

Preferences of ICT among Patients with Chronic Kidney Disease Undergoing Hemodialysis: An Ecuadorian Cross-Sectional Study

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Objectives: The aim of the present study was to assess the frequency of use, and preferences regarding information and communication technologies (ICTs) among Ecuadorian patients with chronic kidney disease (CKD) undergoing hemodialysis. **Methods:** We conducted an anonymous cross-sectional survey-based study from January 2016 to April 2017, involving 393 patients with end-stage renal disease from 9 hemodialysis centers, in which they rated their use and preferences of various ICTs through a modified version of the Michigan Questionnaire. The questionnaire collected information regarding demographics, patients' interest in obtaining health-related information through ICTs, and interest in using ICTs as a potential way to communicate with their healthcare providers. A chi-square test for association and adjusted regression analyses were performed. **Results:** Among all patients who participated, 64.3% reported owning a cellphone, with less than a third reporting active Internet connection. The most used ICT for obtaining information about CKD and/or hemodialysis was web-based Internet, followed by YouTube. SMS was rated the highest to receive and seek health-related information, followed by Facebook. Younger age and higher levels of education were associated with a higher overall usage of ICTs. Finally, more than half of the patients reported interest in using WhatsApp for communicating with their healthcare providers. **Conclusions:** Understanding the preferences of ICTs among patients with CKD undergoing hemodialysis could help to improve their outcomes through the potential uses and benefits of ICTs. Further research is needed to assess their role in improving the care of patients with chronic diseases.

Keywords: Chronic Kidney Diseases, Renal Dialysis, Medical Informatics, Social Media, Internet

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I. Introduction

Chronic kidney disease (CKD) is a worldwide public health problem with more than 70 million individuals suffering from the disease [1]. According to estimates, the prevalence and economic impact on health systems related to CKD care will continue to rise [1]. Worldwide, the number of patients receiving renal replacement therapy is estimated to be more than 1.4 million, with the incidence growing by approximately 8% annually, particularly in developing countries [2,3].

Considering that patients with CKD undergoing hemodialysis are associated with a very high mortality and accelerated cardiovascular disease, it remains critical to find ways to improve their care [4]. This is especially important in developing countries, such as Ecuador, where there is a significant growth in the incidence rate regarding CKD and hemodialysis [5]. Therefore, it is necessary to establish prevention programs, including early diagnosis and treatment of diabetes and hypertension, which remain the leading causes of end-stage renal disease in developing countries [5].

In the setting of this growing health-care burden, providing medical care from a distance can help to achieve improved health outcomes and lower costs [6]. Nowadays, electronic devices, such as smartphones, tablets, laptops, and so forth, are being increasingly used to communicate, manipulate, and store data by electronic means. They are referred to as information and communication technologies (ICTs). Few studies have analyzed the role of ICTs in relation to patients with CKD. For instance, one study reported that regardless of age, the level of access to technology was high [7]. Moreover, Lee et al. [8] found that most patients expect to learn and increase their contact with physicians through an interactive system, providing a potential platform for patient education or management.

Despite the potential benefits of ICTs for healthcare, few studies have addressed the usage and preferences of these technologies among patients with chronic diseases, particularly, end-stage renal disease and renal replacement therapy [9]. We hypothesize there might be a relationship between specific demographic factors, particularly age and educational level, that might influence the preferences and interest in using ICTs. Therefore, we designed this study to identify patterns of use, preferences, and interest in ICTs among Ecuadorian patients with CKD undergoing hemodialysis. We believe the added knowledge will advance our understanding of how ICTs might be able to improve health-related outcomes in the future based on known preferences.

II. Methods

1. Ethical Considerations

This study was approved by the Hospital Clínica-Kennedy's Ethics Committee (No. HCK-CEISH-18-0022), Guayaquil, Ecuador. Informed consent was obtained from each patient before participation in the study. We guaranteed that any information regarding each patient's medical history and identity would not be disclosed.

2. Study Design

We conducted an anonymous cross-sectional survey-based study from January 2016 to April 2017, involving 393 patients with end-stage renal disease in which they rated themselves regarding their frequency of use and preferences of ICTs. Eligible outpatients participated from a total of 9 hemodialysis centers in Guayaquil, Ecuador, and they were surveyed using a Spanish adapted version of the Michigan Questionnaire (MQ) [10]. Eligible patients had to be over 18 years of age with a diagnosis ESRD. We excluded patients with psychiatric diseases, language impairment, and those with difficulty viewing the survey.

3. Procedures

Patients were approached using a consecutive sample. Prior to filling out the questionnaire, patients were informed of the purpose of the study and their role in it. Patients completed the questionnaire by themselves or sometimes with the help of a previously trained individual (e.g. physician, nurse, or intern).

4. Questionnaire

A modified version of the MQ, which measures the frequency and preferences of ICTs by patients in the form of a self-filled questionnaire, was used as the survey method. The original questionnaire was developed for patients with asthma [10]. It included demographical and clinical questions about age, time with the disease, gender, educational level, race, and treatment that patients were receiving. The questionnaire also explored how patients obtained information related to their disease, and their interest in receiving or asking for health-related information through ICTs.

We adopted a rigorous method to translate the MQ into Spanish. An expert panel of nephrologists checked the adapted version and considered additional items to be included in the survey. The final survey included 17 items, and collected information about the following: (1) demographic factors for each patient (including age, gender, educational

level, and years undergoing hemodialysis), (2) cellphone ownership and availability of continuous Internet access, (3) patients' interest in obtaining information through ICTs (i.e., related to kidney transplantation and other treatment modalities, medication reminders, and factors that could affect disease control), and (4) the interest of patients in using ICTs as a potential way to communicate with their healthcare providers (for requesting and receiving information).

Regarding the use of ICTs to communicate with their healthcare providers, participants were asked to quantify their interest in receiving information about factors that might affect their disease control (i.e., conservative treatment instead of dialysis, kidney transplant, automated peritoneal dialysis, medication reminders, keypoints of disease) through each technology. We quantified the level of interest as high, some, low, or none. Using the same scale, participants were asked to quantify their interest in asking questions to their doctor or other healthcare providers using each of the ICTs. Also, we incorporated two new items about the frequency of WhatsApp use. We asked participants whether they were interested in seeking and receiving information about CKD or hemodialysis using WhatsApp.

5. Statistical Analysis

Descriptive analysis was performed. Categorical variables were summarized as frequencies and percentages. For continuous variables, mean and standard deviation were reported. The overall description of each electronic media type was informed.

For each ICT type, the frequency-of-use responses were dichotomized into categories of at least once a week and less than once a week. The degree of interest in receiving information through each ICT type was dichotomized into high or some interest and little or no interest. Age groups were categorized into young adults (18–39 years), older adults (40–65 years), and elderly (≥ 65 years). Educational level was categorized into none or primary school, and secondary school, undergraduate, or postgraduate. The number on years of dialysis was classified as follows: < 3 years, 3–5 years, and ≥ 6 years. Age, gender, educational level, and years on dialysis were used as independent variables for each analysis.

Pearson chi-square test or Fisher exact test when appropriate was used to assess the association between Internet access, or owning a cell phone or smartphone, and the independent variables (age, gender, educational level, and years on dialysis). The same analysis was used to determine the association between the above-mentioned independent variables and the frequency of use of each ICT type, the use

of ICTs to obtain information, high interest in receiving information through each ICT type and having high or some interest in communicating (with a physician) through each media type.

Multiple logistic regression analyses were performed for the use of each ICT to obtain information about CKD, as well as for interest in receiving information and communicating through each ICT using age, gender, education level, and years on dialysis as independent variables. Adjusted odds ratios (OR), with their corresponding 95% confidence intervals (95% CI), were calculated. All data were analyzed using R version 3.4.2 software (R Foundation for Statistical Computing, Vienna, Austria). A value of less than 0.05 was considered significant for all tests.

III. Results

The mean age was 53.5 years (SD = 15.9); 43.9% of the subjects were female, and 54.6% had finished at least secondary school. Hypertension and diabetes were the most frequent comorbidities. Most of the participants had undergone 3 or more years on dialysis (52.3%) (Table 1).

Table 1. Demographic and clinical characteristics (n=393)

Characteristic	Value
Age (yr)	53.5 \pm 15.9
<40	84 (21.4)
40–65	206 (52.6)
≥ 65	102 (26.0)
Sex	
Female	168 (43.9)
Male	225 (56.1)
Education	
None or primary	176 (45.3)
Secondary or more	212 (54.6)
Years on dialysis	3.5 \pm 2.9
<3	186 (47.7)
3–5	125 (32.1)
≥ 6	79 (20.3)

Values are presented as mean \pm standard deviation or number (%).

For categories 'years on dialysis' and 'education level', there are 3 and 5 missing data, respectively.

1. Cellphone Ownership, and Access to the Internet

Of the surveyed population, 64.3% (n = 252) of the participants reported owning a cellphone, with 28.8% (n = 110) of patients reporting continuous access to the Internet. In general, older patients reported lower levels of cellphone ownership and access to the Internet than their counterparts.

2. Overall Frequency of Use of ICTs and to Obtain Information about the Disease

We found that Internet (40.9%), SMS (39.8%) and Facebook (39.5%) were the platforms most commonly used at least once a week, while Internet (42.1%) and YouTube (18.8%) were the preferred platforms to obtain information about the disease (Figure 1). Regarding demographic factors, younger patients and those with higher levels of education showed higher frequency of use for most ICTs and to obtain information about their disease (Table 2). We found no statistically significant differences in frequency of use regarding sex or years undergoing hemodialysis.

3. Interest in Using ICTs to Receive Information and Ask Healthcare Providers about the Disease

SMS, Facebook, and email were rated as the ICTs with the highest interest for both receiving and asking health providers for information about CKD and hemodialysis (Figure 1). Regarding demographic factors, Table 3 shows the adjusted ORs for the association between age, gender, and educational level with interest in using ICTs to receive and ask healthcare providers for information related to their disease. Age continues to show an association with interest in using ICTs, where interest decreases as age increases.

Similarly, the odds of high interest in receiving or asking questions about CKD through ICTs is smaller for older adults and elderly patients in comparison with young adults,

while higher education level is associated with a greater interest in receiving and asking for information through Facebook (Table 3). Finally, we found that 57.2% of patients reported interest in receiving information through WhatsApp, while 56.6% showed interest in asking questions using that app; patients with secondary or higher level of education had an increased likelihood of using this platform versus their counterparts.

IV. Discussion

Chronic disease education programs are increasingly adopting mobile health applications to support self-management practices, but this often requires widespread adoption of ICTs to be effective [11]. For instance, individuals with chronic diseases are less likely than healthy adults to have Internet access, but once online, it appears that the former have a higher likelihood of using social media to share information [12]. Furthermore, the digital differences between racial ethnicities appears to be getting smaller, with a direct implication in diseases such as CKD, where ethnic and racial minorities (such as African-American and Latino) are disproportionately affected, and suffer worse outcomes in comparison to their white counterparts [13-15]. Knowledge about ICTs among patients with CKD undergoing hemodialysis remains crucial if we want to develop new strategies based on these technologies, aimed at improving their outcomes.

Overall, we found that 64.3% of the surveyed population reported owning a cellphone, but less than a third reported an active Internet connection. This compares to a previous study undertaken in US hemodialysis centers, where Internet access was estimated to be 35% [16]. Still, both represent a considerable proportion of patients that could miss any

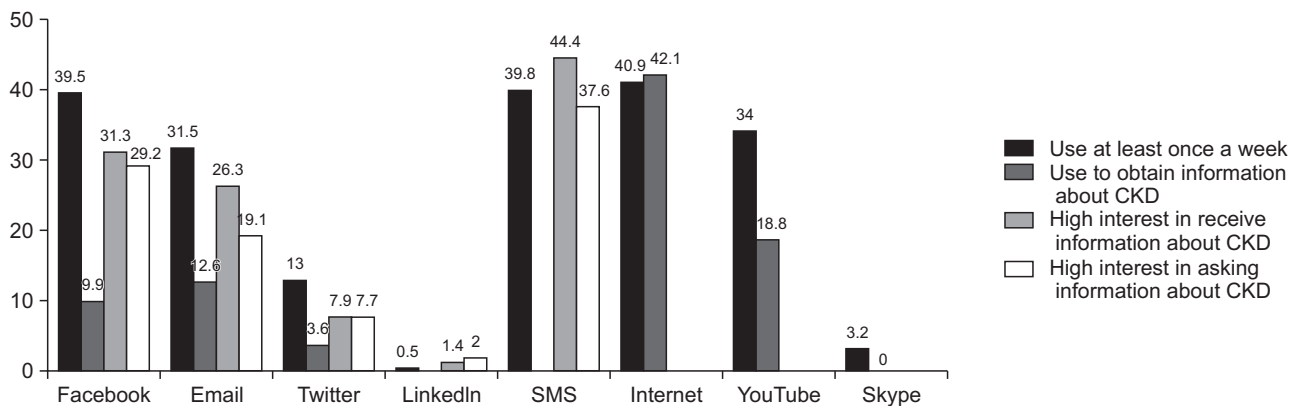


Figure 1. Information and communication technologies usage and preferences among patients with chronic kidney disease (CKD) undergoing hemodialysis.

Table 2. Frequency of use of ICTs and to obtain information about CKD and/or hemodialysis by age and educational level

	Age (yr)				Educational level		
	<40	40–65	≥65	<i>p</i> -value ^a	Primary school or less	Secondary school or more	<i>p</i> -value ^a
Cellphone	78 (92.9)	138 (67.3)	36 (35.3)	<0.01	91 (51.7)	159 (75.0)	<0.01
Internet use	59 (70.2)	46 (23.2)	5 (5.1)	<0.01	14 (8.3)	95 (45.5)	<0.01
Use of ICTs (at least once a week)							
SMS	41 (55.4)	44 (34.1)	7 (25.0)	<0.01	22 (27.8)	70 (46.7)	0.01
Facebook	51 (69.9)	36 (28.8)	2 (7.4)	<0.01 ^b	13 (16.7)	75 (51.7)	<0.01
Twitter	21 (29.2)	8 (6.5)	0 (0.0)	<0.01	2 (2.6)	27 (18.9)	<0.01
YouTube	40 (56.3)	32 (25.6)	4 (14.8)	<0.01	8 (10.4)	68 (47.2)	<0.01
Email	33 (45.8)	33 (26.8)	4 (14.8)	<0.01	7 (9.0)	63 (44.4)	<0.01
Internet	52 (71.2)	34 (27.6)	5 (18.5)	<0.01	11 (13.8)	79 (56.0)	<0.01
LinkedIn	1 (1.4)	0 (0.0)	0 (0.0)	0.45 ^b	0 (0.0)	1 (0.7)	>0.99 ^b
Skype	3 (4.2)	1 (0.8)	3 (11.1)	0.02 ^b	0 (0.0)	7 (5.0)	0.05 ^b
Use of ICTs to obtain information about CKD							
Internet	47 (65.3)	42 (32.8)	7 (25.0)	<0.01	13 (16.0)	81 (55.9)	<0.01
Facebook	12 (17.1)	10 (8.0)	0 (0.0)	0.02 ^b	2 (2.5)	19 (13.5)	0.01
Twitter	2 (3.0)	6 (4.8)	0 (0.0)	0.68 ^b	1 (1.3)	7 (5.0)	0.26 ^b
YouTube	20 (29.0)	19 (15.1)	3 (10.7)	0.03 ^b	6 (7.5)	35 (24.8)	<0.01
Email	9 (13.2)	15 (11.9)	4 (14.3)	0.88 ^b	3 (3.8)	25 (17.7)	<0.01 ^b

Values are presented as number (%).

CKD: chronic kidney disease, ICTs: information and communication technologies, SMS: short message service.

^aPearson chi-square test, ^bFisher exact test.

Table 3. Interest in receiving and asking for information about CKD and/or hemodialysis through ICTs

	Age (yr)	Adjusted OR (95% CI)				
		Facebook	Twitter	Email	SMS	WhatsApp
Interest in receiving information about CKD (some/high)	40–65	0.29 (0.15–0.56)	0.33 (0.10–1.00)	0.42 (0.20–0.86)	0.50 (0.26–0.94)	0.20 (0.08–0.45)
	≥65	0.09 (0.01–0.33)	N/A	0.44 (0.11–1.43)	0.41 (0.15–1.07)	0.05 (0.01–0.27)
	Female	1.25 (0.65–2.40)	1.34 (0.45–4.01)	0.55 (0.27–1.10)	1.63 (0.92–2.93)	1.04 (0.47–2.31)
	Secondary or more education	2.38 (1.16–5.13)	3.23 (0.83–21.45)	5.67 (2.38–15.9)	0.87 (0.47–1.60)	6.38 (2.80–15.57)
Interest in asking physician through ICT about CKD (some/high)	40–65	0.16 (0.08–0.32)	0.33 (0.10–1.00)	0.42 (0.18–0.93)	0.44 (0.23–0.83)	0.23 (0.10–0.51)
	≥65	0.08 (0.01–0.32)	N/A	0.31 (0.05–1.32)	0.36 (0.12–0.97)	0.06 (0.01–0.30)
	Female	1.12 (0.55–2.27)	1.34 (0.45–4.01)	0.70 (0.31–1.50)	1.38 (0.76–2.50)	0.96 (0.44–2.09)
	Secondary or more education	2.66 (1.22–6.14)	3.23 (0.83–21.45)	5.71 (2.07–20.35)	1.05 (0.56–1.97)	4.98 (2.24–11.68)

Bolded values are significant at 0.05 significance level.

Reference age category is <40 years old, sex category is male, and educational level is none or primary education.

CKD: chronic kidney disease, ICT: information and communication technology, SMS: short message service, ORs: odd ratios, CI: confidence interval, N/A: not applicable.

potential intervention through ICTs. Regarding preferences, most of our patients rated SMS as the preferred way of receiving and asking for health-related information, followed by Facebook and email. As reported by a recent meta-analysis, SMS was found to potentially double the likelihood of medication adherence [17]. Possible explanations for using SMS can be attributed to the lower cost in comparison to voice messages, availability in places where there is no data connection, and the ease of using it in situations where it may be impractical to hold a conversation [18].

As healthcare providers and patients are increasingly turning to Internet websites and social media platforms to obtain health-related information and support, there is a bulk of digital education materials related to kidney disease available in some form on the web [19]. Despite this, it has also been reported that low and middle-income countries lack access to high-quality information regarding healthcare [20]. We found that most of the participants rated web-based Internet as the main source for obtaining information related to CKD and/or hemodialysis, followed by YouTube and email. With the Internet becoming a place where individuals can privately explore topics that may not be addressed in a typical office setting, it is no surprise that most of our patients relied on this technology to obtain information about their disease.

Additionally, previous studies among patients with chronic diseases have found that sociodemographic characteristics influence ICT usage, suggesting that adoption of technology is more likely if an individual is younger or more highly educated [21-23]. In our study, we found that younger age and higher level of education, were associated with an overall higher interest in and usage of ICTs. We also found no statistically significant association between ICTs and gender or years on hemodialysis. The fact that we found a higher interest in and usage of ICTs among younger patients can be explained under Marc Prensky's description of digital natives and digital immigrants. Prensky proposed these terms to describe the differences between individuals who were born and grew up speaking the language of computers and Internet, with those who were not born in the digital world but, at some point in their lives, adapted to the emerging post-millennial digital culture [24]. Thus, younger patients will probably find it easier to use technology in the setting of healthcare and use it more consistently than digital immigrant patients.

There are also differences regarding opportunities to access ICTs, generally referred to as the digital divide [25]. Higher education and socioeconomic status have been identified as factors influencing this concept. For instance, among Latin

American patients with COPD and type 2 diabetes, individuals with higher educational levels were more likely to be interested in receiving and seeking health-related information through ICTs [26,27]. In the setting of CKD, it has been reported that more highly educated patients could undertake more sophisticated activities with their mobile phones, and were more likely to use the Internet [7]. In our study, we found that higher education doubled the odds of using ICTs, such as Facebook and WhatsApp, to communicate with the healthcare team, and YouTube as a means to obtain information about the disease.

As reported by Goldstein et al. [19], patients, healthcare providers, and the general public actively use social media platforms, particularly Facebook, to show their knowledge about kidney disease, and to share related stories about themselves or relatives. These channels of communication might prove useful if they are targeted based on known preferences and usage of ICTs. On the other hand, tools like YouTube could potentially serve as powerful platforms to disseminate information about CKD and dialysis. However, it was found by Garg et al. [28] that users tend to favor "misleading content and patient narratives over scientifically accurate information". The same report proposes that relevant and easy to understand educational material on hemodialysis, by credible sources, can serve as an effective adjunct in educating patients at minimal cost.

Finally, we found that more than half of the surveyed patients were interested in using WhatsApp for communication purposes with the healthcare team. This cross-platform application allows smartphone users to exchange not only text, but images, videos, and audio messages for free [27]. Moreover, the reported usage of WhatsApp appears to be the highest among Latin America, thus making this platform ideal for fast and easy communication between patients and the medical team [29].

Our research had some limitations. First this study was conducted on Ecuadorian patients with CKD undergoing hemodialysis; the preferred usage of and interest in ICTs in other Latin American countries could be different. Additionally, to the best of our knowledge, there have been no studies on this subject conducted on ordinary Ecuadorians; therefore, we are unable to draw conclusions or compare our results directly with the general population. Second, our questionnaire has not been validated, so our results could lead to inaccurate conclusions. We also do not know if the role of disease severity or prognosis had any influence on ICT usage. Finally, there was some missing data, but this was not enough to produce loss of power or biased results based

on the statistical analyses performed. However, one strength of the study is the valuable sample size ($n = 393$), including participants with varying demographic characteristics. To the best of our knowledge, this is one of the first studies concerning ICTs preferences among patients with chronic kidney disease undergoing hemodialysis in a Latin American setting.

In conclusion, widespread use of ICTs provides easy access to medical information that can reach wide audiences; however, their position in relation to public health remains relatively new [20,30]. The early use of these technologies can help to increase knowledge and awareness of CKD and its management among patients and healthcare providers [11]. In our study, we found that SMS was rated with the highest interest for both communicating with the medical team and receiving health-related information, while web-based Internet was the tool used most by patients to obtain information about their disease. However, older patients reported less cellphone ownership and continuous access to the Internet, thus representing a group that could miss potential intervention through ICTs. Younger and higher educated patients were associated with overall higher ICT interest and usage, particularly through Facebook and WhatsApp. Further studies are needed to confirm our findings and investigate the potential use of ICTs in improving the care of patients with chronic kidney disease undergoing hemodialysis.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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