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Review

Optimizing Nursing Care for Children Receiving Chronic Hemodialysis: A Narrative Review

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Abstract

Children with kidney failure who receive maintenance hemodialysis face a demanding treatment regimen that affects their physical health, emotional well-being, schooling, and family life. Nurses are the professionals in most continuous contact with these children, yet nursing-specific guidance for pediatric hemodialysis remains fragmented. PubMed/MEDLINE, CINAHL, and Scopus were searched up to August 2026 and the peer-reviewed literature was selected and synthesized narratively, with evidence labeled by its directness to children on hemodialysis. This narrative review synthesizes the available evidence on nursing strategies for children receiving chronic hemodialysis across five domains: vascular access management and infection prevention; procedural pain and needle-related distress; psychosocial support, resilience, and health-related quality of life; family-centered care and caregiver support; and physical activity, symptom management, and education. Guidelines and small pediatric studies suggest that standardized nurse-led catheter care bundles, structured caregiver education, and preference for arteriovenous fistulas where feasible may help reduce catheter-related bloodstream infections. Topical anesthesia, a pharmacological intervention, is recommended in pediatric guidelines; non-pharmacological interventions, including cryotherapy, distraction, and virtual reality, appear to reduce cannulation pain and anxiety, although part of this evidence comes indirectly from other pediatric procedures. Routine psychosocial screening, peer support, resilience-oriented communication, and caregiver support are proposed to address the impaired health-related quality of life consistently reported in this population, largely on the basis of indirect evidence. Intradialytic exercise and in-unit schooling may further support physical and developmental outcomes. Much of the evidence comes from small single-center studies, and several practice considerations are extrapolated from adult cohorts. Integrated, family-centered nursing models, supported by specialized training and structured transition programs, should be evaluated in multicenter longitudinal studies.

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1. Introduction

Chronic kidney disease (CKD) is less common in children than in adults, but children who progress to kidney failure face lifelong treatment and a substantially higher risk of morbidity and mortality than their healthy peers [1]. While kidney transplantation is the preferred treatment, many children require a period of maintenance hemodialysis while awaiting a donor, after graft loss, or when peritoneal dialysis is unsuitable. Pediatric hemodialysis differs from adult practice in its technical demands, including small vessels, low blood volumes, and age-appropriate prescriptions, and in the need to protect growth and development throughout treatment [2].

Nurses are the professionals in most continuous contact with children on hemodialysis. They see each child for several hours, usually three times a week, and over months or years. Their role therefore extends well beyond operating the dialysis machine. This nursing care is delivered within a multidisciplinary team of pediatric nephrologists, dialysis nurses, dietitians, psychologists, social workers, teachers, and play therapists [2,3], and many of the interventions discussed here depend on that team. Nurses with specialized dialysis training also differ from general pediatric nurses in their competencies, including cannulation and access surveillance [4], a distinction that matters when the evidence is interpreted. Nephrology nurses must address complex physiological needs while supporting the child's developmental trajectory [5,6]. Core clinical responsibilities include the rigorous management of vascular access to minimize infection and thrombosis, together with consistent psychosocial support [7,8]. Studies of nurses' knowledge and performance in pediatric hemodialysis units have identified gaps in vascular access care and complication prevention, which underlines the need for evidence-based guidance [9,10].

The treatment regimen itself is a major source of distress. Children must cope with repeated needling, long sessions, fluid and dietary restrictions, missed school, and visible medical devices, while parents take on the burden of home management [11]. The prevalence of pediatric CKD is increasing, and physical strain and social isolation frequently erode the well-being of these patients [12]. Nursing care in this setting must therefore move from a purely technical focus toward a holistic framework that integrates physical, emotional, educational, and family needs.

The chronic setting also differs from acute kidney replacement therapy in critically ill children, where outcomes are driven mainly by the underlying disease and the priorities are hemodynamic stability and short-term survival [13,14]. In chronic hemodialysis, the nurse's work is longitudinal: preserving vascular access over years, building trust, supporting adherence, and protecting quality of life. A recent scoping review of nephrology nursing competencies highlighted that this combination of technical, educational, and relational skills is central to nursing practice in dialysis [4].

Despite this, nursing-specific evidence for pediatric hemodialysis is scattered across small studies, adult literature, and general pediatric nursing research. Existing reviews address single components, such as nephrology nursing competencies in general [4], nursing of catheter-related bloodstream infection [15], pain during fistula cannulation [16], virtual reality [17], and children's experiences of dialysis [18,19]. To our knowledge, no review has integrated these areas for children on chronic hemodialysis while stating how directly each source applies to them; this cross-domain, directness-labeled synthesis

is the novelty of the present work. The aim of this narrative review is to synthesize current evidence on nursing strategies for children receiving chronic hemodialysis and to derive evidence-informed practice considerations. We focus on five domains: (1) vascular access management and infection prevention; (2) procedural pain and needle-related distress; (3) psychosocial support, resilience, and health-related quality of life (HRQoL); (4) family-centered care and caregiver support; and (5) physical activity, symptom management, and schooling. We also consider the implications for nursing education, workforce, and transition to adult care. Our review questions were: (1) which nurse-deliverable interventions have been evaluated in children on chronic hemodialysis, and with what outcomes; (2) where such evidence is absent, which findings from other populations may be transferable, and with what caution; and (3) what gaps remain in the current evidence and guidelines.

2. Materials and Methods

2.1. Review Design

This is a narrative review, and its reporting was guided by the SANRA scale for narrative review articles [20,21]. It was not designed as a systematic review. The five review domains were defined a priori, before the sources were examined. They were derived from the core nursing responsibilities in pediatric hemodialysis described in pediatric dialysis guidance and in the nephrology nursing literature [2–4], and from the review questions stated in the Introduction. The domains were not changed during synthesis; the thematic analysis was used only to organize the findings within each domain (Section 2.6).

We defined nursing care as interventions delivered or coordinated by nurses, recognizing that most are delivered within a multidisciplinary team [2,3]. Interventions delivered solely by other professions were outside the scope of the review. Where reported, we noted whether care was delivered by nurses with specialized dialysis training.

2.2. Search Strategy

PubMed/MEDLINE, CINAHL, and Scopus were searched between January and August 2026. This period refers to when the searches were conducted, not to the publication dates of eligible studies; no limit on publication date was applied. The last search was run on 31 August 2026. Search terms combined pediatric descriptors (child*, pediatric, paediatric, adolescent*) with treatment terms (hemodialysis, haemodialysis, dialysis, kidney failure, end-stage kidney disease) and nursing and outcome terms (nursing, nurse-led, vascular access, arteriovenous fistula, central venous catheter, catheter-related bloodstream infection, pain, anxiety, virtual reality, psychosocial, resilience, quality of life, family, caregiver, exercise, education). The PubMed strategy was: (“Child”[Mesh] OR “Adolescent”[Mesh] OR child*[tiab] OR pediatric[tiab] OR paediatric[tiab] OR adolescent*[tiab]) AND (“Renal Dialysis”[Mesh] OR hemodialysis[tiab] OR haemodialysis[tiab] OR dialysis[tiab] OR “kidney failure”[tiab] OR “end-stage kidney disease”[tiab]) AND (“Nursing”[Mesh] OR nursing[tiab] OR nurse-led[tiab] OR “vascular access”[tiab] OR “arteriovenous fistula”[tiab] OR “central venous catheter”[tiab] OR “catheter-related bloodstream infection”[tiab] OR pain[tiab] OR anxiety[tiab] OR “virtual reality”[tiab] OR psychosocial[tiab] OR resilience[tiab] OR “quality of life”[tiab] OR family[tiab] OR caregiver[tiab] OR exercise[tiab] OR education[tiab]). The strategy was adapted for the other databases. Reference lists of included articles were hand-searched. Clinical practice guidelines and professional society documents were sought through these searches and websites of pediatric nephrology and nephrology nursing societies, e.g., ESPN, KDOQI.

2.3. Eligibility Criteria

The primary population was children and adolescents receiving maintenance hemodialysis. Interventions of interest were nursing care or nurse-deliverable interventions in the five domains. Relevant outcomes were infection rates, patency, and complications for vascular access; patient-reported outcomes and validated measures of anxiety, pain, stress, coping, and resilience for psychosocial interventions; and emotional, physical, school, and social functioning for quality of life, in line with published recommendations for HRQoL assessment in pediatric kidney failure [22].

We included peer-reviewed articles published in English with full text available: original studies, systematic and narrative reviews, clinical guidelines, and expert surveys. Preprints, theses, repository documents, book chapters, and non-English articles were excluded. Product labeling (the US prescribing information [23] and the European Union Summary of Product Characteristics [24]) was used only for the dosing and safety of topical anesthetics.

Because pediatric evidence is limited, evidence from other populations (adult hemodialysis, pediatric peritoneal dialysis, pediatric kidney transplantation, and general pediatric procedural care) was retained only when three conditions were met: no adequate pediatric hemodialysis evidence addressed the question; the intervention could be delivered by nurses in a pediatric unit without substantial modification; and the outcome was relevant to children on hemodialysis. Adult studies were excluded when pediatric hemodialysis evidence was available for the same question. Such extrapolations are identified in the text.

2.4. Source Selection

Titles and abstracts, and then full texts, were assessed by two authors (ALBR and BL); disagreements were resolved by a third author (CM). The search identified 197 records, 98 full texts were reviewed, and 94 sources were retained. The reference list also contains two methodological references on narrative reviews [20,21] and two product labeling documents [23,24], which were not obtained through the search. A source was assigned to the core evidence base if it met the eligibility criteria (Section 2.3) and directly supported at least one practice consideration, either as primary evidence on a nurse-deliverable intervention or relevant outcome, or as a guideline, consensus statement, or review on which a practice consideration was based. On this basis, 41 of the retained sources, together with the US product labeling [23], formed the core evidence base of 42 references. The remaining 53 sources were used only for contextual background, such as epidemiology, the clinical and organizational context of pediatric hemodialysis, the burden of disease, and the definition of concepts, and were not used to support practice considerations.

2.5. Appraisal and Hierarchy of Evidence

Each source supporting a practice consideration was classified on two separate characteristics. The first was the applicability of the study population to children on chronic hemodialysis: direct (pediatric hemodialysis), indirect (other pediatric kidney disease or other pediatric procedures), or extrapolated (adult hemodialysis). The second was the type of source: primary study (with its design), clinical guideline or consensus document, or review (systematic, scoping, integrative, or narrative). The two characteristics were recorded separately because a guideline or review may combine evidence with different degrees of applicability; such sources were labeled according to the population on which their recommendations or conclusions mainly rest. For example, the KDOQI guideline [25] rests mainly on adult evidence and was therefore labeled as extrapolated. For the key sources, we recorded source type and study design, sample size,

population, applicability, and major limitations. . We did not apply formal design-specific risk-of-bias tools or perform a meta-analysis; this is a limitation of the review and not a consequence of its narrative design. We therefore reserved normative wording for practices supported by guidelines and used more cautious wording elsewhere.

Where a systematic or narrative review and a primary study included within it were both cited, the primary study was used to provide detail and was not counted as independent support, in order to avoid double counting of evidence.

2.6. Data Extraction and Synthesis

One author (BL) extracted the study population, design, sample size, intervention or exposure, outcomes, main findings, and limitations, together with the underlying kidney disease and clinical severity where these were reported. Findings were grouped thematically into the five domains, according to the strength and directness of the supporting evidence. A second author (ALBR) checked the extracted data against the original sources; disagreements were resolved by discussion and, when needed, by a third author (CM).

3. Vascular Access Management

3.1. Choice of Access and the Nurse's Advocacy Role

A functioning vascular access is the lifeline of hemodialysis, and its care is among the most demanding nursing responsibilities. Children may be dialyzed through a tunneled central venous catheter (CVC), an arteriovenous fistula (AVF), or, less often, an arteriovenous graft. A recent international survey by the European Pediatric Dialysis Working Group (EPDWG) and the ESPN Dialysis Working Group found that CVCs remain widely used in children and that preventive measures and treatment strategies for catheter-related bloodstream infection (CRBSI) vary considerably between centers [26]. The authors called for uniform, evidence-based pediatric standards. European practical guidelines recommend permanent arteriovenous access whenever the child's size and vessels allow, because catheters carry higher risks of infection, thrombosis, and central venous stenosis [2]. The ESPN Dialysis Working Group consensus, developed with GRADE, emphasizes venous preservation and notes that fistulas may not be suitable for very young children or for those expected to spend only a short time on dialysis [27]. The largely adult KDOQI 2019 update similarly moved from a single access strategy toward an individualized ESKD Life-Plan [25].

Nurses play an advocacy role in this choice. By protecting arm veins from unnecessary venipuncture, raising access planning early in multidisciplinary meetings, and preparing children and families for fistula surgery, nurses may help shift practice away from long-term catheter dependence.

3.2. Prevention of Catheter-Related Bloodstream Infections

When a CVC is needed, meticulous catheter hygiene and standardized protocols are the main defense against CRBSI [15,27]. A recent review of nursing advances in CRBSI among children on maintenance hemodialysis emphasized bundled measures: strict aseptic technique at connection and disconnection, chlorhexidine-based skin antisepsis, standardized dressing changes, minimal manipulation of the catheter, appropriate lock solutions, and systematic surveillance of infection rates [15]. Nurse education may be a useful lever. An evidence-based education program for pediatric hemodialysis nurses significantly improved their knowledge and practice regarding central venous line care [28].

Studies of nurses' performance in pediatric units show that knowledge gaps in the prevention of vascular access complications are common and are associated with unsatisfactory practice [9,10]. Routine assessment of catheter function, exit site, and tunnel at each session allows early detection of thrombosis, dysfunction, or local inflammation before they compromise treatment [29]. Nursing protocols may therefore include a structured site assessment, clear escalation criteria, and documentation that supports unit-level audit.

3.3. Arteriovenous Fistula Cannulation and Care

Cannulation is one of the most technically complex nursing tasks in dialysis and requires advanced skill and continuous monitoring of the access during each session [4]. Cannulation technique influences fistula longevity. In adolescents, a cushion cannulation technique was associated with fewer complications than common cannulation methods [30]. Structured instructional guidelines improved nurses' performance in AVF puncture care for children on hemodialysis, which suggests that targeted training may narrow competency gaps [31].

Patients and families also contribute to fistula survival. In adults, fear of fistula failure is associated with self-care behaviors regarding the AVF, suggesting that anxiety about the access should be addressed explicitly in education [32]. In pediatric care, an empowerment program for mothers on AVF care improved both their knowledge and their children's quality of life [33]. Patient satisfaction with nursing care also appears linked to access functioning and to the patient's experience of cannulation [34]. On this small-study and partly adult evidence, nurses may teach age-appropriate self-checks such as feeling the thrill, protecting the access arm, and recognizing signs of infection, and involve parents in daily surveillance.

3.4. Coordination of Care Around the Access

Pediatric nurses also manage complications after vascular surgery, and specialized nursing programs with adequate staffing have been associated with fewer postoperative and procedural complications [35]. Advanced practice nursing models can extend this role. The Novel Intervention in Children's Healthcare (NICH) program, applied to pediatric hemodialysis, used individualized support to address socioeconomic and family barriers that affect adherence and continuity of care [36]. In another pediatric setting, a cross-sectional study examined factors influencing nurses' knowledge and practice of catheter fixation [37]; this is indirect evidence, and peer learning among nurses could be explored as a support for dialysis access care.

3.5. Body Image and the Visible Access

Adolescents often experience catheters and fistulas as stigmatizing. A qualitative study showed that the catheter carries strong meanings related to body image, restriction, and social difference for adolescents on dialysis [38]. Nurses can reduce this burden by using discreet dressings, discussing clothing and activity choices, and talking about the access in developmentally appropriate language that frames it as a means of participation rather than a mark of illness.

4. Procedural Pain and Needle-Related Distress

4.1. Why Procedural Distress Matters

A child with an AVF may undergo more than 300 needle insertions per year. Repeated painful procedures can lead to anticipatory anxiety, needle fear, avoidance, and long-term medical trauma. A systematic review of pain management for AVF cannula-

tion in children found that several non-pharmacological methods are effective, inexpensive, and feasible within routine nursing care [16]. Expert commentary in vascular access nursing has warned that dismissive reassurance ("it won't hurt") undermines trust and recommended validating children's concerns with evidence-based communication [39]. Pediatric nurses recognize atraumatic care as a core principle but report barriers to applying it consistently during invasive procedures, including time pressure and limited training [40].

4.2. Pharmacological Methods: Topical Anesthesia

Topical anesthesia is a pharmacological intervention. Eutectic lidocaine 2.5%/prilocaine 2.5% cream is a commonly used agent. Topical anesthetic creams applied before fistula cannulation are recommended in pediatric hemodialysis guidelines, and routine use should be considered, with timing built into the session schedule [2]. The cream is applied as a thick layer to intact skin under an occlusive dressing, generally at least 60 min before the procedure; analgesia can increase for up to 3 h under occlusion and persists for 1 to 2 h after removal [23]. In the US prescribing information, maximum doses depend on age and weight: 1 g over 10 cm^2 for 1 h up to 3 months of age or below 5 kg; 2 g over 20 cm^2 for 4 h from 3 to 12 months and above 5 kg; 10 g over 100 cm^2 for 4 h from 1 to 6 years and above 10 kg; and 20 g over 200 cm^2 for 4 h from 7 to 12 years and above 20 kg [23]. The European Union Summary of Product Characteristics, harmonized by the European Medicines Agency, sets doses by age alone and uses different application times: up to 1 g over 10 cm^2 for 1 h from birth to 2 months; up to 2 g over 20 cm^2 for 1 h from 3 to 11 months; up to 10 g over 100 cm^2 for 1 to 5 h from 1 to 5 years; and up to 20 g over 200 cm^2 for 1 to 5 h from 6 to 11 years [24]. It allows a single dose per 24 h below 3 months of age and no more than two doses, at least 12 h apart, per 24 h from 3 months of age, and states that anesthesia of intact skin lasts at least 2 h after removal of the dressing following a 1 to 2 h application [24]. Prilocaine can cause methemoglobinemia. The US labeling contraindicates the cream in congenital or idiopathic methemoglobinemia, whereas the EU Summary of Product Characteristics lists these conditions and glucose-6-phosphate dehydrogenase deficiency among its warnings. Both documents advise that the cream should not be used in neonates born before 37 weeks or in infants under 12 months receiving methemoglobin-inducing agents [23,24]. Young children need observation to prevent ingestion of the cream or dressing and eye contact, and absorption from other local anesthetic products should be taken into account [23]. Because the two labels differ in age bands, weight criteria, application times, and repeat dosing, nurses should follow the labeling authorized in their own country. These limits come from product labeling and, to our knowledge, have not been studied specifically in children on hemodialysis.

4.3. Non-Pharmacological Physical Methods

Cryotherapy at the puncture site reduced pain during AVF cannulation in children on hemodialysis in a one-group pre–post study of 40 children, in which the effects of distraction could not be excluded [41]. Combining cryotherapy with a balloon-inflation technique produced significant reductions in both behavioral pain responses and self-reported pain [42]. A nurse-led dual intervention also reduced puncture pain and discomfort in patients on hemodialysis, in a population not specific to children [43].

4.4. Distraction and Virtual Reality

Evidence on simple distraction comes from other pediatric procedures and is therefore indirect. Simple interactive distraction, such as blowing bubbles or squeezing a ball, reduced anxiety, fear, and pain during venipuncture in children [44]. A scoping re-

view of audiovisual distraction confirmed its value for reducing pain during invasive procedures in children [45]. Immersive virtual reality (VR) is the most studied technology in this area. Direct evidence is available for VR: in children undergoing hemodialysis, immersive VR during AVF puncture reduced pain intensity [46], and a randomized double-blind trial reported reductions in pain, anxiety, and depressive symptoms [47]. A review of VR in pediatric hemodialysis vascular access concluded that it may make a feared procedure more tolerable [17].

Evidence from wider pediatric practice is indirect but consistent with these findings. A meta-analysis found that VR reduced pain and anxiety during venipuncture in children, with some studies also reporting changes in physiological parameters such as heart rate [48]. An integrative review [49] and a randomized trial during peripheral intravenous catheter placement [50] reached similar conclusions, and a recent concept analysis clarified the defining attributes of VR for procedural pain [51]. A case report described a child who coped with a painful procedure using a virtual natural environment, illustrating how relaxation may also make venous access easier [52]. Implementation research shows that integrating VR into routine pediatric care depends on staff buy-in, workflow, device hygiene, and leadership support [53]. Units may benefit from involving nurses early when planning such programs.

4.5. Psychological Support for Needle Fear

Needling-related anxiety should be assessed and managed as part of holistic care planning, with attention to past procedural experiences [54]. An online educational intervention for nephrology nurses improved their confidence and skills in supporting patients with needle fear [55]. Cannulation anxiety also affects nurses. Limited access availability and training deficits can make nurses anxious about cannulation, which may impair performance and the patient's sense of safety [56]. Institutions may consider providing supervised practice, mentoring, and emotional support for staff. Explaining procedures in developmentally appropriate terms can reduce illness uncertainty. In adults on hemodialysis, lower uncertainty and greater hope were associated with better self-management [57]. Table 1 summarizes pharmacological and non-pharmacological interventions that nurses can use during cannulation, together with the type of evidence supporting each.

Table 1. Nurse-deliverable interventions to reduce cannulation pain and distress in children on hemodialysis.

Intervention	Main Reported Effects	Population Studied	Practical Nursing Notes	Type of Intervention; Evidence and Directness
Topical anesthetic cream	Reduced cannulation pain	Pediatric hemodialysis guidelines [2]	Apply in advance; teach parents to apply at home before sessions	Pharmacological; guideline recommendation, pediatric hemodialysis (direct)
Cryotherapy at puncture site	Reduced pain scores	Children on hemodialysis [41]	Low cost; brief application before puncture	Non-pharmacological; one-group pre–post study, pediatric hemodialysis (direct)
Cryotherapy plus balloon inflation	Reduced behavioral and self-reported pain	Children on hemodialysis [42]	Combines physical and breathing-based distraction	Non-pharmacological; pediatric hemodialysis (direct)
Bubble blowing, ball squeezing	Reduced anxiety, fear, and pain	Children during venipuncture [44]	No equipment cost; suitable for younger children	Non-pharmacological; randomized trial, general pediatric venipuncture (indirect)
Audiovisual distrac-	Reduced procedural	Children, invasive	Tablets or videos	Non-pharmacological; scoping

tion	pain	procedures [45]	chosen by the child	review, general pediatric procedures (indirect)
Immersive virtual reality	Reduced pain and anxiety; depressive symptoms in one trial	Children on hemodialysis [46,47]; general pediatrics [48,50]	Requires devices, hygiene protocol, and staff training [53]	Non-pharmacological; randomized trial [47] and intervention study [46], pediatric hemodialysis (direct); meta-analysis and randomized trial, general pediatrics (indirect)
Needle-fear communication and education	Improved nurse confidence and patient support	Nephrology nurses [55]	Validate fears; avoid dismissive reassurance [39]	Non-pharmacological, nurse-targeted; educational intervention for nephrology nurses (indirect)

5. Psychosocial Support, Resilience, and Health-Related Quality of Life

5.1. The Burden on Quality of Life

Children on dialysis consistently report severely impaired HRQoL compared with healthy peers and with children who have received a kidney transplant [58]. A multicenter national study found that both children with CKD and their caregivers perceived lower HRQoL, with caregivers often rating it lower than the children themselves [59]. Physical and social functioning are particularly affected, and HRQoL should be measured routinely with validated pediatric tools as part of clinical care [22]. At the same time, many children show notable resilience in academic and behavioral domains [1].

In adolescents starting hemodialysis, HRQoL is shaped by coping style, and avoidant coping is associated with poorer well-being [60]. Children on regular hemodialysis also show high rates of growth impairment and psychosocial problems [61], and anemia correlates with lower HRQoL in children and adolescents on hemodialysis [62]. Social isolation, fatigue, and missed school recur as major determinants of quality of life [12]. Children's own accounts, synthesized in a systematic review of qualitative studies, describe the loss of normality, the burden of time spent on dialysis, the physical restrictions, and the importance of trusted relationships with staff [18]. A qualitative systematic review of supportive care for children and young people with kidney failure similarly highlighted unmet needs for emotional, informational, and social support [19].

5.2. Screening for Depression and Anxiety

Depression and anxiety are more common in children on dialysis than in their peers. However, a survey of pediatric nephrology practices found wide variation in access to psychologists, social workers, and other psychosocial services [63]. Psychological problems affect both children and parents and should prompt early referral [64]. Patients and caregivers describe mental health as a priority that is often addressed too late [65]. Similar psychosocial issues are reported in children awaiting or receiving organ transplants, supporting a common approach across the kidney failure pathway [66].

Nurses are well placed to screen. Brief validated questionnaires can be built into routine sessions, with defined referral pathways when anxiety, depressive symptoms, school refusal, or low self-esteem are identified [64]. As a practice consideration, screening may be repeated, because needs change with age and time on treatment.

5.3. Developmental and Adolescent Needs

Adolescence brings particular challenges. A qualitative study of psychosocial adaptation in children with CKD found that family acceptance, peer interaction, and guidance from adult mentors helped young people move through identity confusion

toward adaptation [67]. Nurses can support this by encouraging autonomy in self-care, respecting privacy, and creating opportunities for adolescents to talk without their parents present. When disease burden is high, palliative care consultation can address physical and psychosocial symptoms alongside active treatment. Providers, nurses, and caregivers in pediatric dialysis have supported its earlier integration [68].

5.4. Building Resilience and Coping

Direct evidence that nursing care fosters resilience in children on hemodialysis is lacking. A review of resilience in chronic and end-stage kidney disease, focused on peritoneal dialysis, provides indirect background [69]. Translational work on children with complex chronic conditions supports resilience-focused care as a route to better adaptation and quality of life [70].

Almost all of the evidence on resilience and social support comes from adults on hemodialysis. We present it as extrapolated evidence; it is largely associational and does not show that a nursing intervention designed to increase social support will improve resilience. Early studies identified stress, coping, and social support as central to adjustment [71,72], and psychosocial adaptation varies with time on dialysis, so support should be tailored to treatment duration [73]. Social support is strongly associated with psychological resilience [74,75], and family resilience predicts individual resilience over time [76]. Family functioning influences mental well-being through resilience [77], and internal protective factors such as hope and self-efficacy are key components [78]. A qualitative study described how patients achieve effective adjustment over time [79]. Perceived social support is also linked to patient characteristics that nurses can identify [80].

5.5. Self-Efficacy and Self-Management

In children on hemodialysis, self-efficacy mediates the relationship between knowledge, self-management, and quality of life [81]. Nursing education may therefore aim not only to transfer knowledge but to build children's confidence in managing fluids, diet, and access care. A psychoeducational nursing program improved self-efficacy and psychological adjustment in patients on hemodialysis, not specifically children [82]. Nurses may try to support self-efficacy with simple efficacy-enhancing feedback, naming and praising specific self-care successes at each session. Peer support may also be relevant: an integrative review linked social and peer support to self-efficacy in home dialysis [83]. As this evidence is indirect, pediatric units could explore this by organizing peer-support groups, mentoring by older patients, or structured group activities during sessions.

6. Family-Centered Care and Caregiver Support

The family is the main context in which a child lives with kidney failure, and nursing care must include parents and siblings. A qualitative study of families with a child with end-stage kidney disease described how the illness reshapes family relationships and dynamics, with parents balancing caregiving, work, and the needs of other children [84]. Similar strains continue after transplantation, which is indirect evidence [85]. These descriptive studies define the burden but do not test interventions. Caregivers of children on dialysis report high levels of burden, financial strain, and emotional exhaustion, and they call for advocacy and support from the care team [86].

Parents are often responsible for fluid and dietary adherence at home, a role that generates conflict and anxiety. A study of parental experiences in managing fluid adherence among children on hemodialysis highlighted the psychological pressure on both parent and child [87]. Caregiver distress is not only a family issue but also a clinical one.

In association studies of patients on hemodialysis, not specifically children, family resilience and perceived social support are associated with self-efficacy [88], and family functioning and self-efficacy mediate the relationship between depression and family resilience [89]. These associations do not establish causality; screening for parental distress and offering support or referral are therefore proposed as practice considerations. Family-centered nursing care includes validating caregiver stress, sharing information openly, and integrating emotional and, where relevant, spiritual assessment into routine care. Caregivers of children with complex chronic conditions describe the unpredictability of illness, the importance of faith, and the value of their bond with staff [90]. Intervention evidence is limited. In patients on hemodialysis who were not specifically children, a virtual family-centered support program improved the mental health of patients on hemodialysis and their family caregivers [91]. In pediatric hemodialysis, a practical guidance program on positive coping skills improved satisfaction among children on hemodialysis and their caregivers [92]. An empowerment program for mothers improved AVF care and their children's quality of life [33]. As indirect pediatric evidence, a systematic review in children with diabetic kidney disease found that nursing and family-centered care were associated with better quality of life [93]. In practice, units may consider involving parents in care planning, offering flexible education sessions, connecting families with social work and parent support groups, and paying attention to siblings, who are often overlooked.

7. Physical Activity, Symptom Management, and Schooling

7.1. Exercise During and Around Dialysis

Long sessions encourage inactivity, and children on hemodialysis often have reduced muscle mass and physical functioning. In a pediatric trial, muscle stretching and isometric exercises improved quality of life in children on regular hemodialysis [94]. A range-of-motion exercise program delivered by trained hemodialysis nurses improved the HRQoL of children with kidney failure [95]. Intradialytic physical exercise also reduced stress levels in children on hemodialysis [96]. Anemia is associated with lower HRQoL [62], but the reviewed evidence does not define hemoglobin thresholds for adjusting exercise intensity. Exercise should therefore be individualized and coordinated within the multidisciplinary team. Simple in-chair cycling, resistance bands, and stretching routines may be feasible during the session, with safety criteria agreed with the nephrologist.

7.2. Thirst, Fluid Restriction, and Symptom Relief

Fluid restriction is one of the hardest aspects of treatment for children, and thirst and dry mouth add to psychosocial stress. In a randomized trial, combining auricular acupressure with a fluid restriction program increased salivary flow and improved fluid adherence in children on hemodialysis [97]. Nurses can complement such approaches with practical strategies such as small cups, ice chips counted within the allowance, sugar-free gum for older children, and visual fluid charts that give the child a sense of control.

7.3. School and Social Participation

Repeated absences for dialysis sessions disrupt education and peer relationships. In a single-unit report, a unit that employed a full-time schoolteacher reported improved academic success and quality of life among children on hemodialysis [98]; this remains a promising strategy rather than a generalizable recommendation. Where a teacher is not available, nurses can coordinate with schools, schedule sessions to reduce missed classes

where possible, and make space for homework during treatment. Peer-support groups and organized activities within the unit can further reduce isolation and allow children to share strategies for coping with school absence and friendships.

8. Nursing Workforce, Education, and Transition to Adult Care

8.1. Specialized Training and Staffing

The interventions described above depend on a skilled and stable nursing workforce. Nephrology nursing requires a broad set of competencies spanning technical, educational, and relational domains [4]. In pediatric dialysis, these competencies must be adapted to each developmental stage, from infants to adolescents. Specialized dialysis nurses are trained for this role, and their competencies differ from those of non-specialist nurses [4]. The included studies did not, to our knowledge, compare outcomes according to nurses' specialist training, so this effect remains untested.

Structured instructional programs improve nurses' performance in fistula care [31] and central line care [28], and online education improves support for patients with needle fear [55]. Mentoring of novice staff and peer knowledge exchange may support cannulation and catheter care skills [37], although this is indirect evidence. Institutions may also recognize the emotional load of pediatric dialysis nursing and address nurses' own cannulation anxiety through supervised practice and support [56]. Training in atraumatic care could be part of orientation and continuing education [40].

As an organizational proposal derived from our own reasoning rather than from specific evidence, primary nursing, in which the same small team cares for a child over time, may support continuity, trust, and consistent monitoring of the access. Advanced practice nursing roles can coordinate complex cases and address social barriers to care [36]. Nursing leaders may advocate for protected time for psychosocial work and for staffing levels that allow it.

8.2. Transition to Adult Care

Transition to adult services is a high-risk period for loss of adherence, access complications, and graft or treatment failure. Psychosocial adaptation during the move from childhood to adulthood depends on family acceptance, peer relationships, and mentoring [67]. Nurses play a central role in preparing young people for autonomy by teaching self-cannulation or self-assessment of the access where appropriate, building knowledge of medications and fluid management, and gradually shifting responsibility from parents to the adolescent [11]. Structured transition programs with joint pediatric–adult clinics and named nurse coordinators are proposed as an organizational option; direct evidence in pediatric hemodialysis is lacking.

9. Discussion

This review suggests that effective nursing care for children on chronic hemodialysis rests on two interdependent pillars: technical precision in vascular access management and the consistent delivery of developmentally appropriate psychosocial and family support. These pillars are not separate. A child who fears cannulation may resist treatment, which threatens access survival and adequacy. A catheter infection leads to hospitalization, missed school, and further distress. Conversely, a trusting relationship with nurses who manage pain well makes each session safer and more tolerable. In adults, satisfaction with nursing care is closely linked to the experience of access care [34], and children's own accounts emphasize the importance of trusted relationships with staff [18].

This review adds to earlier work by bringing together domains that have previously been reviewed separately [4,15–19] and by labeling how directly the evidence applies to children on chronic hemodialysis. Read across domains, the findings also reveal tensions that single-topic reviews do not. Parental involvement improves access care and is central to family-centered care [33,92], yet adolescents need progressive autonomy and privacy [67]. Schooling, intradialytic exercise, and psychosocial work compete for the same hours and the same nursing time. VR may reduce distress [46,47], but shared devices require hygiene protocols [53] in a population at high risk of infection. Such trade-offs need local resolution and have not been studied directly.

The evidence is also inconsistent in several respects. Permanent access is favored in European guidance [2,27], yet tunneled catheters remain widely used in children [26], fistulas may be unsuitable in very young children [27], and adult guidance has moved away from a single access strategy [25]. Children and their caregivers do not always agree on HRQoL, with caregivers often rating it lower [59], so the choice of informant may change conclusions. Reductions in cannulation pain are reported for several methods [41,42,46,47], but we did not identify head-to-head comparisons between topical anesthesia and non-pharmacological methods, and the benefit of combining them is unknown. Exercise studies report HRQoL or stress [94–96] rather than a shared set of physical outcomes, which limits comparison.

Study quality limits the weight of these findings. Many pediatric studies are small, single-center, pre–post designs without control groups; the cryotherapy study [41], for example, was a one-group study with possible confounding by distraction. Randomized evidence in pediatric hemodialysis is confined to a few areas, such as VR [47] and thirst management [97]. Direct pediatric hemodialysis evidence is strongest for procedural pain and is moderately available for access care and exercise. Psychosocial, resilience, and self-efficacy statements rest heavily on adult or observational evidence [71–80,82], and family interventions are drawn from mixed populations. Observational associations should not be read as evidence that a nursing intervention will change the outcome. Table 2 makes this distinction explicit for each domain.

Current guidelines leave important gaps for nursing practice. The European pediatric hemodialysis guideline dates from 2005 and is general in scope [2]. The ESPN consensus is focused on vascular access and, where evidence is low, relies on graded expert opinion [27], and KDOQI is mainly directed at adults [25]. A recent international survey found that CRBSI prevention and treatment still vary considerably between centers [26]. To our knowledge, current guidelines offer little specific guidance on nurse staffing and specialist training in pediatric units, protocols for needle-related distress beyond topical anesthesia, psychosocial screening intervals, caregiver support, schooling, or intradialytic exercise.

These considerations should be read in the context of team-based care. Physician-led reviews and position papers concentrate on prescription, access choice, technical aspects, outcomes, and unit organization [2,3], and they outline the responsibilities of the interdisciplinary team [3]. Our review complements them by focusing on what nurses deliver at the chairside, but many outcomes cannot be attributed to nursing alone, because dietitians, psychologists, social workers, teachers, and nephrologists contribute to the same outcomes [2,3]. Clinical engineers and technicians are responsible for areas such as water quality and machine safety [2]; their role was outside the scope of our search and deserves separate review. Few studies distinguished specialized dialysis nurses from non-specialist nurses, although education programs improved nurses' performance [28,31], so the contribution of specialization remains uncertain.

Kidney disease etiology and clinical severity also bear on care, for example through syndromic disease, comorbidity, residual kidney function, time on dialysis, or transplant

candidacy, but the included nursing studies rarely reported outcomes stratified by these factors. We could not therefore tailor the practice considerations by pathology or severity, and individualization within the multidisciplinary team remains necessary.

Table 2 summarizes the resulting evidence-informed practice considerations and the directness of their supporting evidence, and Table 3 summarizes the key sources.

Table 2. Summary of evidence-informed nursing practice considerations for children on chronic hemodialysis.

Domain	Key Practice Considerations	Main Supporting References	Source Type; Applicability of Population
Vascular access	Advocate for AVF where feasible; protect veins; consider standardized CVC care bundles; assess site at every session; audit CRBSI rates	[2,15,25–29]	Guidelines and consensus [2,27], narrative review [15], survey and small studies; pediatric hemodialysis—direct; adult guideline [25]—extrapolated
Cannulation	Consider training and mentoring in cannulation techniques; structured guidelines; teaching families AVF care	[30,31,33,37]	Pediatric hemodialysis—direct (small studies); other pediatric—indirect
Procedural pain	Routine topical anesthesia (pharmacological), with labeled precautions; cryotherapy; age-appropriate distraction or VR; validating communication	[2,16,23,39,41,42,44,46,47]	Guideline [2], systematic review [16], small studies and randomized trial; pediatric hemodialysis—direct; other pediatric procedures—indirect (distraction); product labeling [23] (dosing)
Psychosocial care	HRQoL and mood screening with referral pathways; resilience-oriented communication; peer support	[22,58,63,64,69,83]	Pediatric kidney disease—indirect; adult hemodialysis—extrapolated (resilience, peer support)
Family	Consider screening caregiver distress; family-centered education and empowerment programs; include siblings	[84,86,88,91,92]	Pediatric hemodialysis—direct (descriptive, small intervention studies); adult hemodialysis—extrapolated
Physical and daily life	Individualized intradialytic exercise; thirst and fluid strategies; in-unit schooling as a promising strategy	[94–98]	Pediatric hemodialysis—direct (small trials; single-unit report for schooling)
Workforce and transition	Specialized training; primary nursing and transition programs as organizational proposals	[4,31,36,56,67]	Adult nephrology nursing—indirect; pediatric hemodialysis—direct (training); authors' proposal (staffing, primary nursing)

Table 3. Key sources supporting the main practice considerations.

Source	Design	Population/Setting	Population Applicability	Main Limitations
Fischbach et al., 2005 [2]	Practical guideline	Children on hemodialysis; Europe	Pediatric hemodialysis—direct	Older guideline; general scope
Shroff et al., 2019 [27]	Consensus recommendations (GRADE)	Children on hemodialysis; Europe	Pediatric hemodialysis—direct	Expert opinion where evidence is limited
Bakkaloğlu et al., 2026 [26]	International survey	Pediatric dialysis centers	Pediatric hemodialysis—direct	Reports practice, not outcomes
Zeng and Zhang, 2025 [15]	Narrative review	Children on maintenance hemodialysis	Pediatric hemodialysis—direct	Non-systematic

Attia and Hassan, 2017 [41]	One-group pre–post quasi-experiment	Children on hemodialysis; two centers, Egypt	Pediatric hemodialysis—direct	No control group; possible confounding by distraction
Elghoul and Younes, 2025 [47]	Randomized double-blind trial	Children with AVF; Egypt	Pediatric hemodialysis—direct	Single center
Qin et al., 2024 [48]	Meta-analysis	Children undergoing venipuncture	Other pediatric procedures—indirect	Not specific to hemodialysis
Fayed et al., 2025 [81]	Mediation analysis	Children on hemodialysis	Pediatric hemodialysis—direct	Associational
Suarez and Whittington, 2020 [98]	Single-unit report	Children on hemodialysis	Pediatric hemodialysis—direct	Single unit; no comparator
Wang et al., 2024 [76]	Longitudinal study	Adults on maintenance hemodialysis	Adult hemodialysis—extrapolated	Associational; adult population

9.1. Implications for Practice

Three organizational changes could help translate this evidence into care, and they are offered as practice considerations rather than directives. First, units may adopt written protocols that combine CRBSI prevention bundles with standard pain management for every cannulation, so that atraumatic care is the default rather than an option. Second, psychosocial assessment could be embedded in nursing workflow, with brief screening at set intervals and clear referral routes to psychology and social work. Third, units could adopt a family-centered model that addresses caregiver burden and includes schooling, exercise, and peer support as part of routine care rather than as extras. Nursing leaders have a role in advocating for these changes, including specialized pediatric dialysis training, adequate staffing, and protected time for psychosocial interventions. Interprofessional focus groups can help identify local barriers to new practices such as VR, ensuring that protocols are both feasible and acceptable [53].

9.2. Limitations of the Evidence

The evidence base has important limitations. Most pediatric studies are small, single-center, and of short duration, often with quasi-experimental designs and without control groups. Many come from a limited number of countries, which may restrict generalizability to other health systems. Several recommendations, particularly on resilience, self-efficacy, and peer support, are extrapolated from adult hemodialysis populations or from other pediatric procedures. Outcome measures vary widely, which prevents direct comparison. The review process has its own limitations. Selection bias cannot be excluded, because sources were chosen narratively by the authors rather than through exhaustive screening (Section 2.4). Restricting the review to peer-reviewed English-language articles (Section 2.3) may also have excluded relevant studies published in other languages or outside peer-reviewed journals. We did not apply formal design-specific appraisal tools, and only key sources were appraised structurally (Section 2.5). The populations included are broad and heterogeneous, and evidence from adults and other pediatric settings was retained under explicit rules (Section 2.3). The narrative design has clear merits here: it allows heterogeneous designs, qualitative work, and guidelines to be integrated across domains in a field too sparse for meta-analysis. Its problems are equally clear: it provides no pooled estimates, depends on the authors' judgment, is harder to reproduce, and may give small studies more weight than they deserve. The findings should therefore be read as a structured map of the evidence and not as estimates of effect.

9.3. Future Research

The gaps identified here are the scarcity of multicenter pediatric studies, the predominance of single-center studies, the absence of comparator groups, heterogeneous outcomes, and the frequent need to extrapolate from adults. Future research should therefore include multicenter randomized trials of nurse-led interventions in pediatric hemodialysis, using standardized outcome measures for pain, anxiety, CRBSI, access survival, and HRQoL. Longitudinal studies are needed to determine whether integrated nursing models improve long-term developmental trajectories and outcomes after transition to adult care. Implementation research should examine how interventions such as VR, intradialytic exercise, and peer support can be sustained in routine practice and in lower-resource settings. Children's and parents' perspectives should guide the choice of outcomes.

10. Conclusions

Optimizing nursing care for children on chronic hemodialysis requires a dual commitment to rigorous, standardized vascular access care and to holistic, family-centered psychosocial support. Nurse-led infection prevention, atraumatic cannulation, routine psychosocial screening, caregiver support, exercise, and educational continuity are supported to varying degrees by the available evidence, much of which is preliminary, indirect, or extrapolated, and several of these strategies require confirmation in stronger pediatric studies. By embedding these strategies in unit protocols and investing in specialized training, healthcare systems may help children on hemodialysis achieve both clinical stability and psychological resilience. Rigorous multicenter studies are now needed to confirm the benefits of integrated nursing models for long-term outcomes.

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