Title: Green Home-Based Dialysis and Sustainability: A Scoping Review

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Green home-based dialysis and sustainability: A Scoping Review

Andreas Vilhelmsson, Ida Knutsson

Abstract

Background: Climate change is among the foremost threats to global health, and the healthcare sector is itself a substantial source of greenhouse gas (GHG) emissions. Dialysis is one of the most resource- and carbon-intensive treatments in medicine, and home-based modalities have been proposed as a more sustainable alternative to in-centre care. Despite growing interest, the empirical evidence on the environmental impact of home dialysis, and on whether sustainability influences its uptake, has not been systematically mapped. This scoping review aimed to summarise the available evidence on (1) the environmental impacts of home-based dialysis, (2) resource use across water, energy, waste, and transport, and (3) whether sustainability considerations affect the uptake of home-based dialysis.
Methods: Following the PRISMA extension for Scoping Reviews (PRISMA-ScR), an information specialist searched five databases — PubMed, Embase, Scopus, Web of Science, and GreenFile — with the final search conducted on 5 August 2026. Two independent reviewers screened records in Covidence; data were extracted in NVivo and synthesised using a relational analytical framework.
Results: The search identified 3,929 records, reduced to 2,704 after removing duplicates; 14 studies, published between 2007 and 2026 and almost half appearing in 2024–2026, met the inclusion criteria. The evidence base was methodologically heterogeneous but anchored by six life cycle assessments; haemodialysis was the focus of eight studies, peritoneal dialysis of four, and two examined both modalities. Home haemodialysis consistently showed a lower carbon footprint than in-centre treatment, driven largely by avoided patient travel. Resource use was the most-reported domain, where consumables and packaging, rather than energy, typically formed the largest burden, with transport a consistent secondary contributor, and PVC recycling identified as a tangible mitigation lever. Only two studies addressed whether sustainability affects uptake, and both did so speculatively; person-centred outcomes were reported in just three studies.
Keywords

Chronic kidney disease; Climate change; Home dialysis; Life cycle assessment; Green Nephrology; Sustainability

1. Introduction

Climate change is widely considered to pose one of the most significant threats to global health in the twenty-first century [1] and is already impacting human health while threatening the stability of care delivery systems [2]. Global greenhouse gas (GHG) emissions continue to rise [3] and global warming has now reached record-breaking levels, where each of the past 11 years have been the warmest years on record [4].
The provision of healthcare itself is associated with abundant GHG emissions. The health-care sector contributes substantially to this problem, accounting for 4.4% of global GHG emissions [5], through its resource-intensive and climate-damaging activities and as a significant source of emissions and air pollution. If global health care were a country, it would be the world's fifth largest emitter [5].

The combined effect of increasing heat extremes and water shortages is creating a new era of climate-health crises, in which known diseases are being exacerbated and new diseases are arising [6]. One climate-sensitive disease in particular is kidney disease [7]. A changing climate increases the risk of kidney disease, since rising temperatures and heat stress can cause dehydration, mechanisms linked to kidney stone formation, acute kidney injury, and, with repeated exposure, chronic kidney disease (CKD) [8]. CKD is a growing global public health problem that has received increasing attention in recent decades. It is estimated that over 850 million people worldwide now live with impaired kidney function, [9] and in 2023, chronic kidney disease caused an estimated 1.5 million deaths, a 90% increase compared to 2000 [10]. This makes it the ninth leading cause of death globally, but if trends continue, it is projected to become the fifth leading cause of death by 2040 [11].

Patients with chronic kidney disease, and especially those treated with dialysis, are extra sensitive to a changing climate [12]. While kidney health is being threatened by global warming, treatment of kidney disease is contributing to increasing resource utilization and leaving a substantial carbon footprint [13], often reported in carbon dioxide equivalents (CO_2e), a standard measure of atmospheric heat-trapping of different GHG [14].

Within healthcare, dialysis is considered the most environmentally impacting treatment after surgery,[15] primarily driven by three key factors: excessive water usage, high energy consumption, and the generation of large volumes of medical waste, especially plastics, but also repeated patient travel to in-center facilities [16]. A dialysis treatment uses roughly 500 liters of water and with a mean of three treatments per week gives a total of 156 dialysis treatments per year and 80 000 liters of water per patient and year [16]. The amount of plastic waste that is produced per dialysis session ranges from 1.5 to 8 kg, depending upon the type of dialysis machine and supplies, differentiation and emptying policies [17].

There are two forms of treatment: hemodialysis (HD) and peritoneal dialysis (PD). Both forms of treatment can be performed autonomously as self-care at home, though uptake of home-based care is considerably higher for PD than for HD. In contrast to hospital-based dialysis, home-based dialysis offers a flexible framework that empowers patients to manage their treatment in the comfort of their own homes [18] and is considered to promote the patient's quality of life. [19]. It is also economically beneficial for regions, resulting in a reduced need for personnel in dialysis care.

Realizing that dialysis is one of the more costly health care-related procedures in terms of energy and water consumption as well as plastic production, environmentally-aware nephrologists have started to take action to minimize its impact [16]. Thus, green dialysis has emerged as a critical area in nephrology, with the aim of minimizing the environmental impact of treating kidney diseases [20]. While much of the initial focus has been on dialysis performed in hospitals, there is a growing trend towards green dialysis in the home, that aligns with person-centered care (PCC) and shared decision-making [21].

However, use of home PD and HD remains low in Europe, with the highest use in Scandinavian countries and the lowest in Eastern and Central Europe despite the advantages for people on dialysis and economic advantages for healthcare systems [22].

Considering the health benefits associated with home dialysis and the environmental concerns from excessive water usage, high energy consumption, transportation emissions and large volumes of medical waste, especially plastics, it is imperative to know how we can move towards a more green home dialysis.

The aim of this review was to summarize the key environmental considerations for implementing green home dialysis. This was done by addressing these three review objectives.

1. What empirical evidence exists for the environmental impacts for interventions for people with kidney failure in the area of home-based dialysis?
2. Which interventions have been used to assess the environmental impacts for people with kidney failure in the area of home-based dialysis?
3. What impact does sustainability have on the uptake of home-based dialysis?

2. Methods

2.1. Protocol and registration

The review protocol was developed using the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) [23] and follows the Joanna Briggs Institute's (JBI) methodology framework [24]. The review protocol was pre-registered on PROSPERO (CRD-420251172958) on October 23, 2025 (https://www.crd.york.ac.uk/PROSPERO/view/CRD420251172958).

To address the review objectives and synthesize the evidence, a scoping review was initiated. Scoping reviews map out the overall scope of the topic, its primary themes, and relevant literature. Scoping reviews are especially appropriate for broad topics in which there has been prior research on some aspects of the topic but less work pulling it all together [25].

2.2. Eligibility criteria

Study eligibility criteria were drafted through team discussion (Table 1). Only human studies were included in the review. There were no restrictions for participant age and publication date, but kidney failure and dialysis as intervention had to be included with hospital-based dialysis as comparator. Only center-based (hospital) dialysis were excluded. Only original empirical peer-reviewed studies were included. Non-empirical studies such as commentaries, editorials, validation studies, conference abstracts, dissertations, study protocols, reviews etc. were excluded. Outcomes of interest included greenhouse gas emission, water use, energy use, waste, and transportation. Reviews were not included to avoid overrepresenting studies that may have been included in multiple reviews. Finally, studies were only included if they were written in English or in the Nordic languages.

[Table 1 here]

Table 1. The characteristics of inclusion and exclusion criteria

	Inclusion criteria	**Exclusion criteria**
Patient population	Kidney failure	
	Both children and adult	
Intervention/exposure	Dialysis	Withdrawal dialysis
		Advanced care planning
		Only center-based (hospital) dialysis
Comparator/context	Hospital-based dialysis	
Outcome	Greenhouse gas emission, water use, energy use, waste, transportation	
Study characteristics	Original empirical per-reviewed studies	Non-empirical studies such as commentaries, editorials, validation studies, conference abstracts, dissertations, study protocols, reviews etc.
Languages	Nordic or -English papers	-

2.3. Search strategy and sources

The lead author (AV) developed a systematic search strategy with the assistance of an information specialist at the Faculty of Medicine Library, Lund University. Five databases were searched in October 2025: PubMed (National Library of Medicine), Embase (Elsevier), Scopus (Elsevier), Web of Science (Clarivate) and GreenFile (EBSCOhost) using a combination of thesaurus terms and relevant keywords focusing on home dialysis and the environmental footprint. A set of key papers was used to test the sensitivity of the search. The full search strategy is provided in online supplementary S1. The entire dataset can be found in the online supplement (https://doi.org/10.5281/zenodo.21842627).

The following terms were searched in PubMed focusing on dialysis: ("Hemodialysis, Home"[Mesh] OR "Peritoneal Dialysis"[Mesh] OR peritoneal dialysis[tiab] OR "home dialysis"[tiab] OR "home hemodialysis"[tiab] OR "home haemodialysis"[tiab] OR "home-based dialysis"[tiab] OR "home-based hemodialysis"[tiab] OR "home-based haemodialysis"[tiab] OR at-home dialysis[tiab] OR at-home hemodialysis[tiab] OR at-home haemodialysis[tiab] OR self-administered dialysis[tiab] OR self-administered hemodialysis[tiab] OR self-administered haemodialysis[tiab] OR domestic hemodialysis[tiab] OR domestic haemodialysis[tiab] OR domestic dialysis[tiab] OR remote dialysis[tiab] OR remote hemodialysis[tiab] OR remote haemodialysis[tiab] OR hemodialysis center*[tiab] OR dialysis center*[tiab] OR haemodialysis center*[tiab] OR "drop-in dialysis"[tiab] OR "drop-in hemodialysis"[tiab] OR "drop-in haemodialysis"[tiab] OR "satellite dialysis"[tiab] OR "satellite hemodialysis"[tiab] OR "satellite] OR "hemodialysis outsourcing"[tiab] OR "haemodialysis outsourcing"[tiab]).
A corresponding search was made focusing on climate change

The following terms were searched in PubMed focusing on climate change and the environmental burden: Climate Change"[Mesh] OR "Global Warming"[Mesh] OR "Environmental Pollution"[Mesh] OR "Water Supply"[Mesh] OR "Water Resources"[Mesh] OR "Fresh Water"[Mesh] OR "Electric Power Supplies"[Mesh] OR "Greenhouse Gases"[Mesh] OR "Carbon Dioxide"[Mesh] OR "Greenhouse Effect"[Mesh] OR "Polyvinyl Chloride"[Mesh] OR climate[tiab] OR climate change[tiab] OR global warming[tiab] OR environmental pollution*[tiab] OR environmental impact*[tiab] OR environmental burden*[tiab] OR ecological burden*[tiab] OR ecology[tiab] OR consumption[tiab] OR "energy use"[tiab] OR "energy saving"[tiab] OR "energy savings"[tiab] OR "energy consumption"[tiab] OR "energy supply"[tiab] OR "water use"[tiab] OR "water supply"[tiab] OR "water consumption"[tiab] OR "water saving"[tiab] OR "water savings"[tiab] OR fresh water[tiab] OR waste water[tiab] OR "resource use"[tiab] OR electricity[tiab] OR "power supply"[tiab] OR "power consumption" [tiab] OR environmental resource*[tiab] OR energy resource*[tiab] OR water resource*[tiab] OR power resource*[tiab] OR waste[ti] OR wastes[ti] OR wastage*[ti] OR "waste volume"[tiab] OR "waste volumes"[tiab] OR "waste management"[tiab] OR "waste saving"[tiab] OR "waste savings"[tiab] OR plastic[tiab] OR bisphenol[tiab] OR emission*[tiab] OR environmental sustainability[tiab] OR ecological sustainability[tiab] OR CO2[tiab] OR carbon dioxide[tiab] OR greenhouse gas[tiab] OR greenhouse gases[tiab] OR footprint*[tiab] OR recycling[tiab] OR planetary health[tiab] OR Polyvinyl chloride[tiab] OR PVC[tiab] OR sustainable material*[tiab] OR biodegradable material*[tiab] OR biocompatible material*[tiab] OR biohazardous[tiab] OR patient transport*[tiab].

The Query translator tool from Embase was used to convert these search terms for use on Embase, Scopus, Web of Science and GreenFile.

Search results were imported into EndNote for further refinement, and then the web-based collaboration software platform Covidence [26] for storage and review. Initial searches were made in October 2025 and updated on 5 August 2026.

2.4. Study selection

After the search was conducted, two authors individually screened studies to determine whether they met the inclusion criteria. Any discrepancies in opinion were solved after discussion to reach a consensus. This screening process occurred in two stages using Covidence online software. First, titles and abstracts were screened independently in a blinded process by both researchers. Second, the full-text articles were then screened for the eligibility criteria by the lead investigator (AV). The exclusion of any article at this stage was confirmed by a second investigator (IK). Any disagreements were resolved by discussion.

2.5. Data extraction

The lead author (AV) systematically extracted the following information from each included study: authors, publication year, title, country, study design, population, sample size, dialysis modality, care setting, intervention/exposure, comparator type, comparator details, environmental assessment method, outcomes measured, GHG emissions reported, water use reported, energy use reported, waste reported, transportation reported, person-centred care outcome reported, key findings, sustainability impact on uptake of home dialysis (review objective 3), review objective(s) addressed, funding source, and comments. The study team developed a data extraction form to standardize this process.

Full-text of all included studies was imported into NVivo [27] and coded using the coding tree by one of the authors (IK). The coding was then discussed with a the second author (AV) and further adjusted and revised. The coding tree was based on a preliminary analysis of the included studies using artificial intelligence Anthropic Claude (Sonnet 5 version) [Computer software]. https://claude.ai/

2.6. Synthesis of results

Inductive coding was used to identify themes and categorize the extracted data. The following themes were identified by lead author (AV) during review of the extracted data:

3. Results

3.1. Scoping review

The initial search returned 3929 studies. Endnote and Covidence removed 1225 duplicates, leaving 2704 studies to screen. 1941 studies were excluded based on title and abstract review. Of the 103 remaining studies, 89 were excluded for a diverse set of reasons. Of the excluded studies, 21 did not concern home dialysis, 18 were review articles, 16 had the wrong study design, and 11 were editorial comments. Five of the studies were book chapters, five had the wrong outcome, three were not in English, three targeted the wrong patient population, and two had the wrong comparative unit. Single studies that were excluded was because of wrong indication, having the wrong intervention, being a clinical trial protocol, lacking an abstract or having the wrong route of administration. In total, 14 were selected for inclusion following full-text review (Fig 1).

3.2. Study characteristics

Table 2 and Table S1 in the online supplement (https://doi.org/10.5281/zenodo.21842627). present a descriptive summary of the 14 studies identified in the literature search. In general, we observed a greater number of published studies focusing on this topic across time, where almost half of studies (n = 6) were published between 2024-2026 (Fig 2). Most studies were conducted in Australia [28-30] and United Kingdom [31-33] and Canada [34, 35] followed by Italy [36, 37], with individual studies from Denmark [38], China [39], and Iran/France [40] and a multicountry study [41] (Table 2). The included studies were primarily Life Cycle Assessments (LCAs) (n = 6) [28, 29, 33, 35, 36, 39], followed by cross-sectional study design [31, 32]. Two studies were simulations [34, 40] and one was a case study [37], one was quasi-experimental [38] and one was a retrospective cost analysis [30] (Table 2).

[Figure 1 here]

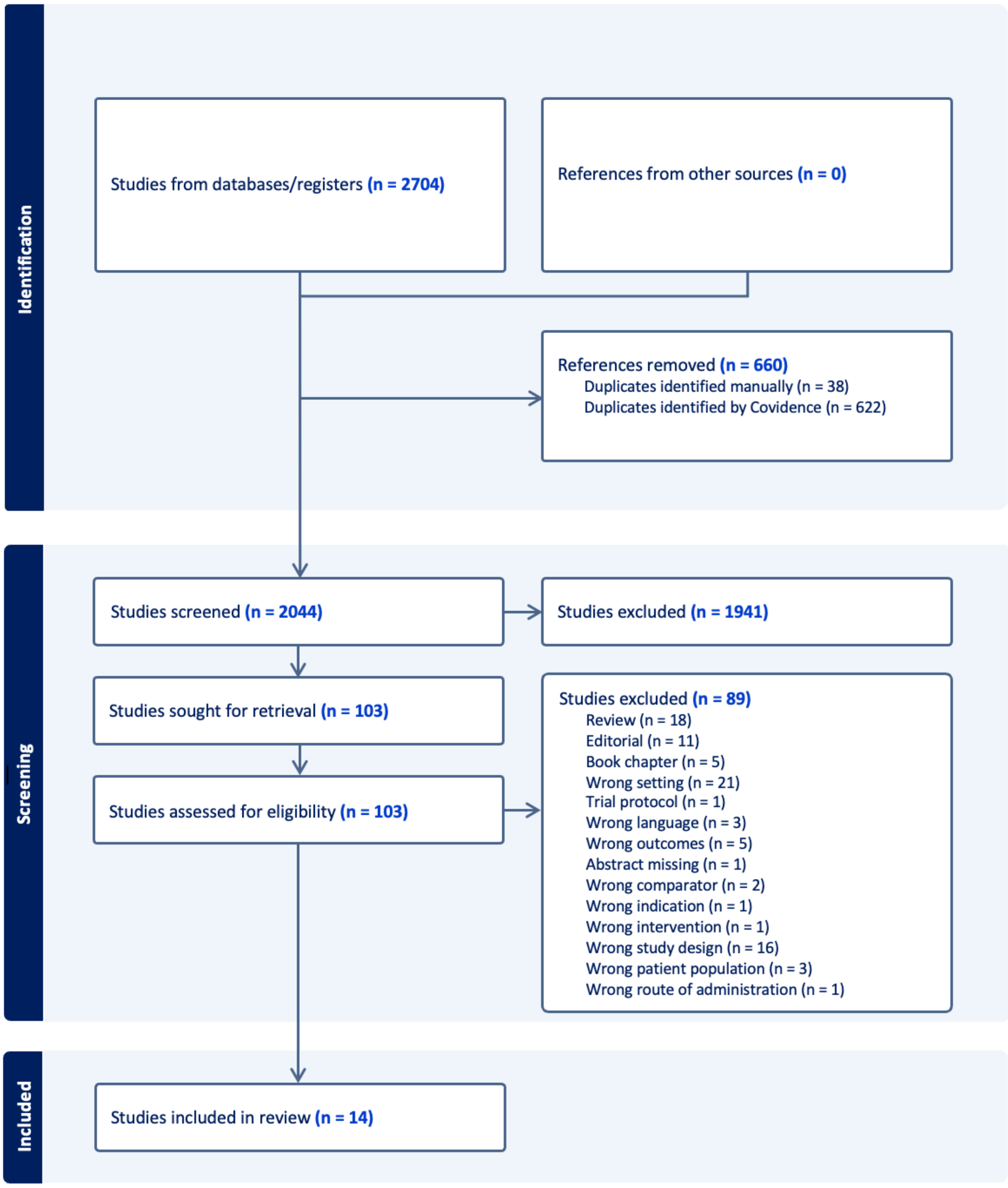

Fig 1. PRISMA diagram for a scoping review on sustainability in home dialysis

[Figure 2 here]

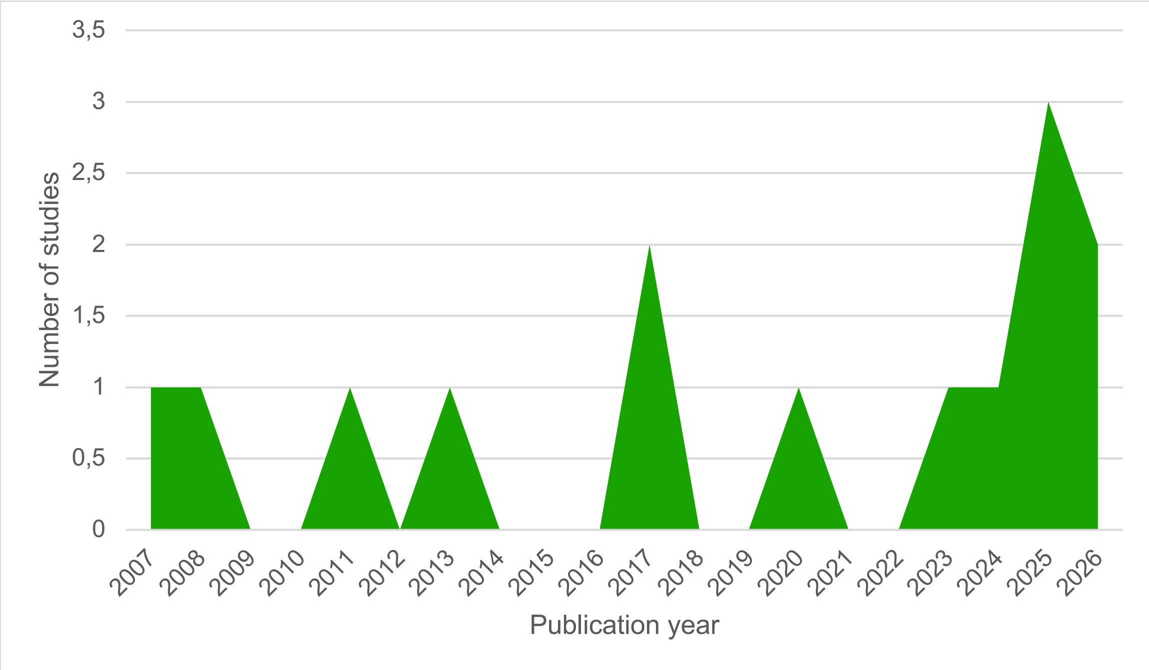

Fig 2. Publication year of studies in a scoping review on Green home-based dialysis and sustainability

Most studies focused on haemodialysis [31, 32, 33, 34, 37, 38, 40, 41], while four studies focused specifically on peritoneal dialysis [29, 30, 36, 39] and two focused on both [28, 35]. Most studies looked at a mixed care setting [28, 31, 33, 35, 37, 39, 41] followed by the home as an explicit care setting [32, 29, 34, 36, 40]. One study has a center-based care setting [38].

[Table 2 here]

Table 2. Characteristics of included studies in the review

Table 2 Characteristics of included studies in the review

First author (year)	Country	Study design	Dialysis Modality	Study Setting	Intervention	Environmental outcome	Key findings
Bhopal (2023)	Multi-country	Case study	HD	Mixed	Theoretical estimation	Carbon-footprint, MCC	Lower carbon footprint for home HD (3.9–7.2 tCO_2e/yr) than in-centre HD.
James (2007)	United Kingdom	Cross-sectional	HD	Mixed	CO_2 footprint	CO_2 emissions (water treatment, water supply, transport) patient/year	Unit HD: 1.404 tCO_2/patient/yr (water treatment 0.397, supply 0.052, transport 0.955). Home HD saved 1.197 tCO_2/patient/yr (~492 t/yr nationally); transport was the main source of the saving.
Heaf (2013)	Denmark	Quasi-experimental	HD	Center-based	MPHD	Solute clearance dialysate/water volume	MPHD (6×8h/wk) gave greater small- and large-molecule clearance than conventional HD (3×4h/wk) using ~50% less dialysate, potentially enabling lower-water home HD.
Barraclough (2025)	Australia	LCA	Both	Mixed	4 Dialysis modality selection	Carbon footprint (kg CO_2e/patient/yr)	Per-patient/yr: in-centre HD 4,814 kg CO_2e (highest), home HD 2,938 (−41%), APD 3,339 (−29%), CAPD 1,969 (−59%). Consumables were the largest source for all modalities; patient travel drove in-centre HD, consumable transport drove home dialysis
Blenkharn (2008)	United Kingdom	Cross-sectional	HD	Home	Local-authority clinical waste collection services for home dialysis patients	Availability/adequacy of clinical-waste collection service	50% (262/526) of UK local authorities published clear guidance on home-dialysis clinical-waste collection; arrangements were inconsistent and sometimes unsafe
Connor (2011)	United Kingdom	LCA	HD	Mixed	HHD vs in-centre HD regimens	Carbon footprint (tCO_2e/patient/yr) by regimen and equipment type	In-centre HD 3.8 tCO_2e/patient/yr (equipment 37%, energy 21%, travel 20%); home HD 3.9–7.2 tCO_2e by regimen (higher with frequent/nocturnal sessions); portable NxStage cut it to 1.8–2.1 tCO_2e; frequency drove footprint more than duration.
Chen (2017)	China	LCA	PD	Mixed	Home vs in-centre peritoneal dialysis (DAPD/CAPD) -	Carbon footprint ($kgCO_2Eq$) by PD modality/site,	In-centre PD had higher fixed (electricity) but lower overall (waste+transport) emissions than home PD; packaging/consumables was the

					carbon footprint component analysis	incl. water/waste/transport components	largest contributor; total footprint was lower for in-centre PD.
McAlister (2024)	Australia	LCA	PD	Home	APD vs CAPD (home PD modalities) - LCA, incl. PVC recycling	Carbon footprint (kg CO_2e/patient/yr) by PD modality and Australian state	APD > CAPD (manufacture+disposal 1,992 vs 1,245 kg CO_2e/patient/yr; total incl. transport 2,350–4,503 vs 1,455–2,716 by state). PVC recycling could cut emissions up to 14% (APD)/30% (CAPD).
Zito (2025)	Italy	Case study	HD	Mixed	Tele-assisted self-assisted/assisted home HD (SA-HHD/A-HHD) via telemedicine	Cost per session, CO_2 emissions (transport), water consumption	Telemedicine-supported HHD is a cost-effective alternative to in-centre care, reducing resource use and environmental impact. SA-HHD cut costs 38–59% (car) to 55–67% (ambulance) vs in-centre HD, with the largest CO_2 and water savings of all modalities compared.
Nickel (2017)	Canada	Modelling/ Simulation	HD	Home	Home HD utility (water/electricity) consumption simulation across prescriptions	Utility cost ($/yr), water consumption, electricity consumption	Annual patient utility costs ranged $420 (conventional home HD) to $1,269 (nocturnal); water dominated cost (electricity ~12%), rising sharply with treatment intensity/frequency.
Asghari (2020)	Iran / France	Modelling/ Simulation	HD	Home	Green delivery-pickup/sharing-economy logistics model for home HD machines	Total system cost and total GHG emissions from delivery/pickup logistics	A green sharing-economy delivery-pickup model for home HD machines (fleet device-sharing, load-dependent fuel/GHG modelling) achieved notable joint reductions in system cost and carbon emissions vs baseline logistics.
Larkin (2026)	Italy (multinational authorship: Ireland, Italy, Spain, UK)	LCA	PD	Home	APD vs CAPD peritoneal dialysis pathways (incl. incremental dialysis) - Life Cycle Assessment	Carbon footprint (kg CO_2e/patient/yr) by PD modality and activity; electricity, water, procurement/consumables, travel and waste contributions	APD emitted more than CAPD annually (3267 vs 2975 kg CO_2e/patient/yr), driven by higher electricity and PVC use. Monthly exams added ~250 kg CO_2e (mainly travel, ~29 km round trip). CAPD generated more healthcare waste (320 kg→810 kg CO_2e) than APD (374 kg CO_2e). Incremental dialysis cut emissions substantially (APD 1642, CAPD 1517 kg CO_2e). Polyethylene and PVC were the largest contributors.

Nicdao (2026)	Australia	Retrospective cost analysis	PD	Home	Incremental PD (1–3 x 2L CAPD exchanges or 3 x 1.8L APD cycles, with dry days) vs full-dose PD - direct healthcare cost & resource-use analysis	Direct healthcare cost analysis (third-party payer perspective) with resource-use/waste estimation (water, plastic, cardboard saved from reduced consumables)	Incremental PD cost ~AUD 339/patient/month less than full dose (monthly outpatient \$1242 vs \$1581; p<.001), mainly PD consumables (\$810 vs \$1190). It saved 2,255,143 L water (15,034 L/patient), 9,740 kg plastic (65 kg/patient) and 8,259 kg cardboard (55 kg/patient), plus large dialysis-free time gains. Estimated national savings \$1M–\$2.2M/yr if 30–60% of ~900 annual incident PD patients start incremental PD.
Saleem (2025)	Canada	LCA	Both	Mixed	Comparison of three kidney replacement therapies (deceased-donor KT, in-centre HD, automated/cycler PD) - comparative LCA of environmental impacts over 1 year	Climate change (tCO_2e), air pollution, human toxicity, water depletion, metal depletion, ozone depletion, ecotoxicity	HD had the highest environmental impact across nearly all categories, KT the lowest. Annual climate impact: HD 2.7 tCO_2e vs PD 1.4 vs KT 0.7 (HD 74% > KT, 46% > PD). HD accounted for 65% of air pollution, 54% of human toxicity and 44% of water depletion; PD highest in water (41%) and metal depletion (81%); KT lowest except terrestrial ecotoxicity. Travel and consumables were the largest GHG contributors within each therapy. KT is the most environmentally preferred KRT; PD has fewer impacts than HD.

APD - Automated peritoneal dialysis
CAPD - Continuous ambulatory peritoneal dialysis
CKD - Chronic kidney disease
DAPD - Daytime ambulatory peritoneal dialysis
HD – Haemodialysis
HHD - Home haemodialysis
HLY - Healthy life years
INPD - Incremental start peritoneal dialysis
LCA - Life cycle assessment
MCC - Mortality cost of carbon
MPHD - Multipass haemodialysis
PD - Peritoneal dialysis
SA-HHD - Self-assisted/assisted home haemodialysis

NVivo was used to system map how included studies addressed our different review objectives (Table 3). Nearly all studies addressed our second review objective of resource use from home dialysis. Here, consumables/packaging repeatedly emerged as the largest emission source, with transport second. Nine studies addressed the review objective of the environmental impact of home vs in-centre dialysis with the consistent HD finding that home dialysis has a lower carbon footprint than in-centre, largely driven by eliminating patient travel. Only 2 studies [30, 37] addressed the sustainability impact on uptake of home dialysis and PCC. Here is a clear evidence gap. Both studies touching on this subject only argue that cost/environmental savings could support wider adoption of home dialysis, but neither empirically test uptake. PCC outcomes were reported in just three studies [29, 37, 30] (Table 4). As shown in table 4, the included studies focused on different environmental emission factors. 71% of the studies measured different greenhouse gases [28, 29, 31, 33, 35, 36, 37, 39, 40, 41], 71% measured water [28, 30, 31, 33, 34, 35, 36, 37, 38, 39], 43% focused on energy [28, 31, 33, 34, 36, 39], 64% measured waste [28, 29, 30, 31, 32, 33, 35, 36, 39] and 64% transportation [28, 29, 31, 33, 35, 36, 37, 39, 40]. Only 21% of the studies addressed PCC.

[Table 3 here]

Table 3. Review objectives addressed by the included studies

Included interventions (*n* = 14)	Environmental impact of home vs in-centre dialysis (*n* = 9)	Resource use (water, energy, waste, transport) (*n* = 13)	Sustainability impact on uptake/PCC (*n* = 2)
Bhopal et al. [41]	X		
James [31]	X	X	
Heaf et al. [38]		X	
Barraclough et al. [28]	X	X	
Blenkharn [32]		X	
Connor et al. [33]	X	X	
Chen et al. [39]	X	X	
McAlister et al. [29]	X	X	
Zito et al. [37]	X	X	X
Nickel et al. [34]		X	
Asghari & Al-e. [40]		X	
Larkin et al. [36]	X	X	
Nicdao et al. [30]		X	X
Saleem et al. [35]	X	X	

Review Objectives

[Table 4 here]

Table 4. Reported environmental emission factors from dialysis in the included studies

Studies reporting each outcome	**Yes**	**% of 14**
GHG Emissions	**10**	**71%**
Water Use	**10**	**71%**
Energy Use	**6**	**43%**
Waste	**9**	**64%**
Transportation	**9**	**64%**
Person-Centred Care	**3**	**21%**

4. Discussion

This scoping review compiled available literature on key environmental considerations for implementing green home dialysis. This was done by looking at how three review objectives have been addressed, namley (1) empirical evidence for the environmental impacts for interventions for people with kidney failure in the area of home-based dialysis, (2) interventions assessing the environmental impacts for people with kidney failure in the area of home-based dialysis, and (3)

what impact (if any) sustainability have on the uptake of home-based dialysis. Overall, our review objectives 1 and 2 are well-supported (mostly by LCAs favouring home dialysis, with transport and consumables as key levers), while objective 3 is essentially unaddressed, and no study directly examined whether sustainability influences dialysis uptake or patient choice. This is in line with a previous scoping review underscoring a critical need for the development and evaluation of structured PCC interventions tailored to the specific needs of patients undergoing home-based dialysis [42]. This is especially important, since managing dialysis at home requires the involvement of the patient in decisions regarding treatment.
Knowledge that home-based dialysis can provide comparable survival rates and improved quality of life to in-center dialysis, often at lower cost, but also with a sustainability message can provide additional rationale for prioritizing home dialysis where feasible [43].

Despite an initial search yielding 2700 papers, we ultimately identified only 14 articles, published between 2007 and 2026, that met our criteria, underscoring the scarcity of relevant research in this important area. Most studies were done in only four countries, indicating the need for more studies from different parts of the world. The evidence base was methodologically heterogeneous, but anchored by six LCAs, which provide its most rigorous quantitative foundation, since they quantify emissions of the whole life cycle of products or services, including raw material extraction, manufacture, transport, use, and end of life ("cradle to grave"). The LCAs, while rigorous, are predominantly single-centre and single-provider, often in urban settings, limiting generalisability; several explicitly excluded pharmaceuticals owing to a lack of proprietary manufacturer data, meaning reported footprints are likely underestimates.

Consistent with other health care carbon footprint studies [44], included studies show that for all dialysis modalities the majority of the carbon footprint derives from the supply chain, specifically from the consumables used during treatments. This underscores a critical need for "green procurement," which involves prioritizing the purchase of goods with minimal environmental impact.

HD was the focus of eight studies, peritoneal dialysis of four, and two examined both modalities, reflecting a literature that remains weighted toward HD despite the growing environmental interest in PD and incremental approaches. Despite having numerous potential advantages over HD, only 11% of the people worldwide that are treated with dialysis for kidney failure receive PD [45]. While PD reduces patient travel to hospital and is associated with lower infrastructure and staffing needs, it is highly dependent on single-use plastics and packaging contributing large volumes of non-biodegradable waste [46]. Therefore, reducing the environmental impact of PD is a vital component of health systems transition to sustainability [47]. Here it is necessary to find sustainable solutions that also can be a nudge towards increasing home dialysis. This can be achieved by operationalizing the Centre for Sustainable Healthcare's sustainability framework: health promotion, patient empowerment, lean resource management, low-carbon alternatives and operational resource use [47].
For instance, Larkin et al. (2026) [48] demonstrated that redesigning PD products using sustainable materials, renewable energy and low-carbon logistics can substantially reduce their environmental impact. Most redesigned items achieved carbon footprint reductions exceeding 40% without compromising functional performance. This work must at the same time balance between reduced environmental footprint (for example, regarding packaging and water consumption) with the patient's quality of life and person-centered care.

5. Conclusion

The findings of our scoping review highlight a significant gap in the literature regarding sustainability studies focusing on home-based dialysis and the transition to green home dialysis. Taken together, the charted evidence makes a coherent case that shifting appropriate patients to home-based dialysis, favouring lower-intensity and incremental regimens where clinically suitable to reduce the environmental footprint of kidney replacement therapy, primarily by cutting patient travel and consumable use. The most actionable levers identified are travel avoidance, consumable and packaging reduction, and end-of-life plastics recycling. The priority for future research is equally clear: to move beyond quantifying footprints toward understanding whether and how environmental sustainability can be integrated into shared decision-making without compromising person-centred care.

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Statement of Ethics
Ethics approval was not required due to the design, as a scoping review.

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Data availability statement
Data are available in Covidence through the corresponding author. All data relevant to the study are included in the article or uploaded as supplementary information. The dataset used in this study is uploaded to the repository Zenodo: Data identification number: DOI:

Supporting information

S1 Checklist. Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist.
(PDF)

S1 Appendix. Search terms

Author contributions

Conceptualization: AV
Data curation: AV, IK
Formal analysis: AV, IK
Methodology: AV
Supervision: AV
Writing– original draft: AV
Writing–review & editing: AV, IK

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