EFFECTS OF DIGITAL INTERVENTION ON IMPROVING SELF-MANAGEMENT PATIENTS WITH PERITONEAL DIALYSIS: A SYSTEMATIC REVIEW

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ABSTRACT

Continuous Ambulatory Peritoneal Dialysis (CAPD) is an effective alternative for renal failure patients to undergo treatment with more independence and flexibility. However, the success of CAPD is highly dependent on the patient's skills and knowledge. Many patients lack sufficient information, which may hinder the effectiveness of the dialysis process. The Objectives of this study is to determine the best way to use digital interventions to enhance self-management capabilities in peritoneal dialysis patients. A systematic review following the PRISMA 2020 guidelines was conducted. Article selection used PICO. The research focused on peritoneal dialysis patients and how the use of applications to improve self-management skills. article searches in 2015-2024 in 4 databases, namely EBSCO, Proquest, Scopus, and Pubmed databases. MeSH was used in the medical domain for keyword search. Papers were evaluated for quality using the Jonna Briggs Institute (JBI) framework. There were 7 relevant papers found in the literature search. Implementing digital interventions in healthcare in peritoneal dialysis patients has been used worldwide. Digital interventions used include the use of mobile health text messages, websites and apps. Significant improvements in peritoneal dialysis-related knowledge as well as patient satisfaction are characteristic of most therapies. The resulting impact of digital interventions varies widely with the attitudes and decision-making of individuals undergoing peritoneal dialysis. Digital interventions present a new approach to enhancing self-management capabilities in patients with chronic kidney disease who use peritoneal dialysis. The use of technology can provide the necessary support to manage their condition effectively.

Keywords: digital intervention; peritoneal dialysis; self-management

INTRODUCTION

Continuous Ambulatory Peritoneal Dialysis (CAPD) is a method developed to make it easier for care givers to perform dialysis activities at home (Cartwright et al., 2021a). CAPD allows patients to continue engaging in activities including work and socializing (Kramer et al., 2016). Although there are advantages for patients to choose CAPD over hemodialysis (HD), the success rate of CAPD is strongly influenced by self-management and patient knowledge, where patients must be able to manage dialysis effectively at home (Kramer et al., 2016). Self-Management and knowledge are important parts of the dialysis process, but the information is still poor, such as patients receiving inadequate information about CAPD self-management (Utami et al., 2023). So far, the steps taken to improve self-management include an initial education program, and patients only have check-ups once a month if there are no complaints. Control activities that are only conducted once a month, along with the insufficient educational methods provided, prevent nurses from monitoring the implementation process at home (Dey et al., 2016; Nayak et al., 2016).

The global prevalence of CAPD among 272,000 patients is estimated to be 11% of the population undergoing dialysis (Kiberd et al., 2018). According to the Indonesian Renal Registry (IRR) 2018, in 2010, the number of Indonesians undergoing CAPD was 1,012 patients, and it continued to increase, with 2,105 patients undergoing CAPD in 2018 (IRR, 2018). Poor CAPD care will increase the risk of complications, one of which is peritonitis (Kemenkes, 2023). Peritonitis is a problem for CAPD patients, contributing to a mortality rate of 5.9 million per year and a death toll of 9,661 thousand people. The number of peritonitis patients in Indonesia using CAPD is around 9% of the population or approximately 179,000 patients (Sayuti, 2020). This complication occurs due to the self-management ability of patients undergoing peritoneal dialysis, which has not yet reached 30% of the required national target (Jonny et al., 2022).

Poor self-management will result in various complications, one of which is peritonitis. Severe and recurrent peritonitis can lead to damage to the function of the peritoneal membrane (Pernefri, 2023). The main causes of peritonitis in patients undergoing CAPD are the lack of patient discipline in maintaining cleanliness, insufficient patient knowledge, inadequate supervision from healthcare professionals, and many violations of Standard Operating Procedures related to routine Exit Site care at home (Lydia & Divisi, 2020). Therefore, patients undergoing peritoneal dialysis require communication with healthcare professionals to ensure that the series of dialysis activities are conducted according to the SOP standards in the healthcare system (Chao et al., 2024). The advancement of the healthcare system in the era of globalization must prioritize the utilization of technological developments to obtain existing information, one of which is using dialysis care support applications, such as the Home PD Care application (Kitrenu et al., 2023). The use of digital technology is becoming increasingly important to address existing issues and as a means for health promotion that can enhance patient engagement in self-management. The rapid digitization of social and health care services has various implications for providing better access, knowledge, and behavior among patients (Oh et al., 2021). Based on the existing phenomenon, this study aims to find effective methods for using mobile applications to enhance self-management capabilities in peritoneal dialysis patients

METHOD
The method used by the author is a systematic review. This method was carried out according to PRISMA 2020 guidelines (Page et al., 2021).The procedure of searching the literature was done till March 20, 2024. Using four databases Scopus, ProQuest, EBSCO, and Pubmed an article search covering research conducted over the last ten years, from 2015 to 2024, was conducted. Searching for articles or journals uses keywords and Boolean operators (AND, OR, and NOT) which are used to expand or specify the search, making it easier to determine the articles or quantities you want to use. Keywords in the systematic review adjusted to the Medical Subject Heading (MeSH) of the article were identified with the keywords ("mobile health" OR telehealth OR telemedicine OR smartphone OR "mobile application") AND ("peritoneal dialysis" OR dialysis) AND ("self-management" OR management). Inclusion and exclusion criteria. To select the articles to be analyzed, the authors used the PICOS framework, namely P (Population): Peritoneal Dialysis Intervention Patients, I (Intervention): digital-based, C (Comparison): No comparator, O (Outcome): Study describing the effect of digital, (Study design and publication type): Randomized controlled trials, Randomized crossover controlled trials, Quasi-experimental, Retrospective studies. In addition to PICOS, the authors also determined inclusion criteria based on year and language. Articles included in the analysis were those published in the last 10 years, 2015-2024. And exclusion criteria were patients with Hemodialysis and only Peritoneal Dialysis Risk with Conventional educational

interventions, Studies that did not describe the impact of digital interventions. Study design and publication type, review article, analysis article, study cohort, cross-sectional. Year of publication before 2015 and in a language other than English

Quality assessment
The quality of all the papers received must be evaluated. The Joanna Briggs Institute (JBI) provides an assessment of an article's quality. Researchers carried out independent data sorting, including the design of the intervention approach, and the outcomes will be evaluated, to reduce the possibility of bias. The study satisfies the inclusion criteria if its percentage is greater than 75%.
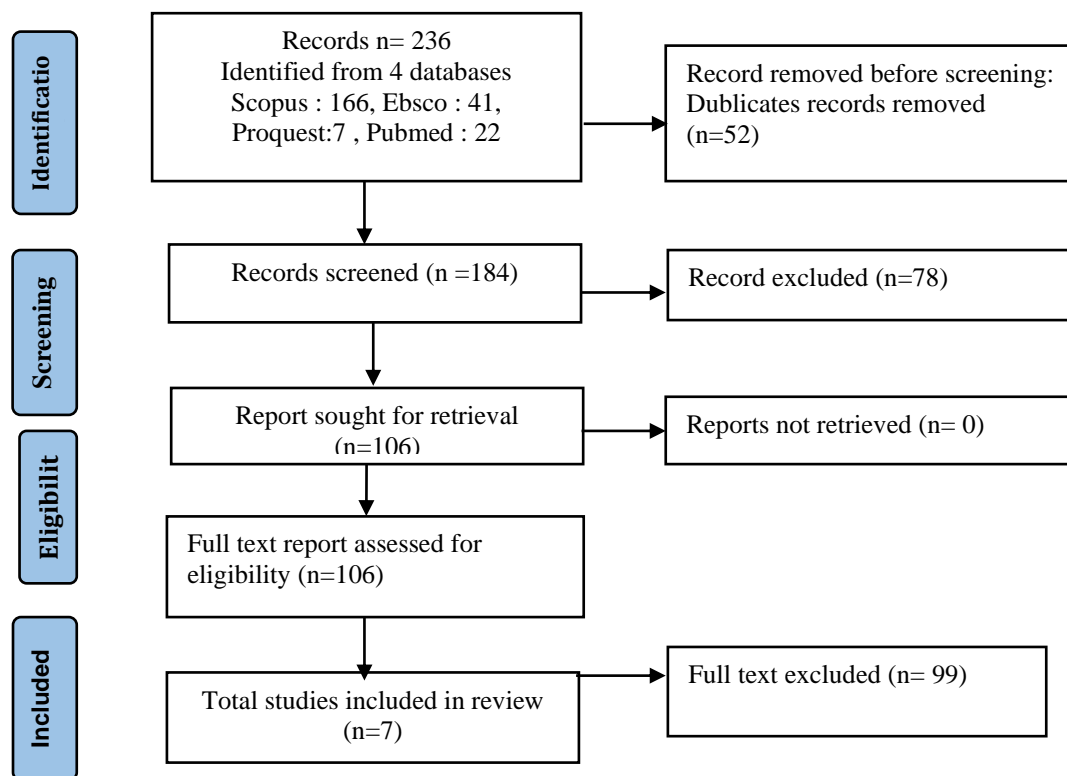
RESULT

Table 1.
Study Characteristics

Author, year, Country	Sample, and Desain, Duration	App Name/Device/ Platform/Objectives	Intervention	Result
(Kitrenu et al., 2023)

Thailand | - 62 responden
- Quasi-experimental design
- 12 weeks | - HomePDCare
- Mobile
- Android
- To support self-management for patients undergoing Peritoneal Dialysis (PD) by providing healthcare resources, enabling daily health data recording, and facilitating two-way communication with PD nurses and researchers. | The Chronic Health Needs Telehealth Care (CHNTC) program, which included educational sessions, mobile application support, and regular | The outcomes of the study indicated that the experimental group receiving the Chronic Health Needs Telehealth Care (CHNTC) program showed significant improvements in self-management capabilities and quality of life (QOL) compared to the comparison group receiving standard care.
- post-test mean scores |

			follow-ups to enhance self-management capabilities and quality of life (QOL) among patients undergoing peritoneal dialysis (PD).	for - overall self-management (p <.05). - Post-test mean scores related to kidney disease effect and kidney disease burden (p < .01)
(Milan et al., 2020) Italy	- 73 responden - Retrospective case-control - 6 month	- N/A - Claria™ - Connected to the Sharesource platform by Baxter Healthcare and the Sleep-safe Harmony system connected to the Home Bridge Connectivity PD by Fresenius Medical Care - The objective was to compare clinical outcomes and quality of life in patients undergoing automated peritoneal dialysis (APD) with and without remote monitoring.	Intervention in the context of peritoneal dialysis involves the use of telemedicine and remote monitoring (RM) to enhance the quality of patient care. This approach allows for daily monitoring of peritoneal dialysis (PD) treatments and more timely adjustments to PD prescriptions, which can reduce the frequency of in-person visits to healthcare facilities.	- The RM-APD group had significantly fewer disease-specific hospitalizations (2 patients, 18.2%) compared to the control group (7 patients, 77.8%), with a p-value of 0.022, indicating a statistically significant difference. - The internal QoL PD questionnaire revealed a significant difference favoring the RM-APD group, with a p-value of 0.018, indicating higher patient satisfaction and perception of safety.
(Cao et al., 2018) China	- 160 responden - Rondomized controlled trial. - 11 month	- The QQ application - Smartphone and tablet - Android - Investigate the effectiveness of the QQ application.	Nurses provide health education and disease-related information to patients through the QQ application, engaging in online conversations to address their health concerns	Compared with the patients in the traditional follow-up group, patients in the QQ follow-up group showed higher levels of serum albumin (P=0.009) and hemoglobin (P=0.009), lower levels of phosphorus (P<0.001) and calcium-phosphorus product (P=0.001), and better degree of satisfaction (P<0.001).
(Chae & Kim, 2023)	- 53 responden - Rondomized	- PD with you - N/A - Android	Patients used the self-management	Compared to the controls, the intervention group showed significant

Japan	controlled trial. - 10 weeks	- Developing a mobile application for enhancing self-management and assessing its effectiveness for patients with PD.	mobile application to record PD dialysis (i.e., replacement time and amount of removed fluid) and observe the physical indicators (i.e., body weight and blood pressure).	improvement in PD-related knowledge and health behavior, albumin, and hemoglobin. HRQoL domains of symptoms/problems of kidney disease and disease impact on daily activity were improved in the intervention group.
(Molnar et al., 2021) Canada	- 140 responden - Rondomized controlled trial - 55 months	- Interactive Health Communication Application (IHCA) - Web - A/N - The IHCA aimed to reduce decisional conflict and enhance shared decision-making among patients by providing educational content about dialysis, with an emphasis on home dialysis, and offering social support.	Interactive Health Communication Application (IHCA) and received an orientation session for the website at the randomization visit. They were asked to log on to the website at least monthly, in addition to receiving usual care provided in the multidisciplinary kidney clinic.	The results of the study showed no significant difference in home dialysis uptake between the IHCA group and the usual care group. Specifically, 37.7% of the IHCA group and 32.4% of the usual care group initiated home dialysis within 90 days of starting dialysis. The odds ratio was 1.3 with a p-value of 0.5, indicating no statistically significant effect of the IHCA on the primary outcome. Additionally, among those who started dialysis, 60.5% in the usual care group and 65% in the IHCA group received home therapy, with an odds ratio of 1.2 and a p-value of 0.7
(Chen et al., 2021) China	- 150 responden - Rondomized controlled trial - 6 month	- Dialysis Companion - Mobile - iOS and Android - This app aims to enhance the self-management capabilities of peritoneal dialysis patients by integrating educational resources, community support, and health monitoring tools.	The intervention involved providing peer support to peritoneal dialysis (PD) patients to improve their self-management abilities. This was done through two main methods: a WeChat group and face-to-face interactions.	The study results indicate that both WeChat and face-to-face peer support interventions significantly improved self-management abilities and biochemical indicators (such as hemoglobin, calcium, and phosphorus levels) in patients undergoing peritoneal dialysis (PD) compared to the control group. After six months, both intervention groups showed better outcomes in self-management scores and biochemical markers (PA, Hb, P, Ca) than the control group ($P < 0.01$)

| (García et al., 2018) Mexico | - 24 Responden
- Quasi-experimental design
- 9 months | - N/A
- A mobile Web application (for HCP) and Android application (for patients)
- Android
- Evaluating the usability of a remote monitoring system for patients undergoing peritoneal dialysis treatment | Providing applications to patients to monitor the patient's condition and assess the usability of the app | Satisfaction, acceptance (1) 94.5% of participants were satisfied with the app among patients with APD and 92.3% among CAPD. (2) 89.5% of participants accepted. |

Article characteristics

Seven articles published between 2015-2024 were included in the final review. Tabel 1 present the characteristics of each mHealth app. Two studies were conducted in China (Cao et al., 2018; Chen et al., 2021), Italy (Milan et al., 2020), Thailand (Kitrenu et al., 2023), Canada (Molnar et al., 2021), Mexico (García et al., 2018), and Japan (Chae & Kim, 2023). The study design varied, with four using randomized controlled trials (RCTs) (Cao et al., 2018; Chae & Kim, 2023; Chen et al., 2021; Molnar et al., 2021), two using quasi-experimental design (García et al., 2018; Kitrenu et al., 2023), and one Retrospective case-control (Milan et al., 2020).

Digital intervention approaches

Digital intervention approaches varied widely across th e included studies. mHealth apps were used on various devices: 42,8% (3/7) on smartphone 14,3 (1/7), on tablets 14,3 (1/7), and 28,6 (2/7) on unspecified devices. In terms of operating system 85,7 (6/7), were Android-based 71,4%, were IOS-based 14,3 (1/7), were internet-based : 28,6% (2/7), and 14,3 (1/7) were unspecified. The measurement durations of these studies ranged from 10 weeks to 55 months. None of the studies used advanced technologies such as artificial intelligence or robots, and the aim was to use digital interventions in studies focused on improving self-management, health monitoring and reducing the risk of complications in patients.

Effects of digital interventions on self-management patients peritoneal dialysis

Of the 7 included research articles, all used digital interventions to improve self-management of patients on peritoneal dialysis. The participants were enrolled in an Interactive Health Communication application (IHCA) and received an orientation session to the website at a randomized visit. Each participant was asked to log into the website at least monthly, in addition to receiving usual care at a multidisciplinary renal clinic (Molnar et al., 2021). Based on the results of the systematic review, mobile app-based applications may consist of several features designed to improve patient self-management and health, which include Health Education, which provides information on diet management and food exchange calculations, and Peer Support, which allows patients to participate in support activities through WeChat groups or face-to-face meetings to share experiences. In addition, the app also provides Health Condition Monitoring, which keeps an eye on important health indicators such as albumin and hemoglobin, and Emotional and Social Management to help patients manage emotions and adapt back to society. The Physical Activity Settings feature offers appropriate exercise guidance, while Reminders and Schedules help patients remember support activities and health check-ups (Chen et al., 2021). However, in the context of telemedicine application for remote monitoring in peritoneal dialysis, some of the features that may be included are: Daily monitoring, Problem recognition and correction, Interaction with care team, Mileage reduction, Ease of use. These features aim to improve patient quality of life and healthcare efficiency (Milan et al., 2020).

Use of the Home PDC are App includes the ability to upload health information and resources useful to peritoneal dialysis (PD) patients and their caregivers. The app also supports two-way communication with PD caregivers and researchers through a chat messaging menu, as well as allowing image submission for assistance. In addition, PD patients can record daily health data such as weight, height, food consumption, PD self-management practices, and complications in an assessment form. The intervention associated with the HomePDCare app involves a telehealth program led by community nurses to improve self-management and quality of life of PD patients. The program included a 90-minute face-to-face education and counseling session, during which PD patients and their caregivers received an orientation on the use of the app. The intervention aims to support patients in recording daily health data and communicating with the PD nurse for further assistance and information (Kitrenu et al., 2023).

A different intervention using instant messaging (IM) software may also improve access to research and health services, especially in rural areas. Individually tailored programs delivered via the Internet and email can increase motivation to quit smoking and self-efficacy. In addition, the use of IM software in nursing care for peritoneal dialysis patients shows that this method is feasible and can improve patients' knowledge of peritoneal nursing care. Tencent QQ app has various features, including online chat, video chat, voice chat, file transmission that can be resumed from a disconnected point, file sharing, remote control, QQ mailbox, network favorites, file storage, offline file delivery, and many other functions. The app can connect with various communication methods, making it the most popular and powerful IM software in China. Features of the telemonitoring app for patients with chronic kidney disease (CKD) undergoing peritoneal dialysis (PD) include PPE and CAPD exchange data registration service, alert service, and notification search service. The data registration service allows patients to enter biomedical data needed to monitor and control dialysis. The alert service notifies doctors of the patient's risk situation through text messages and emails. The notification lookup service allows patients to check the date of events related to their PD treatment, such as medication, reminders, and doctor recommendations (Cao et al., 2018; Chae & Kim, 2023; García et al., 2018).

DISCUSSION
Given the increasing trend of technology use worldwide, digital interventions can make a significant contribution to the provision of high-quality health services and health promotion. The results obtained show that digital interventions have a significant impact on improving the self-management ability of peritoneal dialysis patients. One of the digital interventions is the mHealth app. In addition, evidence from this review was conducted to identify and map evidence related to the features, functions and usability of mHealth apps in peritoneal dialysis patients. The findings showed that the apps mainly focused on self-efficacy in performing PD procedures, user satisfaction, and the ability to monitor and improve health conditions. Regarding functionality, mHealth apps mostly include features listed in the STI. Regarding usability, these findings are similar to those found in Cartwright et al., (2021) systematic review of eHealth. However, results relating to outcomes were inconsistent.

The most successful features for mHealth apps should be multifunctional (Farzandipour et al., 2017). In this systematic review, most apps were found to have multiple functions such as displaying, guiding, recording, reminding/alerting, communicating and facilitating remote monitoring (Kitrenu et al., 2023) (Milan et al., 2020). The app allows patients to upload data, such as fluid volume during the PD process, enabling communication and interaction between HCPs and patients to ensure treatment outcomes. HCPs can also track patient treatment

outcomes (Cao et al., 2018). These results are consistent with Eberle et al., (2021) which found that the app improved laboratory data and facilitated health promotion. In addition, the app provided disease-related information for patients with PD and resulted in increased user satisfaction.All study findings reported patient satisfaction in using digital interventions (Milan et al., 2020) (García et al., 2018) (Chae & Kim, 2023) (Molnar et al., 2021) (Cao et al., 2018). In the use of digital interventions, one of them is the mHealt application which has the main advantage that they are not bound by space and time constraints, thus allowing users to access disease-related information, record personal data (blood pressure, weight, and PD fluid), and monitor their health status at any time. Patients can also communicate with HCPs if they experience problems or difficulties. Patient satisfaction increases significantly if the app is comprehensive, practical, easy to use, and suitable for patients (Cao et al., 2018) (Milan et al., 2020).

The effectiveness of the app in improving biochemical parameters shows inconsistency, while according to Eberle et al., (2021) it showed some improvement in diabetic patients, no statistically significant differences were found in other patients. Continuous monitoring of nutritional management can help maintain normal hemoglobin and albumin levels (Molnar et al., 2021). Learning fatigue, which results in low willingness to use digita interventions, can occur when patients need to learn how to use them correctly, which can be a contributing factor to the lack of improvement in physiological health indicators. This can lead to no effective outcomes (Farzandipour et al., 2017). However, in a four-year study on the use of PD apps, Wang et al., (2015) found improvements in all physiological indicators, e.g. cause-specific mortality and hemodialysis cause-specific permanent displacement, suggesting that long-term consistent use of apps to record activities of daily living is effective.Based on the research obtained, 6 out of 7 studies used mobile application-based management. (Milan et al., 2020) (García et al., 2018) (Chae & Kim, 2023) (Molnar et al., 2021) (Cao et al., 2018) In line with the results of this study, Kramer et al., (2016) conducted a systematic review to evaluate the effects of mobile interventions on peritoneal dialysis patients. The results of this study indicate that mobile technology interventions have helped improve self-management and quality of life in peritoneal dialysis patients (Kramer et al., 2016). Monitoring dialysis-related issues through mobile health, along with effective guidance, constitutes an effective intervention in peritoneal dialysis treatment. Promoting the efficient use of this technology will enhance self-management and patient experience (Mukarromah & Azinar, 2021).

CONCLUSION
The review shows that digital interventions offer a new approach to enhancing self-management capabilities in peritoneal dialysis patients. The use of technology allows peritoneal dialysis patients to actively participate in their care. Patients can also easily communicate with healthcare professionals when they want to consult about fluid exchanges and if any problems occur during treatment. Further research on the economic evaluation of this intervention may be needed in the future.

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