs [56]. Our study highlighted how skill acquisition is not confined to the educational context [29, 31, 33, 38] but also integrates into the working environment [32, 34, 37]. In this context, Ortega et al. [57] conceive the training process as a continuum, beginning with the basic training of the professional and continuing throughout their professional life. Our review highlights that, in practice, professionals enhance their skills through various modalities, including individual study, mentorship from colleagues, and training. A recent conceptual analysis suggests that competence

emerges through a process where nurses continually update their knowledge, maintaining a state of "continuous development" in constant evolution [50]. Regarding this, De Pietro [35] considers on-field training as the predominant mode through which nephrology and dialysis specialized nurses acquire skills, often under the expert guidance of colleagues serving as tutors. Similarly, according to Bonner and Walker [58], experience is essential for expertise acquisition. Although our study aligns with literature asserting that clinical experience and on-field training are crucial stages in skill acquisition [43, 59, 60], literature analysis has revealed conflicting opinions regarding the validity of different forms of on-field skill acquisition [32, 37].

Limitations

A limitation of this study is the inclusion of a limited number of studies within our scoping review. This is attributed to both the linguistic inclusion criteria chosen and the limited availability of studies in the literature that specifically address the skills acquisition journey of nephrology and dialysis nurses. Additionally, the low number of studies may also be attributed to the fact that the search for grey literature was conducted solely through the Google Scholar search engine. Nevertheless, precisely delineating available training pathways based solely on the literature is challenging. In this regard, our study has taken the initial step, namely, the examination of literature pertaining to the training of nephrology and dialysis nurses. The obtained data, however, may assist in expanding research in this field.

Implications for clinical practice

This study aims to provide a synthesis of the available global literature concerning the skills acquisition journey of nephrology and dialysis nurses. The understanding of the current state is intended to serve as support and a starting point for institutions responsible for specialized training of nephrology nurses to reflect on the need for standardization of pathways and to initiate a process of aligning training methods, both at the national and international levels.

Conclusions

Given the expected increase in chronic kidney disease in the 21st century, with a significant rise forecasted, a comprehensive and adequate response from global healthcare systems becomes essential. Within the healthcare context of patients with renal conditions, nephrology and dialysis nurses play an indispensable role in delivering excellent nursing care. The safety and effectiveness of specific professional interventions are inherently linked to the acquisition of high-level professional skills. Consequently, this study provides the basis for reflecting on the need for a review and standardization of training pathways. However, this should entail a clear definition of nephrology and dialysis nurses' competencies through the involvement of International Nephrology Nursing Societies and universities, laying the groundwork for the development of a specific curriculum.

Supplementary file

Supplementary File (Search strategy, JBI quality and bias assessment) are available upon request.

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