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EFFECTIVENESS OF NURSE-LED MHEALTH ON SELF-EFFICACY AND ADHERENCE HEMODIALYSIS PATIENTS: A SYSTEMATIC REVIEW

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Abstract

Hemodialysis patients with end-stage renal disease (ESRD) often experience low self-efficacy and poor adherence to treatment regimens, which negatively affect their health outcomes and quality of life. Conventional education methods have shown limited effectiveness in sustaining behavioral change. Nurse-led mobile health (mHealth) interventions provide an innovative approach that combines nursing expertise, behavioral theory, and digital technology to enhance self-efficacy and long-term adherence. Methods this systematic review followed the PRISMA 2020 guidelines and included studies published between 2019 and 2025 from four databases: Scopus, PubMed, ProQuest, and Web of Science. Eligible studies examined nurse-led mHealth interventions aimed at improving self-efficacy and adherence among adult hemodialysis patients. The methodological quality of the included studies was evaluated using the JBI critical appraisal tools. Results fourteen studies met the inclusion criteria, comprising randomized controlled trials and quasi-experimental designs. Nurse-led mHealth interventions were delivered through mobile applications, telehealth platforms, and instant messaging systems, demonstrating consistent improvements in self-efficacy, adherence, and clinical indicators. Interventions guided by the FITT (Frequency, Intensity, Time, Type) framework and behavioral theories such as the Health Belief Model, Self-Efficacy Theory, and Transtheoretical Model achieved the most sustainable outcomes. Conclusions nurse-led mHealth interventions effectively improve self-efficacy and adherence among hemodialysis patients. Integrating behavioral theory, optimized digital dosage, and nursing leadership represents a scalable strategy to strengthen chronic disease management and patient empowerment in contemporary nursing practice.

Keywords: Adherence**,** HBM , Health Education, Self-management, Self-efficacy

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INTRODUCTION

End-stage renal disease (ESRD) represents the final stage of chronic kidney failure that requires renal replacement therapy, such as hemodialysis, to sustain life. Hemodialysis patients often experience complex physical and psychological challenges, including nausea, pruritus, muscle cramps, sleep disturbances, anxiety, depression, and social isolation, which collectively reduce their quality of life (Hasanzamani et al., 2020; Nurbadriyah et al., 2023; Widyawati et al., 2019). Conventional education delivered during dialysis sessions has not been sufficient to sustain behavioral change, as it tends to be unidirectional and limited to the clinical setting, leaving patients with difficulties in maintaining self-efficacy and adherence to dietary, fluid, and medication regimens in daily life.

Globally, chronic kidney disease has become a major public health issue and is ranked among the top ten causes of death worldwide (Okpechi et al., 2022). The global prevalence of ESRD continues to rise, ranging from 10% to 16% (Ibitoba et al., 2022; Zhu & Yao, 2019). Data from the Indonesian Renal Registry (IRR, 2020) also indicate a significant upward trend in the number of hemodialysis patients in Indonesia, with 61,876 newly registered patients and 130,931 active cases recorded (IRR, 2020). This upward trend indicates that a growing number of patients are dependent on long-term hemodialysis, underscoring the need for innovative and sustainable educational strategies to improve self-management and treatment outcomes.

The complexity of hemodialysis treatment requires continuous motivation and behavioral regulation. However, many patients still exhibit low adherence and self-efficacy due to limited ongoing educational support. The Kidney Disease: Improving Global Outcomes guidelines recommend integrating digital and interactive approaches to complement conventional education and enhance patient engagement (Stevens et al., 2024).

In line with these recommendations, mobile health (mHealth) has emerged as an effective platform for improving patient self-management through interactive, accessible, and nurse-led educational interventions(Khoury, 2020; Saadatifar et al., 2022a; St-Jules et al., 2021) . Nurse-led mHealth programs combine clinical expertise, behavioral guidance, and technological innovation to empower patients in managing their treatment regimens(Glenn et al., 2025; Jabeen et al., 2021; Shobha et al., 2023). Therefore, this systematic review aims to evaluate the effectiveness of nurse-led mHealth interventions in improving self-efficacy and adherence among hemodialysis patients and to explore their clinical and practical implications for modern nursing practice.

METHODS

This systematic review aims to address the research question: "How effective are nurse-led mHealth interventions in improving self-efficacy and adherence among patients undergoing hemodialysis?"

Search strategy

The literature search in this systematic review was conducted across four major databases: Scopus, PubMed, ProQuest, and Web of Science. The search included all studies published until March 2025 without restriction on publication year. The search strategy combined Medical Subject Headings (MeSH) and free-text terms related to digital health, nursing interventions, and hemodialysis outcomes. Keywords used included combinations of: ("education" OR "digital education" OR "e-learning" OR "online learning") AND ("mobile applications" OR "smartphone" OR "mHealth" OR "mobile health" OR "mobile app" OR "telemedicine") AND ("treatment adherence" OR "medication adherence" OR "self-efficacy") AND ("hemodialysis" OR "haemodialysis" OR "renal dialysis" OR "renal replacement therapy" OR "kidney dialysis").A detailed description of the search strings used in each database is presented in Table 1.

Table 1. Search strategy

Database	***Keyword***
Scopus	Education OR digital education OR e-learning AND Mobile Applications OR Smartphone OR mHealth OR mobile health OR mobile app OR smartphone AND hemodialysis
PubMed	("Education OR "digital education" OR "e-learning" OR "online learning") AND ("Mobile Applications" OR "Smartphone" OR "Cell Phone" OR "Telemedicine" OR mHealth OR "mobile health"

	OR "mobile app*" OR smartphone*) AND ("Treatment Adherence OR "Medication Adherence" OR adherence) AND ("Self Efficacy" OR "self-efficacy") AND ("Renal Dialysis"OR "Renal Replacement Therapy" OR hemodialysis OR haemodialysis OR "kidney dialysis")
ProQuest	"Education OR "digital education" OR "e-learning" AND "Mobile Applications" OR "Smartphone" OR mHealth OR "mobile health" OR "mobile app" OR smartphone AND adherence AND "Self Efficacy AND hemodialysis OR haemodialysis Education OR digital education OR e-learning AND Mobile Applications OR Smartphone OR mHealth OR mobile health OR mobile app OR smartphone AND hemodialysis and HBM or health belief model
Web of Science	("Education OR "digital education" OR "e-learning" OR "online learning") AND ("Mobile Applications" OR "Smartphone" OR "Cell Phone" OR "Telemedicine" OR mHealth[OR "mobile health" OR "mobile app*" OR smartphone*) AND ("Treatment Adherence OR "Medication Adherence" OR adherence) AND ("Self Efficacy" OR "self-efficacy") AND ("Renal Dialysis"OR "Renal Replacement Therapy" OR hemodialysis OR haemodialysis OR "kidney dialysis")

Eligibility criteria

The inclusion of all eligible studies in this systematic review was based on using the PICOS framework (Liberati et al., 2009).

PICOS Framework	**Inclusion Criteria**	**Eksclusion Criteria**
Population	Adult patients undergoing hemodialysis	Studies conducted on children or on populations other than hemodialysis patients
Intervention	Health education interventions delivered through Mobile Health (mHealth) applications, including smartphone- or tablet-based digital programs that describe elements of frequency (exposure frequency), intensity (level of interaction or user engagement), duration (session length or intervention period), and type of content (video, quiz, reminder, storytelling, or educational modules).	Conventional health education interventions that are not based on digital or mobile applications
Comparator	No comparator or routine standard care.	-
Outcomes	Primary outcomes included self-efficacy and adherence (hemodialysis attendance, medication, diet, fluid restriction, or clinic visit compliance).	
Publication year	2019-2025	Before 2019
Study design	Randomized Controlled Trials (RCTs) and quasi-experimental studies.	Other study designs
Language	Articles published in English or Indonesian.	Other languages

Study selection and data extraction

Literature searches were conducted across four electronic databases: Scopus, PubMed, ProQuest, and Web of Science. All references retrieved were managed using Mendeley Reference Manager to organize and remove duplicate records prior to the screening process. The titles and abstracts of all identified studies were independently screened by two reviewers (IMDBAS and IK) based on the predefined inclusion and exclusion criteria. Any discrepancies during the selection process were resolved through discussion with a third reviewer until a consensus was reached.

In the full-text screening phase, only studies that met all inclusion criteria were retained for further analysis. Data extraction was performed independently by IMDBAS using a structured data extraction sheet. Extracted information included author and country, study design, dosage of intervention based on the FITT framework (Frequency, Intensity, Time, and Type), intervention provider, characteristics of the intervention and control groups, instruments used to measure outcomes, and the main study findings. All extracted data were cross-checked by all authors to ensure consistency and accuracy.

Study risk of-bias assessment

The reviews were jointly and independently conducted by three reviewers (IMDBAS, IK and IDK) who used the Joanna Briggs Institute (JBI) Critical Appraisal Tool to identify and assess individual studies included in this review. Two JBI instruments were used in this systematic review according to the study design of each article.

The JBI Checklist for Randomized Controlled Trials (RCTs), a 13-item version, was the first tool used to assess the quality of included studies. Randomization and allocation concealment; similarity of groups at baseline; blindness of participants, providers for the intervention and outcome assessors; treatment almost equal between groups other than the intervention; independent, valid, and reliable outcome measurement; follow-up that is complete; analysis that is (at least) intent-to-treat by initial group assignment; appropriate statistical analysis; and suitable trial design, which includes addressing deviations from the standard RCT format, are the domains assessed by this tool (Barker et al., 2023).

Second, for quasi-experimental studies, we applied the JBI Checklist for Quasi-Experimental Designs, nine items. It evaluates whether the cause-effect relationship (intervention and outcome) is clear, whether there is a control group, whether groups are comparable at baseline, whether treatment is similar except for the intervention, whether outcome is measured before and after the intervention, whether measurement methods are uniform, whether outcome measurement is reliable, whether follow-up is complete, and appropriateness of statistical analysis (Barker et al., 2024).

Responses for each item were "Yes", "No", "Unclear", or "Not applicable". "Scored one (1)" only for those with a response "Yes"; otherwise, zero (0). A classification of the methodological quality of each study was obtained based on a total score. For practical purposes (and using quantitative cut-offs that are usually set for similar literature), studies with a score of ≥10 out of 13 for RCTs (≥76.9%) and ≥8 out of 9 for quasi-experimental studies (≥88.9%) were classified "High Quality".

The risk of bias was further interpreted based on each study's methodological rigour, including the intervention's theoretical basis, study design, sample characteristics, clarity of variables, reliability of instruments, and appropriateness of data analysis. The details of the risk-of-bias assessment can be seen in Table 2.

Table 2. Quality Assessment

No	Citasi	Desain Studi	JBI Skor													Hasil
			1	2	3	4	5	6	7	8	9	10	11	12	13	
1	(Hosseini et al., 2023)	Quasi-eksperimental	1	1	0	1	1	1	1	1	1					8/9= 88,9%
2	(Özdemir & Şendir, 2025)	Quasi-eksperimental	1	1	1	1	1	1	1	1	1					9/9= 100%
3	(Mollaoğlu et al., 2024)	RCT	1	1	1	1	1	1	1	1	1	1	1	1	1	13/13= 100%
4	(Li et al., 2024)	RCT	1	1	1	0	0	1	1	1	1	1	1	1	1	11/13= 84,6%
5	(Nursalam et al., 2020)	Quasi-Eksperimental	1	1	1	1	1	1	1	1	1					9/9=100%
6	(Beer et al.,	RCT	1	1	1	1	1	1	1	1	1	1	1	1	1	13/13=100%

No	Citasi	Desain Studi	JBI Skor													Hasil
			1	2	3	4	5	6	7	8	9	10	11	12	13	
	2025)															
7	(Thongsunti et al., 2024)	RCT	1	1	0	0	1	1	1	1	1	1	1	1	1	11/13= 84,6%
8	(Min & Park, 2020)	Quasi-Eksperimental	1	1	0	1	1	1	1	0	1					7/9= 77,8%
9	(Muchangi et al., 2023)	*Quasi-Eksperimental*	1	1	0	1	1	1	1	1	1					8/9= 88,9%
10	(Ki & So, 2020)	RCT	1	0	1	0	0	1	1	1	1	1	1	1	1	10/13= 77%
11	(Shin & Kim, 2024)	Quasi-Eksperemintal	1	1	1	1	1	1	1	1	1					9/9= 100%
12	(Pack & Lee, 2021)	RCT	1	0	1	0	1	1	1	1	1	1	1	1	1	11/13= 84,6%
13	(M. T. Khah et al., 2023)	RCT	1	1	1	0	0	1	1	1	1	1	1	1	1	11/13=84,6%
14	(Saadatifar et al., 2022b)	Quasi-Eksperimental	1	1	1	0	1	1	1	1	1					8/9= 88,9%

Study selection

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines to ensure transparency, completeness, and reproducibility throughout the study selection process (Page et al., 2021; Haddaway et al., 2022). A total of 389 records were initially identified from four electronic databases: Scopus (n = 19), PubMed (n = 44), ProQuest (n = 207), and Web of Science (n = 119). After removing 29 duplicate records, 360 studies remained for initial screening. During the title and abstract screening phase, 325 studies were excluded for not meeting the predefined inclusion criteria, such as irrelevance to the population, intervention, or outcomes of interest. Subsequently, 35 full-text articles were retrieved for eligibility assessment, of which 10 could not be accessed in full text. In the eligibility assessment stage, 25 studies were examined in detail. From these, 11 studies were excluded for the following reasons: ineligible population (n = 3), irrelevant intervention (n = 3), and ineligible study design (n = 5). Finally, a total of 14 studies met all inclusion criteria and were included in the qualitative synthesis of this systematic review.

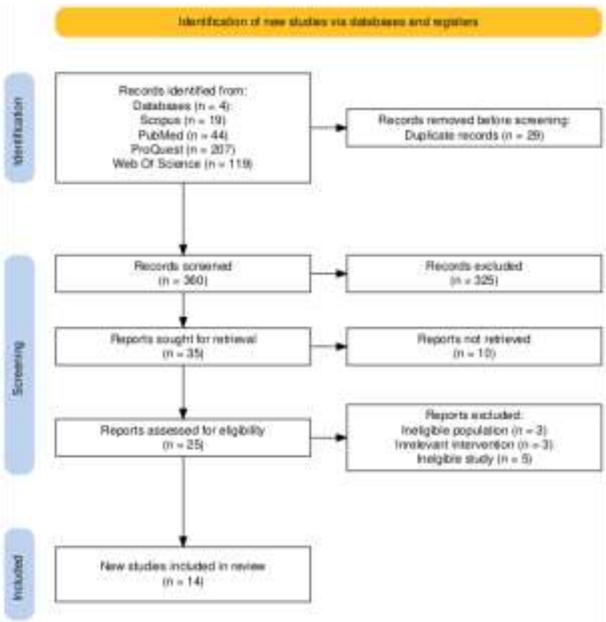

Figure 1. PRISMA flow diagram
(Haddaway et al., 2022)

Study characteristics

This systematic review included 14 studies examining the effectiveness of nurse-led mobile health (mHealth) interventions on self-efficacy and adherence among hemodialysis patients. Of these, seven studies implemented randomized controlled trial (RCT) designs (Beer et al., 2025; Ki & So, 2020; Li et al., 2024; Mollaoğlu et al., 2024; Pack & Lee, 2021; Thongsunti et al., 2024), while the remaining seven studies adopted quasi-experimental designs (Hosseini et al., 2023; Min & Park, 2020; Muchangi et al., 2023; Nursalam et al., 2020; Özdemir & Şendir, 2025; Saadatifar et al., 2022b; Shin & Kim, 2024).Click or tap here to enter text.

The studies were conducted across a wide range of cultural and healthcare settings, demonstrating the global adaptation of mHealth technologies for hemodialysis care. The largest representation came from Asian countries, with Iran (4 studies) (Hosseini et al., 2023; T. Khah et al., 2023; Ki & So, 2020; Saadatifar et al., 2022b), South Korea (4 studies) (Ki & So, 2020; Min & Park, 2020; Pack & Lee, 2021; Shin & Kim, 2024), Turkey (2 studies) (Mollaoğlu et al., 2024; Özdemir & Şendir, 2025), China (1 study) (Li et al., 2024), Indonesia (1 study) (Nursalam et al., 2020), Thailand (1 study) (Thongsunti et al., 2024), Kenya (1 study) (Muchangi et al., 2023), and Australia (1 study) (Beer et al., 2025).

Across all studies, participants were adult patients with end-stage renal disease (ESRD) undergoing maintenance hemodialysis (HD). The sample sizes ranged from 38 to 180 participants, yielding a cumulative total of approximately 1,049 participants. Most participants were middle-aged to older adults (40–70 years), reflecting the typical demographic of long-term HD patients. All interventions were grounded in digital education and behavioral modification, leveraging mobile or web-based platforms to enhance treatment adherence and psychological empowerment. Nurses were the primary providers in the majority of studies (10 of 14), while the remaining studies involved multidisciplinary teams (e.g., dietitians, nephrologists, or behavioral scientists) with nurses facilitating patient interaction and follow-up. Examples of prominent nurse-led interventions include the ALISA app (Nursalam et al., 2020) and FISTUL-M (Özdemir & Şendir, 2025), both developed and delivered by nurse researchers, while studies adopted team-based models with nursing oversight (Beer et al., 2025; Muchangi et al., 2023).

The frequency, intensity, and duration (FITT) of interventions varied considerably. The majority of studies provided interventions once to three times per week, with session durations ranging from 10 to 40 minutes and total intervention periods spanning 4 weeks to 6 months. For instance, T. Khah et al. (2023) applied a micro-learning model with three daily short video sessions (3 minutes each) for one month, while Thongsunti et al. (2024) conducted 24 weekly telehealth sessions integrating Motivational Interviewing and Transtheoretical Model principles. Similarly, Hosseini et al. (2023) allowed continuous app use over six months, while (Ki & So, 2020; Pack & Lee, 2021) offered structured exercise or dietary programs over 8–12 weeks.

The reviewed mHealth interventions included Android-based mobile apps (Hosseini et al., 2023; Nursalam et al., 2020; Saadatifar et al., 2022b), telehealth video platforms (Mollaoğlu et al., 2024; Thongsunti et al., 2024), and instant messaging tools such as KakaoTalk (Shin & Kim, 2024). Most applications provided multimedia educational content, including videos, quizzes, reminders, and self-monitoring features for fluid, diet, and medication management. Some, like My Dialysis and Diapass, also enabled real-time tracking of weight, IDWG, and laboratory values with nurse feedback integrated remotely.

Across studies, the main outcomes were self-efficacy and treatment adherence, while several also assessed quality of life, psychological well-being, and clinical indicators. Five studies (Hosseini et al., 2023; Ki & So, 2020; Nursalam et al., 2020; Shin & Kim, 2024; Thongsunti et al., 2024) showed significant gains in self-efficacy, and seven (T. Khah et al., 2023; Mollaoğlu et al., 2024; Muchangi et al., 2023; Nursalam et al., 2020; Özdemir & Şendir, 2025; Pack & Lee, 2021; Saadatifar et al., 2022b) reported improved adherence to diet, fluid, medication, or dialysis schedules. Several RCTs (Beer et al., 2025; Mollaoğlu et al., 2024; Pack & Lee, 2021) also demonstrated improvements in blood pressure, phosphate, potassium, and IDWG.

Measurement tools included validated questionnaires such as the End-Stage Renal Disease Adherence Questionnaire (ESRD-AQ), CKD Self-Efficacy Scale (CKD-SE), and SF-36 or EQ-5D-5L for quality of life, alongside objective parameters (laboratory and clinical values). Several interventions were grounded in behavioral theories, notably the Health Belief

Model (HBM) (Nursalam et al., 2020), Self-Efficacy Theory (Ki & So, 2020), and Transtheoretical Model TTM (Thongsunti et al., 2024), which strengthened personalization and motivation by targeting beliefs, barriers, cues to action, and confidence building.

Tabel 3. Summary of included studies

No	Title, Author, Country	Study Design	Sample Size (n) (Intervention/ Control)	Intervention Provider	Dosage (Frequensi, Intensity, Time, Type)	Main Findings
1	*The effect of an educational app on hemodialysis patients' self-efficacy and self-care: A quasi-experimental longitudinal study,*(Hosseini et al., 2023) , Iran	Quasi-Experimental	60	Nurse	**F**: Participants were free to use the app at any time. **I**: Not reported. **T**: 6 months (assessments at 1, 3, and 6 months). **T**: Offline Android app "Diapass," including modules on HD introduction, AV access care, nutrition and fluid restriction, infection prevention, complications, medication, exercise, rest/sleep, and sexual health.	The Diapass app significantly improved self-efficacy from month 1 to month 6 and enhanced self-care across all subdomains (diet/fluid, AVF/skin care, activity-fatigue, rest/sleep, and complication control).
2	*The Effect of Fistula Care Education Given with a Mobile Application on Disease Adherence and Self-Care Behaviors in Hemodialysis Patients: A Quasi-Experimental Study*, (Özdemir & Şendir, 2025),Turki	Quasi-Experimental	60 (30/30)	Nurse	F: Once per week. I: 15 minutes per session. T: 3 months. T: FISTUL-M app providing educational content (kidney/HD anatomy, AVF care, visual complications, 3D videos, bibliography).	The FISTUL-M app was effective in improving knowledge, self-care, and overall adherence (diet, fluid, medication, attendance) measured by ESRD-AQ.
3	*The Effect of Education and Art Therapy with Telehealth Method on Diet-Fluid Restriction and Anxiety in Hemodialysis Patients During the COVID-19 Pandemic*, (Mollaoğlu et al., 2024),Turki	RCT	60 (30/30)	Nurse	F: Tele-education once weekly; art therapy twice weekly. I: 30 minutes per art therapy session. T: 12 weeks. T: Telehealth via WhatsApp + educational booklet.	The telehealth intervention significantly improved diet, fluid, and medication adherence ($p < 0.05$) and reduced clinical parameters such as blood pressure, urea, creatinine, IDWG, and dry weight.
4	*Analysis of the application effect of the Clark comfortable nursing approach in hemodialysis*	RCT	81 (41/41)	Nurse	F: Health education once weekly. I: Not reported. T: 3 months. T: App-based educational model integrated with	The Clark comfortable nursing model improved self-care ability, treatment

No	Title, Author, Country	Study Design	Sample Size (n) (Intervention/ Control)	Intervention Provider	Dosage (Frequensi, Intensity, Time, Type)	Main Findings
	patients with end stage renal failure,(Li et al., 2024), China				individualized nursing care plans (diet, medication, AVF, emotional counseling).	adherence (diet, fluid, medication, dialysis regimen), reduced self-perceived burden, and enhanced quality of life (SF-36)
5	*Automatic reminder for fluids management on confidence and compliance with fluid restrictions in hemodialysis patients*, (Nursalam et al., 2020), Indonesia	Quasi-Experimental	60 (30/30)	Nurse	F: Automatic daily reminders during each HD session. I: Not reported. T: Not reported. T: Android app ALISA containing educational content, fluid input graphs, HD schedule tracking, and automatic reminders based on the Health Belief Model (HBM).	The ALISA app, based on the HBM, improved self-efficacy, enhanced adherence to fluid restriction, and reduced interdialytic weight gain (IDWG).
6	*a randomised controlled trial comparing the effect of digital health to standard care on serum phoSphate control in patients on dIalysiS (TeleKinesis Study),* (Beer et al., 2025). Australia	RCT	180 (90/90)	Renal dietitians and nephrologists, supported by renal nurses	F: Twice weekly. I: Not reported. T: 3 months. T: Smartphone app with one-way messages, infographics, animations, weekly diet summaries, and quizzes.	The TeleKinesis program significantly improved secondary outcomes of adherence (diet, medication), quality of life (EQ-5D-5L), and reduced IDWG.
7	*Effect of a transtheoretical model-based intervention and motivational interviewing on hyperphosphatemia management via telehealth (TMT program) among hemodialysis patients during the COVID-19 pandemic*,(Thongsunti et al., 2024),Thailand	RCT	80 (40/40)	Nurses and behavioral reasearchers	F: Once weekly. I: 20–30 minutes per session. T: 24 weeks. T: Telehealth based on TTM + Motivational Interviewing via LINE app, including synchronous group discussions, three educational videos (dietary phosphate, binder dosing, phosphate sources), text messages, and individual counseling.	The TMT program effectively improved dietary adherence related to phosphate management and increased self-efficacy in phosphate binder use over 24 weeks.
8	*Effects of a Mobile-App-Based Self-Management Support Program*	Quasi-Experimental	60 (30/30)	Clinical Nurse	F: Once weekly. I: Not reported. T: 10 weeks. T: Native mobile app	The app effectively enhanced self-efficacy and

No	Title, Author, Country	Study Design	Sample Size (n) (Intervention/ Control)	Intervention Provider	Dosage (Frequensi, Intensity, Time, Type)	Main Findings
	for Elderly Hemodialysis Patients,(Min & Park, 2020) Korea Selatan				integrated with EMR; features included graphical visualization of lab/weight data, test result notifications, non-adherence alerts, reminders, and structured feedback from nurses/doctors.	adherence behaviors (diet, medication, dialysis attendance).
9	*Effects of mHealth on kidney disease knowledge, stress management and adherence to treatment among hemodialysis patients in selected regions of* Kenya,(Muchangi et al., 2023) Kenya	Quasi-Experimental	132 (66/66)	Multidisciplinary, with nurses facilitating implementation	F: Continuous scheduled mobile messages throughout study period. I: Not reported. T: 9 months. Type: mHealth messaging including education on medication, nutrition, and coping support.	The intervention improved kidney disease knowledge, treatment adherence (medication, attendance, diet, fluid), and reduced stress, depression, and anxiety.
10	*Development and Effects of Smartphone App-Based Exercise Program for Hemodialysis Patients,*(Ki & So, 2020) ,Korea Selatan	RCT	63 (33/33)	Nurse	F: 3 sessions per week on non-dialysis days and 3 on dialysis days (6 sessions total per week). I: 15–25 minutes/session (dialysis days); 20–40 minutes/session (non-dialysis). T: 12 weeks. Type: Educational app with exercise videos, exercise logs, notifications, and small-group forums based on Self-Efficacy Theory.	The intervention significantly improved self-efficacy, physical fitness, physiological indices, and quality of life across all domains.
11	*Effects of self-care intervention using amobile instant messenger on hemodialysis patient's knowledge, self-efficacy, self-care behavior and physiological index,*(Shin & Kim, 2024) , Korea Selatan	Quasi-Experimental	38 (19/19)	Nurse	F: Once weekly. I: 40 minutes/session. T: 8 weeks. T: KakaoTalk-based personal counseling focused on goal setting and action evaluation; weekly topics included diet (Na/K/P), dry weight, nutrition, dining out, exercise, and Q&A; patients sent diet/activity photos for weekly feedback.	The KakaoTalk intervention significantly improved self-efficacy, but not self-care behavior, knowledge, or physiological indices possibly due to short duration.
12	*Randomised controlled trial of a smartphone application-based dietary self-*	RCT	75 (37/37)	Nurse	F: 3 sessions per week + home counseling. I: 30 minutes/session. T: 8 weeks. Type: Smartphone dietary	The app effectively reduced serum phosphorus and potassium,

No	Title, Author, Country	Study Design	Sample Size (n) (Intervention/ Control)	Intervention Provider	Dosage (Frequensi, Intensity, Time, Type)	Main Findings
	management program on haemodialysis patients,(Pack & Lee, 2021), Korea Selatan				app with diary, food search, portion-based nutrient simulation (calorie, protein, P, Na, K, albumin), real-time feedback, "My Chart," and online counseling.	improved self-efficacy and quality of life; no significant change in albumin levels.
13	*Comparing the effects of mHealth application based on micro-learning method and face-to-face training on treatment adherence and perception in haemodialysis patients: a randomised clinical trial*, (M. T. Khah et al., 2023),Iran	RCT	70 (35/35)	Nurse	F: 3 educational videos and 3 notifications per day. I: 3 minutes/video (total 9 minutes/day). T: 1 month; follow-up at 5 and 8 weeks post-intervention. Type: Micro-learning mHealth app (videos + text + images + audio) covering 7 topics: HD importance, complication management, diet, fluid restriction, physical activity, vascular access care, medication adherence; 78 total videos; weekly meeting with researcher for performance review.	The DiCare app significantly increased overall adherence sustained up to 8 weeks post-intervention, with strongest effects on medication adherence and HD attendance; effects on fluid/diet domains were moderate.
14	*Effect of mHealth Training on Treatment Adherence in Hemodialysis Patients,*(Saadatifar et al., 2022b) ,Iran	Quasi-Experimental	80 (40/40)	Nurse	F: Not specified. I: 4–5 minutes/session. T: 3 months. Type: "My Dialysis" app with five multi-topic educational videos + Goftino support platform (direct messaging, dry/pre-HD weight logs, fluid intake chart, lab indicator records, educational clips).	The My Dialysis app significantly improved overall adherence measured by the ESRD-AQ.

Risk of bias

The JBI Critical Appraisal Tools were applied to evaluate the risk of bias and overall quality of the included studies; methodological quality assessment of all nine studies included for systematic review was performed based on the findings shown in Table 2. The RCT-design studies had low runaway risks of bias, with risk of minor bias, in randomization procedures and blinding. The absence of blinding of participants and intervention providers in two studies has a high risk of introducing performance bias and detection bias. Two studies also did not specify whether allocation concealment was conducted or not, increasing the risk of detection bias in one study. Conclusion The methodological quality scores were overall high for the quasi-experimental studies. Each study had similar outcome measures, appropriate statistical analysis, and clearly reported follow-up. Nevertheless, the non-randomized design and the possible lack of blinding carries an inherent risk of bias in the delivery of interventions and assessment of outcomes. However, none of these studies were excluded based on methodological quality and all met the minimum criteria. The high quality of included studies enhances the confidence in synthesised findings of this review.

RESULT AN DISCUSSION

The Role of Nurses in Delivering mHealth Interventions

Across all fourteen studies, nurses played a central and leading role in the design, implementation, and monitoring of mHealth interventions for hemodialysis patients. In ten studies, interventions were explicitly nurse-led, where nurses acted as educators, facilitators, and motivators, guiding patients through digital applications or telehealth platforms (Hosseini et al., 2023; Ki & So, 2020; Li et al., 2024; Min & Park, 2020; Mollaoğlu et al., 2024; Nursalam et al., 2020; Özdemir & Şendir, 2025; Pack & Lee, 2021; Saadatifar et al., 2022b; Shin & Kim, 2024).

Nurses' involvement extended beyond direct patient education, they also participated in content development, app usability testing, and data monitoring, ensuring the interventions were patient-centered and clinically relevant. In studies nurses collaborated with other professionals (psychologists, nephrologists, and dietitians) but maintained leadership in session delivery and follow-up through telehealth or instant messaging systems (Mollaoğlu et al., 2024; Thongsunti et al., 2024).

Effectiveness of mHealth Interventions

The effectiveness of nurse-led mHealth interventions varied according to the dose parameters defined by the FITT framework (Frequency, Intensity, Time, and Type). In terms of frequency, interventions ranged from daily exposure (T. Khah et al., 2023; Nursalam et al., 2020) to weekly sessions (Min & Park, 2020; Shin & Kim, 2024; Thongsunti et al., 2024). Higher exposure frequency, particularly in micro-learning models with multiple daily sessions, was associated with more sustained improvements in adherence—especially in medication compliance and dialysis attendance. Regarding intensity, session durations ranged from 3–5 minutes in brief micro-learning formats (T. Khah et al., 2023; Saadatifar et al., 2022b) to approximately 40 minutes in interactive counseling sessions (Shin & Kim, 2024). Interventions of moderate intensity (15–30 minutes) delivered consistently tended to produce better retention of knowledge and self-efficacy compared to short-duration exposures. For time, the total duration of interventions varied from one month to six months (Hosseini et al., 2023; T. Khah et al., 2023). Studies lasting at least 12 weeks demonstrated greater improvements in sustained adherence and self-efficacy, suggesting that extended engagement promotes long-term behavioral change.

With respect to type, modalities included mobile applications (Hosseini et al., 2023; Ki & So, 2020; Saadatifar et al., 2022b), telehealth-based video programs (Mollaoğlu et al., 2024; Thongsunti et al., 2024), and instant messaging platforms (Shin & Kim, 2024). Applications incorporating interactive elements—such as reminders, self-monitoring dashboards, educational videos, and real-time feedback were markedly more effective than static educational content.

Overall, the most effective combination across studies involved frequent and moderately intense interventions maintained for 8–12 weeks through interactive mHealth platforms, which consistently improved self-efficacy (Hosseini et al., 2023; Ki & So, 2020; Nursalam et al., 2020; Shin & Kim, 2024; Thongsunti et al., 2024) and adherence (T. Khah et al., 2023; Mollaoğlu et al., 2024; Muchangi et al., 2023; Nursalam et al., 2020; Özdemir & Şendir, 2025; Pack & Lee, 2021; Saadatifar et al., 2022b).

Use of Behavioral Theories in mHealth Application Development

Behavioral theories served as the foundation for structuring, motivating, and personalizing mHealth interventions for hemodialysis patients, with six studies explicitly integrating such frameworks. The Health Belief Model (HBM) guided the development of the ALISA app (Nursalam et al., 2020), emphasizing perceived susceptibility, benefits, and barriers related to adherence. The Self-Efficacy Theory was adopted in exercise- and self-management-based programs (Ki & So, 2020; Min & Park, 2020) to strengthen patients' confidence in their ability to perform daily self-care. The Transtheoretical Model (TTM) combined with Motivational Interviewing in the TMT Telehealth Program (Thongsunti et al., 2024) tailored education according to patients' readiness for change. Meanwhile, the Micro-learning approach grounded in Adult Learning Theory (T. Khah et al., 2023) and the Clark Comfortable Nursing Model (Li et al., 2024) emphasized behavioral reinforcement and emotional support through digital learning and personalized feedback. Collectively, these frameworks enhanced the motivational and interactive components of mHealth tools by translating theoretical constructs, such as cues to action, perceived control, and self-confidence into app features like reminders, goal tracking, and feedback systems

Discussion

The findings of this review underscore the strategic role of nurses in leading digital interventions based on mobile health (mHealth) for patients with chronic kidney disease undergoing hemodialysis. The evolution of mHealth in hemodialysis nursing care represents more than a technological shift; it signifies a transformation in nursing practice where the therapeutic relationship between nurses and patients extends beyond the dialysis room into a continuous, technology-mediated process of empowerment (Arad et al., 2021; Azizi et al., 2024; Jung et al., 2023; Stevens et al., 2024). Nurse-led mHealth interventions demonstrate the profession's ability to adapt clinical, educational, and behavioral competencies to digital contexts, ensuring continuity of care and more personalized patient engagement (Arad et al., 2021; Sarker et al., 2022). This transformation aligns with the principles of patient-centered care and the use of digital media as educational tools in hemodialysis management, emphasizing that behavioral change can be sustained when patients actively participate in decision-making processes through information that is accessible, personalized, and aligned with their needs.

Professionally, nurses possess unique attributes that position them as primary drivers of mHealth innovation. Their holistic understanding of patient needs, therapeutic communication skills, and behavioral counseling expertise enable them to bridge the gap between humans and technology. Unlike software developers, nurses are capable of translating health information into educational content that is culturally and emotionally meaningful (Maynard et al., 2019; Nurdina et al., 2025). This humanized digital interaction resonates with the Theory of Nursing as Caring and Self-Determination Theory, which emphasize that empathy and autonomy-supportive communication can enhance patients' intrinsic motivation toward treatment adherence (Hindman et al., 2025; Kurz, 2024). The consistent effectiveness of nurse-led programs across diverse cultural contexts further indicates that technological solutions achieve the greatest impact when grounded in the relational values of nursing positioning mHealth not merely as a digital transaction tool, but as a therapeutic medium that strengthens patient relationships, trust, and empowerment.

The variations in intervention effectiveness identified through the FITT framework (Frequency, Intensity, Time, Type) highlight that successful mHealth design relies not only on technical parameters such as frequency and duration but also on an understanding of behavioral learning principles. Frequency and intensity reflect not just repetition or exposure but the cognitive load, reinforcement schedule, and attention span required for sustained behavioral learning. The pattern that moderate-intensity interventions with repeated exposure produce superior outcomes aligns with the Cognitive Load Theory and Bandura's Social Cognitive Theory, which posit that learning is optimized when conducted gradually, supported by active feedback, and presented with manageable information loads (Bandura, 1997; Masoudi et al., 2020). Within this context, micro-learning models and daily reminders act as behavioral reinforcements that bridge the gap between knowledge acquisition and consistent action. Furthermore, the duration and type of mHealth interventions play a crucial role in the internalization of behavior change. Longer interventions allow for cognitive restructuring and emotional adaptation, supporting habit formation and long-term engagement. The key strength of mHealth lies in its ability to provide adaptive, stage-specific education, making the learning experience more relevant and personalized to each patient's readiness and condition.

The integration of behavioral theories into mHealth development serves as a critical element that strengthens the scientific foundation of digital interventions. Frameworks such as the Health Belief Model (HBM) and Self-Efficacy Theory offer conceptual guidance in understanding how individuals perceive risks, evaluate benefits, and develop confidence in managing chronic conditions (Bandura, 1978; Glanz et al., 2008; Rosenstock et al., 1988). The application of these theories aligns with Bandura's assertion that self-efficacy is the strongest predictor of behavioral adherence. Digital features such as reminders, progress tracking, and goal-setting functions represent concrete operationalizations of theoretical constructs like cues to action and perceived control, effectively translating abstract psychological principles into tangible user experiences.

Overall, nurses hold a pivotal role in optimizing the use of mHealth to enhance self-efficacy and adherence among hemodialysis patients. They act not only as implementers of interventions but also as designers, facilitators, and evaluators capable of integrating clinical approaches with behavioral and technological principles. The FITT-based framework helps nurses determine the optimal digital intervention dosage, while the application of behavioral theories provides a robust scientific foundation for building patients' confidence and commitment to self-care. This synthesis reaffirms that the success of mHealth in nursing practice depends not on technological sophistication alone, but on how nurses humanize technology to strengthen therapeutic relationships, facilitate self-directed learning, and foster sustainable behavior change in chronic disease management.

LIMITATIONS

This review presents several limitations that should be considered. Although most of the included studies highlighted the active involvement of nurses in the design, implementation, and evaluation of mHealth interventions, the degree and specificity of nursing roles varied considerably across different healthcare contexts. Variations in healthcare systems, interdisciplinary collaboration, and the absence of standardized definitions for "nurse-led" interventions made it difficult to identify the most effective model of nursing leadership in digital health. Therefore, future research should focus on establishing clearer conceptual and operational criteria for nurse-led mHealth practices to facilitate consistency, comparability, and replication across diverse clinical settings.

Furthermore, substantial heterogeneity in intervention design, FITT parameters, theoretical integration, and outcome measures limited the possibility of conducting quantitative synthesis or direct cross-study comparisons. Most studies were conducted in middle to high income countries, employing relatively small participant groups and short monitoring durations, thereby constraining the broader applicability and understanding of sustained outcomes. Future studies should emphasize the development of theory-driven, nurse-led mHealth programs using standardized frameworks and validated measurement tools to enhance methodological rigor and ensure wider applicability across varied cultural and clinical environments.

RELEVANCE FOR CLINICAL PRACTICE

The findings of this review have significant relevance for clinical nursing practice. First, the evidence highlights the pivotal role of nurses as leaders in implementing mHealth interventions, demonstrating their capacity to integrate clinical expertise, behavioral counseling, and digital literacy to enhance patient engagement and self-management in hemodialysis care. Second, the application of the FITT framework provides practical guidance for optimizing the dosage and structure of digital interventions, ensuring that frequency, intensity, duration, and modality are tailored to patient needs for maximal impact on self-efficacy and adherence. Third, the integration of behavioral theories such as the Health Belief Model, Self-Efficacy Theory, and Transtheoretical Model offers a scientific foundation for designing psychologically informed and motivationally effective mHealth programs. Collectively, these insights reinforce the essential contribution of nurses in leading technology-assisted education and behavioral interventions to improve treatment adherence, self-efficacy and long-term self-management outcomes among hemodialysis patients.

CONCLUSIONS

This systematic review provides strong evidence that nurse-led mobile health (mHealth) interventions are effective in improving self-efficacy and adherence among hemodialysis patients. The reviewed studies demonstrate that when nurses lead digital interventions by integrating clinical expertise, behavioral support, and continuous education, patients achieve higher engagement in self-management and better treatment adherence. The application of the FITT framework (Frequency, Intensity, Time, and Type) emphasizes the importance of determining appropriate intervention dosage and delivery structure to optimize behavioral outcomes. Moreover, the integration of behavioral theories such as the Health Belief Model, Self-Efficacy Theory, and Transtheoretical Model enhances the motivational and cognitive components of mHealth programs and supports sustained behavior change. Overall, these findings confirm the essential role of nurses in designing and implementing theory-based mHealth interventions and highlight the potential of such approaches to advance patient-centered, technology-assisted care that promotes long-term adherence and empowerment in hemodialysis management.

AUTHOR CONTRIBUTIONS

Study conception, design, and data collection: IMDBAS, Data analysis: IMDBAS,

IKW, IDK; Drafting and critical revision of the article: All authors.

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