PERCEPTIONS OF MHEALTH TECHNOLOGY USE BY PATIENTS UNDER DIALYTIC TREATMENT

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ABSTRACT

Objective: To understand the perceptions of mobile health technology use in adherence to the treatment of patients with chronic kidney disease under hemodialysis.

Method: This is a descriptive study, with a qualitative approach, carried out in a reference hemodialysis clinic in the city of Juazeiro, Bahia, Brazil. Patients with chronic kidney disease under hemodialysis who used the Renal Health application between February and October 2022 were included in the study. The data was analyzed using the content analysis method.

Results: A total of 12 patients were interviewed, the majority of whom were male, with an average age of 35.3 (±9.7) years and an average of 2.7 (±1.5) years of hemodialysis. After analyzing the content, two thematic categories emerged: "Support from mHealth technology in treatment management" and "Suggestions for improving the application", in which patients describe how the application is practical, favors the storage of information related to treatment, such as weight, water intake and medication taking times. In addition to generating graphs of the exams carried out monthly, it provides strategies that can promote disease self-management and consequently better adherence to treatment.

Conclusion: The Renal Health application proved to be a useful tool capable of enhancing knowledge about chronic kidney disease and helping patients better manage their diet, fluid control and taking prescribed medications.

DESCRIPTORS: Chronic renal insufficiency. Renal dialysis. Mobile applications. Treatment adherence and compliance. Health promotion.

PERCEPÇÕES DO USO DE TECNOLOGIA *MHEALTH* POR PACIENTES EM TRATAMENTO DIALÍTICO

RESUMO

Objetivo: compreender as percepções do uso de uma tecnologia *mobile health* na adesão ao tratamento do paciente renal crônico em hemodiálise

Método: estudo descritivo, com abordagem qualitativa, realizado em uma clínica de referência em hemodiálise no município de Juazeiro, Bahia, Brasil. Foram incluídos no estudo pacientes renais crônicos hemodialíticos que utilizaram o aplicativo *Renal Health* entre os meses de fevereiro a outubro de 2022*.* Os dados foram analisados através do método análise de conteúdo

Resultados: foram entrevistados 12 pacientes, a maioria do sexo masculino, idade média de 35,3 (±9,7) anos e média de 2,7 (±1,5) anos de hemodiálise. Após análise do conteúdo surgiram duas categorias temáticas: "Apoio da tecnologia *mHealth* no gerenciamento do tratamento" e "Sugestões para aperfeiçoamento do aplicativo", nas quais os pacientes descrevem como o aplicativo é prático, favorece o armazenamento de informações relacionadas ao tratamento, como peso, ingestão hídrica e horário da tomada de medicamentos. Além de gerar gráficos dos exames realizados mensalmente, proporcionando estratégias que podem favorecer o autogerenciamento da doença e consequentemente uma melhor adesão ao tratamento.

Conclusão: o aplicativo *Renal Health*, demonstrou ser uma ferramenta útil, capaz de potencializar o conhecimento sobre a doença renal crônica e auxiliar os pacientes a gerenciarem melhor a dieta, o controle de líquidos e a tomada das medicações prescritas.

DESCRITORES: Insuficiência renal crônica. Diálise renal. Aplicativos móveis. Cooperação e adesão ao tratamento. Promoção da saúde.

PERCEPCIONES SOBRE EL USO DE TECNOLOGÍA *MHEALTH* POR PACIENTES EN TRATAMIENTO DIÁLTICO

RESUMEN

Objetivo: comprender las percepciones sobre el uso de la tecnología móvil de salud en la adherencia al tratamiento de pacientes con enfermedad renal crónica en hemodiálisis.

Método: estudio descriptivo, con enfoque cualitativo, realizado en una clínica de referencia en hemodiálisis de la ciudad de Juazeiro, Bahia, Brazil. Se incluyeron en el estudio pacientes en hemodiálisis renal crónica que utilizaron la aplicación *Renal Health* entre los meses de febrero y octubre de 2022. Los datos se analizaron mediante el método de análisis de contenido.

Resultados: se entrevistaron 12 pacientes, la mayoría del sexo masculino, con una edad promedio de 35,3 (±9,7) años y un promedio de 2,7 (±1,5) años de hemodiálisis. Tras el análisis del contenido surgieron dos categorías temáticas: "Apoyo de la tecnología *mHealth* en la gestión del tratamiento" y "Sugerencias para mejorar la aplicación", en el que los pacientes describen cómo la aplicación es práctica, favorece el almacenamiento de información relacionada con el tratamiento, como peso, ingesta de agua y tiempos de toma de medicamentos. Además de generar gráficos de los exámenes realizados mensualmente, brinda estrategias que pueden promover el autocontrol de la enfermedad y en consecuencia una mejor adherencia al tratamiento.

Conclusión: la aplicación Renal Health demostró ser una herramienta útil capaz de mejorar el conocimiento sobre la enfermedad renal crónica y ayudar a los pacientes a gestionar mejor su dieta, control de líquidos y toma de medicamentos prescritos.

DESCRIPTORES: Insuficiencia renal crónica. Diálisis renal. Aplicaciones móviles. Cumplimiento y adherencia al tratamiento. Promoción de la salud.

INTRODUCTION

Chronic kidney disease (CKD) consists of the progressive and irreversible loss of kidney function. It is seen as a global public health concern due to its high incidence and prevalence, in addition to the high cost of treatment, especially in developing countries, such as Brazil[1].

CKD is one of the three fastest growing causes of death in the world. Between 1990 and 2017, there was a 42.5% increase in the overall CKD mortality rate. In 2017 alone, around 1.2 million people died from this condition[2]. In Brazil, between 2009 and 2020, around 81 thousand deaths were recorded, with the northeast region being the second region with the highest number of deaths[3].

CKD is considered a condition that reduces the quality and life expectancy of patients due to the various complications triggered by this disorder, mainly cardiovascular complications[4]. Treatment involves strict drug therapy, dietary regimen and fluid control. Furthermore, individuals in an advanced stage, with a glomerular filtration rate below 15 ml/min/1.73m², need to undergo a form of renal replacement therapy, such as dialysis[5].

A progressive increase in the number of new dialysis patients in Brazil has recently been observed, in 2020, around 44,264 new cases were registered, in total, approximately 140,000 Brazilians undergo dialysis treatment, of which 92% undergo hemodialysis (HD). CKD is more prevalent in the age groups between 45 to 64 years and 65 to 74 years, accounting for 42.5% and 23%, respectively[6]. In the Northeast region, it is estimated that 11,308 people undergo HD treatment, and in the fourth region with the highest prevalence of dialysis patients, in 2020, the estimated prevalence was 599 patients per million inhabitants[6,7].

The effectiveness of treatment directly depends on patients' adherence to drug therapy, diet and fluid restriction as well as participation in all HD sessions[4]. Due to this complex therapeutic regimen, non-adherence to treatment, especially in aspects involving water and dietary restriction, are frequently reported. Therefore, it is essential to develop strategies that encourage patients to better manage their condition and promote better adherence to treatment[5].

In recent years, there has been a growing interest in the development of innovative and effective methods that help patients with chronic diseases improve behaviors related to treatment adherence. Among these methods, mobile health technology (mHealth) use has stood out, mainly because it is an easily accessible and widely disseminated tool worldwide. Technological interventions that support self-management are becoming increasingly common and can have a positive impact on the health and quality of life of people with chronic illnesses in general[8].

Thus, mHealth consists of using mobile devices such as smartphones and tablets and other wireless devices to support the achievement of health goals[9]. Using this technology is seen as an important means of promoting and preventing health, and has become a tool with great potential to provide information and assist people with chronic illnesses in self-managing their conditions[10].

The Renal Health application is a tool developed by researchers at *Universidade de Fortaleza* (UNIFOR), located in the state of Ceará, and aims to inform the general population about CKD and support people undergoing CKD treatment with information and features for continuous monitoring of their condition. Using this tool, users can schedule appointments, exams and set alarms for medications to be taken, in addition to monitoring the amount of liquids they drink on a daily basis[11].

Through this application, users can also record the results of their monthly exams and monitor progress through graphs. Moreover, they have access to a nutritional table that presents some information about foods that contain large, medium and small amounts of phosphorus, potassium and sodium[11].

Although there are promising results in aspects involving using technology and self-management of chronic conditions, there are still few Brazilian studies that assess its applicability and its real benefits for users. Therefore, it is important to ask patients about the benefits and difficulties in managing

technologies, their perceptions and thus provide healthcare professionals with strategies for better adherence to treatment. Given this context, this study aimed to understand the perceptions of use in adherence to treatment for patients with chronic kidney disease under HD.

METHOD

This is a descriptive study, with a qualitative approach, whose data were analyzed using the content analysis technique in the thematic analysis modality[12]. The development of research considered the COREQ (COnsolidated criteria for REporting Qualitative research) guidelines[13].

This research was carried out in a clinic that provides services for the Brazilian Health System (SUS – *Sistema Único de Saúde*), which provides high and medium complexity healthcare to patients with CKD for HD and training for peritoneal dialysis, located in the city of Juazeiro, Bahia, Brazil, with around 235 thousand inhabitants.

The study population consisted of patients with CKD registered in the HD program of the aforementioned clinic, who participated in a previous study linked to a doctoral thesis entitled "*Uso de Tecnologia mHealth: Impacto no tratamento de pacientes com Doença Renal Crônica em Hemodiálise - Ensaio Clínico Randomizado*". The final sample was 60 patients who used the Renal Health application.

For the present study, the sample was selected by convenience, and the inclusion criteria consisted of being 18 years of age or older and having used the Renal Health application between February and October 2022. Patients who had cognitive limitations, indicated in medical records, which would prevent them from responding to the research instruments, were excluded. A sociodemographic questionnaire and a previously structured script containing open questions to guide the interviews in an individualized manner were used as data collection instruments, both produced by the study researchers.

The interview script consisted of six questions related to participants' experience using the application, changes in treatment after its use, application contributions in relation to diet, water control, taking medications and scheduling exams. Finally, participants were asked to suggest changes to the application to improve their experiences.

The interviews were carried out between August 2022 and May 2023, during the HD sessions, by two researchers, a doctoral nurse and a nursing graduate. These lasted an average of five minutes. Theoretical data saturation was used to interrupt collection[14], when statements began to repeat themselves and/or new information was not added by the participants. 17 patients were invited to respond to the interview guide; of these, four refused to answer and one did not reach the study objective, with the final sample being 12 participants.

The interviews were recorded with the aid of a portable recorder, then the interviews were transcribed into Microsoft Office Word 2020. Participants were identified using the letter P (Participant), followed by numbering in the chronological order of data collection. Everyone signed an Informed Consent Form (ICF).

Data analysis occurred in a few steps. After carrying out the interviews, a literal transcription was carried out and, subsequently, a floating reading was carried out to approximate understanding and familiarization with what was given by the researcher. After this stage, an exhaustive reading in order to extract the meaning cores of statements for subsequent analysis theme construction[12]. This entire procedure was performed manually, through the creation of tables containing the full speech, excerpts from speeches, meaning cores and thematic analysis categories.

The present study followed the precepts of Resolution 466/2012 of the Brazilian National Health Council. The study was linked to the doctoral thesis, which was approved by the *Universidade de Pernambuco* Research Ethics Committee, under Opinion 4,044,382, in 2020.

RESULTS

A total of 12 patients aged between 23 and 56 years were interviewed, with an average of 35.3 (±9.7) years and an average of 2.7 (±1.5) years of HD. There was a predominance of males with ten participants. As for marital status, the majority were married (6), with a monthly income between one and two minimum wages (9). Regarding education, complete secondary education or incomplete higher education prevailed (5), and regarding color, the majority declared themselves brown (7).

Participants' reports were organized into two thematic categories, such as "Support from mHealth technology in treatment management" and "Suggestions for improving the application". From the first category, three thematic subcategories emerged, such as "Weight control and water intake", "Food control and exams" and "Time control and taking medication".

Support from mHealth technology in treatment management

It was possible to identify, based on statements of participants in this study, that the Renal Health application is a practical, easily accessible tool that favors the storage of information related to CKD treatment, such as weight, water intake and medication intake times. In addition to generating graphs of the exams carried out monthly, it provides strategies that can promote disease self-management and consequently better adherence to treatment.

Weight control and water intake

Participants emphasized that the Renal Health app helped to control the amount of liquid consumed on a daily basis. Better management of water intake resulted in a reduction in interdialytic weight gain (IDWG):

[...] *It was good, it helps with nutrition, with fluid control too, it was a good help* [...], *before I was very heavy, 5 kg, then it helped to control it* (P6).

[...] *It contributed a lot, because before I only arrived heavy, sometimes I look at it* [the application] *and remember to control, I see the right amount to see if it didn't go over the limits* (P7).

[...] *Before, I didn't have any water control, I drank whatever I wanted to drink, and sometimes I felt very full, very bloated, and there* [in liquid control] *I put the right amount of water to drink. There, I control the day, the amount I can drink from one day to the next, and it has improved a lot. Today I know that there is that amount for me to drink from one dialysis to another and especially on weekends* (P9).

Food control and exams

In this subcategory, participants revealed that the nutritional table helped them to know and avoid consuming foods that had a large amount of phosphorus and potassium. Furthermore, they reported that the application helped to store and track information related to exams carried out monthly with greater practicality:

He gave me a lot of guidance about the nutrients in each food, there are things there that I didn't know about, there are fruits that I no longer consume because of the table (P5).

The list [nutritional table] *favored having control, of what we had to avoid in relation to phosphorus, potassium, if people forgot they could consult* [...] (P8).

It [nutritional table] *informs new food options, because sometimes you have this information, but it is limited* [...]. *There is this lack of knowledge on the part of patients, they are very restricted* [on what they can eat]. [The application] *helped to store* [exam results], *it's like a folder for you to have quick access to the results you obtain* [...], *it's something more practical* (P10).

Regarding the exams, it was the part that helped me the most because we do tests every month to find out the level of the main toxins [...] phosphorus, potassium. Through this application, patients can monitor and see what needs to be improved (P11).

Time control and taking medication

Participants noted that the application helped them separate medications they took daily, and helped them remember to take them at the correct time, as the application issued alarms at the informed times:

It [the application] *helped a lot to remember whether I had taken the medication or not. I often forget this, sometimes I took the same medication twice. With the alarm, it makes this easier, reminding me of the time* [...] (P2).

It helped a lot, I was a bit sloppy, it [the app] *gave me the time and reminded me to keep taking my medication* [...] (P3).

It contributed because I was anxious not to miss the schedule. There are many medications, I had to remember them all, and I didn't remember (P12).

It helped me with my schedule, with taking my medications at the right time, before the application, I basically took them all at the same time [...]. *After I entered the information into the application, I saw that there were some that were 8/8 hours, others were 10/10 hours and others were 12/12 hours, it wasn't all at the same time. It helped me sort it out* (P5).

Suggestions for improving the application

This thematic category emerged from participants' reports, who assessed the application as good, but made suggestions for updates to make it more complete and interactive. Some of the suggestions are related to adding information about medications, diet and care for arteriovenous fistulas. One of the participants also highlighted the importance of adding information related to mental health:

A little more information [...] *for new patients, for fistulated patients, because it requires great care* [...], *to avoid infections and bigger problems* (P1).

I think there is a lack of interaction with videos, videos encouraging kidney patients, with content about medications, weight, diet, especially about diet (P4).

You need to enter some information [...] *regarding some medications for what they are used for* [...], *at what point you should use them and see a doctor* [...] *another important piece of information for those undergoing kidney treatment is a part of psychology that must be included in relation to patients knowing how to deal with treatment* [...], *taking care not only of the body, but also of the mind* (P11).

DISCUSSION

Furthermore, mHealth technology is now a reality when it comes to new strategies to enhance the self-management of patients with chronic diseases. Interventions that use apps stand out for their ease of access and are increasingly being used in the daily lives of people who want to monitor their health status and acquire healthier lifestyle habits[15]. Furthermore, this technology can be used as an alternative for intervention in groups as well as to benefit mental health conditions[16].

In the present study, it was observed that Renal Health use contributes positively to several aspects involving CKD treatment. The application helped them manage and monitor their fluid intake, medication intake and test results in a more practical way as well as providing nutritional information on foods frequently consumed on a daily basis.

It was observed, based on participants' statements, that using the application helped them remember and control liquids more effectively. It is known that adequate fluid intake between

dialysis sessions is essential for well-being and cardiovascular complication reduction[17]. However, in a recent study, it was observed that approximately 30 to 60% of patients have difficulty following the recommended guidelines, resulting in detrimental effects on quality of life and survival[18]. Among the main causes of non-adherence to water restriction are physiological aspects, such as thirst and xerostomia, lack of motivation and very strict intake targets[17,18].

IDWG is used as a parameter for fluid and sodium intake. The high weight gain and rapid loss during the HD session result in continuous cardiovascular stress. Furthermore, IDWG greater than two and a half kilos are directly related to increased blood pressure (BP) pre- and post-dialysis. On the other hand, during the intradialysis period, excessive weight loss is associated with episodes of cramps, arrhythmias and hypotension, which can lead to shorter dialysis time or even session interruption[18,19]. As pointed out by P6, his interdialytic gain used to be five kilos and using the Renal Health app helped him with this control.

In a randomized controlled study carried out in Iran, positive results were also found related to the effectiveness of using a mobile application in self-management of high blood pressure. Using an application, medication reminders and encouraging messages were sent to record BP measurements at home. With this intervention, adherence to treatment increased by an average of 5.9%. Better adherence to treatment resulted in a decrease in mean BP over time by an average of 3.4 mmHg in the intervention group compared to the control group[20].

In CKD, due to ineffective renal function, hyperphosphatemia and hyperkalemia, they are frequent complications and, if not monitored and controlled, can trigger more serious problems such as renal osteodystrophy, cardiovascular and soft tissue calcification and secondary hyperthyroidism[21]. Hyperkalemia alters the function of the nervous system, causing electrophysiological dysfunctions, observed through clinical manifestations such as paresthesia, paralysis, cardiac arrhythmias and cardiac arrest[22].

The Renal Health application is a tool capable of helping users store and monitor the results of exams that are carried out monthly. With these results, the application generates a graph indicating whether or not they are within the normal range. The graphical visualization of these exams allows users to better understand the results, as mentioned by P11.

Another randomized clinical trial carried out in Iran, which compared the effects of using a mobile application and in-person training on clinical and laboratory parameters of diet adherence and fluid intake in HD patients, demonstrated that patients who used the application significantly reduced IDWG, albumin, triglycerides and total cholesterol levels, in addition to a decrease in average phosphorus and potassium values[23].

Non-adherence to pharmacotherapy is a frequent problem among individuals with chronic diseases in general, such as diabetes and hypertension. A study carried out in Brazil indicated that the prevalence of non-adherence to pharmacological therapy is 20.2%. When analyzed regionally, the northeast region has the highest prevalence, reaching 27.8%. Several factors are associated with this problem, with socioeconomic factors such as income and education being the main ones. Furthermore, psychosocial factors, such as forgetfulness, depression and lack of social support, are commonly related to non-adherence[24,25].

Research participants reported that using the application contributed positively in relation to taking medications, as it allowed them to organize their schedules and issued sound and visual alerts at previously informed times. The effectiveness of using mHealth technology to improve medication adherence can also be seen in research carried out in the Netherlands, in which using an interactive application that provided educational and motivational videos, in addition to alarms and reminders about medications, had a positive impact on the medication adherence rate of adolescents with asthma, with an increase from 33.3% to 36.8% in the intervention group[26].

In this study, it was observed that the young public was more adherent to using the application. This finding can be justified by the difficulties that the elderly population still faces in adhering to this type of technology[27]. Many older adults may feel uncomfortable or unsafe interacting with mobile health apps due to unfamiliarity. In this scenario, the implementation of accessible technologies for the elderly population becomes an increasingly relevant concern, as aging is often associated with a greater risk of developing chronic diseases, including CKD[27,28].

An appropriate educational alternative for older adults can be an educational booklet. A study regarding the validation of an educational booklet on vascular access care for HD patients, with a sample of patients mostly between 60 and 80 years old, showed the importance of the booklet as educational support for this audience. A holistic and objective approach to the various aspects of HD and vascular access care, combined with accessible language, illustrations, as well as fixation games suitable for the adult target audience, is an educational technology with potential for use in clinical practice[29].

The results of this study provide relevant information on mHealth technology application in real scenarios, as it presents usage characteristics and highlights improvement strategies so that tools, such as Renal Heath, are increasingly integrated into the chronic healthcare routine. New studies will be able to verify whether platforms with videos and training can increase adherence to technological tool use.

Using mHealth technology, also by healthcare professionals, is growing. A study with nurse managers demonstrated that technologies contribute to improving the work process, facilitating records, time management and, consequently, improving results that can influence the quality and safety of patients treated[30].

This study has some limitations mainly related to participants' adherence to answering the research questionnaire. Some of the interviewees limited themselves to answering the questions succinctly, resulting in short answers. The fact that the interview took place in a HD room and not in a private environment may have favored obtaining short answers. Furthermore, the massive application use by younger people restricted the age range studied, making it impossible to analyze application use repercussions by older adults.

CONCLUSION

In the present study, the perception of Renal Health application use, an mHealth technology, was related to being a useful tool capable of enhancing knowledge about CKD and assisting patients in managing their diet, controlling fluids and taking prescribed medications. Moreover, mHealth technology has great potential to improve health promotion and self-management of chronic diseases, but challenges such as accessibility and integration with traditional care still need improvement to achieve broad adoption and maximum effectiveness in patient care.

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NOTES

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APPROVAL OF ETHICS COMMITTEE IN RESEARCH

Approved by the Ethics Committee in Research of the *Universidade de Pernambuco*, Opinion n.º4,044,382 and Certificate of Presentation for Ethical Consideration.

CONFLICT OF INTEREST

There is no conflict of interest.

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