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Frequency of In-Home Internet Use Among Prekidney and Postkidney Transplant Patients—Facilitators and Barriers to Use and Trends Over Time

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Background. As health-related communications become digitized, strategies to increase adoption of these Web-based platforms are needed. The purpose of this study was to assess facilitators and barriers to in-home Internet use among prekidney and postkidney transplant patients. **Methods.** A single center, cross-sectional survey of 240 consecutive patients of all levels of technological proficiency who presented to an urban transplant center in the United States. The Patient Information and Technology Assessment consists of 6 demographic questions, 3 disease-related questions, and 8 technology-related questions. **Results.** Much of the sample was African American, male with a mean age of 51 years, and median income of $53 800/year. Logistic regression analysis was undertaken, and after adjusting for covariates, we found Smartphone ownership (odds ratio [OR], 4.94; 95% confidence interval [CI], 2.32-10.52), a higher number of Internet users in the home (OR, 2.00; 95% CI, 1.11-3.62), and having college education and beyond (OR, 4.88; 95% CI, 2.03-11.74) increased the likelihood of being a frequent Internet user. African American or Hispanic/Latino patients were less likely to be frequent Internet users compared with white patients (OR, 0.26 and 0.24, respectively, compared with whites, all $P < 0.05$). As the total number of people in the household increased, frequent Internet use decreased (OR, 0.52; 95% CI, 0.29-0.92). As age increased, reports of frequent Internet use decreased. **Conclusions.** Lower rates of Internet use among African Americans and Hispanic/Latinos in urban areas in the United States remains a problem despite a significant increase in access to the Internet and Smartphone ownership. The finding that Internet use increases as the number of Internet users in the household increases indicates that leveraging the patient's social support network and/or the development of patient information champion programs may aid with patient's adoption of health technology and patient engagement in self-care.

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Over the past 25 years as the Internet has expanded to become a powerful global information and communication network, healthcare providers have sought to leverage information and communication technologies (ICT) to improve human health.[1-4] Understanding facilitators and barriers to Internet use takes on new importance as healthcare information systems become digitized and patients have increasing access to their health information online.

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Additionally, in the last decade, there has been a significant investment in health information systems in the United States under the American Recovery and Reinvestment Act of 2009.[5] Despite these investments, effective strategies to promote patient adoption of health-related technologies are lacking, because the role of the patient in basic health information systems is evolving.

In solid organ transplantation, efforts have been made to use the Internet for integration of care,[6] patient education,[7-10] and to aid in screening potential donors and recipients[11,12]; however, little work has been done to understand potential facilitators and barriers to Internet use. Our previous work characterizing device ownership trends and attitudes related to ICT in prekidney and postkidney transplant patients represented a narrow window into the many nuances of technology use in this chronically ill population.[13,14] In our 2012 technology survey of prekidney and postkidney transplant patients, we found a significant disparity among racial/ethnic minorities particularly with regard to frequent Internet use, defined as using the Internet more than 5 hours per week.[13] In addition, we found that device ownership and frequency of technology use were less in our prekidney and postkidney transplant population than what had been previously reported in an earlier national survey of people with one or more chronic health conditions in the United States.[15] Thus, because we expect technology use will change over time, continued assessments related to technology use is warranted in at-risk populations with chronic illness including racial/ethnic minorities, patients with lower socioeconomic status (SES), and those over 40 years of age.

Accordingly, in this period of rapid technological change, the purpose of the study was to: (1) Predict facilitators and barriers to in-home Internet use among prekidney and postkidney transplant patients at an urban transplant center in the United States, (2) describe the prevalence of Internet use change among this population from 2012 to 2016, and (3) determine if the disparity between Whites and racial/ethnic minorities has narrowed.

MATERIALS AND METHODS

Between January 2016 and August 2016, we conducted a cross-sectional survey of 240 prekidney and postkidney transplant patients at an urban transplant center in the United States. A consecutive sample of all adult English-speaking patients who presented to the transplant center for the prekidney transplant evaluation or postkidney transplant clinic were offered the opportunity to participate in the study. Of the 249 patients offered participation in the study, 240 patients agreed for a response rate of 96%. Sample characteristics of the 9 patients who declined participation in the survey were like that of the study sample. Although primary language other than English was an exclusion criterion for the study, there were no participants excluded due to language barriers. In addition, comparisons of technology trends including frequency of Internet use and Smartphone ownership were made between the 2016 survey and a previous technology survey conducted in 2012. The sample characteristics and methods of the 2012 technology survey were like the 2016 survey and can be found elsewhere.[13,14] All participants provided informed consent before participation in the study. Both studies were approved by the University of Chicago Institutional Review Board before the administration of the study survey and conducted in adherence with the Declaration of Helsinki.

Outcomes and Covariates

The primary outcome was frequency of Internet use (frequent, >5 hours per week; infrequent, ≤5 hours per week). Demographic variables included in bivariate models were age, race/ethnicity, education, income, and sex. Disease-specific variables included in bivariate models were years of kidney disease, dialysis status (receiving dialysis: yes/no), type of dialysis (not yet on dialysis, hemodialysis, peritoneal dialysis), and transplant status (pretransplant, on the waiting list, posttransplant). Age, race/ethnicity, education, and sex were obtained from patient self-report. Income was based on zip code median household income derived from the 2010 US census zip code tabulation areas.[16] Disease-specific variables were also based on patient self-report. A description of variables for the 2016 assessment can be found in Table 1.

Instruments

The Patient Information and Technology Assessment survey was developed after extensive literature review and

TABLE 1.

Description of technology variables

Do you use the following to get on the Internet?	Potential answers	Variable type
A desktop computer?	Yes/no	Binary
A laptop computer?	Yes/no	Binary
A tablet computer?	Yes/no	Binary
A Smartphone?	Yes/no	Binary
How many devices do you have in your home that you can use to get on the Internet?	Varies	Continuous
How many people live in your household?	Varies	Continuous
How many people in your home use the Internet?	Varies	Continuous
What is the primary device you use to connect to the Internet?	(1) I don't use the Internet, (2) desktop computer, (3) laptop computer, (4) tablet computer, (5) cellphone/Smartphone, (6) other	Categorical
I can get on the Internet whenever I want?	5-point Likert [a]	Categorical
There are times I would like to use the Internet but can't because someone else is using it?	5-point Likert [a]	Categorical
I use the Internet to look up information about kidney transplantation?	5-point Likert [a]	Categorical
I use the Internet to look up other health information?	5-point Likert [a]	Categorical
How many hours per week do you use the Internet?	(1) less than 5 h/wk, (2) 5 h or more	Binary

[a] Likert responses included 0, strongly disagree; 1, disagree; 2, no/opinion/not sure; 3, agree; 4, strongly agree.

content validity was assessed using a focus group including several multidisciplinary transplant clinicians including physicians, nurses, and intake personnel. In addition, prekidney and postkidney transplant patients (both sexes, and a variety of age, race, and economic/educational background) were included in the development of the survey. Both clinicians and patients rated the extent to which the survey items represented the dimensions being measured, such as Internet use and technology ownership, and determined if any content was ambiguous. After a thorough review, the survey questions were modified for clarity and simplicity.

The final survey consisted of 6 demographic questions, 3 disease-specific questions and 8 technology-related questions. Yes/no and 5-point Likert scale questions were used in the survey. A test of the readability of the survey was conducted using the Flesch Kincaid readability test. The Flesch Reading ease score was 73.6, indicating that the survey would be easily understandable by 10- to 11-year-old students and written at a sixth-grade level. The reliability statistic was acceptable (Cronbach $\alpha = 0.74$).

Several of the survey questions were included in both the 2012 and the 2016 technology surveys; therefore, comparisons were made between these samples when possible. Of note, this was not a longitudinal study. Participants in the 2016 sample were not the same as the participants from the 2012 technology assessment; however, both samples were drawn from the same population.

Data Collection Procedures

The principle investigator (M.B.L.) administered the survey to participants. To reduce potential social desirability bias, the principle investigator assured participants that the principle investigator was not a member of their transplant team and that answers would not be shared with the transplant team. Technologies included in the survey were briefly described to participants before the administration of the survey to ensure clarity of technological devices. In addition, participants were given an opportunity to have questions about the survey answered during administration of the survey.

Study data were collected and managed using research electronic data capture electronic data capture tools hosted at the University of Chicago.[17] Research electronic data capture is a secure, Web-based application designed to support data capture for research studies, providing: (1) an intuitive interface for validated data entry, (2) audit trails for tracking data manipulation and export procedures, (3) automated export procedures for seamless data downloads to common statistical packages, and (4) procedures for importing data from external sources.

Analysis

Demographic variables included in bivariate models were age, race/ethnicity, education, income, and sex. Disease-specific variables included in bivariate models were years of kidney disease, dialysis status (receiving dialysis: yes/no), type of dialysis (not yet on dialysis, hemodialysis, peritoneal dialysis), and transplant status (pretransplant, on the waiting list, posttransplant). Candidate predictor variables were identified by using χ^2, Student *t*, or Fischer exact tests where appropriate and included in multivariable logistic regression models if the *P* value in bivariate models was less than or equal to 0.2. A final multivariable logistic regression model including race/ethnicity, sex, age, education, income, type of dialysis, transplant status, Smartphone ownership, the number of people in the household, and number of Internet users in the home was used to identify predictors of frequency of Internet use (frequent, >5 hours per week; infrequent, ≤5 hours per week). A model using the proportion of Internet users in the household (all member Internet users versus not all member Internet users) was also run. Descriptive statistics were used to make comparisons between the technology assessment conducted in 2012 and 2016. These included questions about device ownership and frequency of Internet use that were included in both the 2012 and 2016 technology assessments. All statistical analyses were conducted using Stata 11.0 (Stata Corporation, College Station, TX). All *P* values less than 0.05 were deemed significant.

RESULTS

Much of the sample was African American, male, with a mean age of 51 years (SD, 13.48), and a zip code-based median household income US $53 800/year (SD = 21 809.97). Most participants reported having kidney disease for greater than 5 years and were on dialysis. Education was evenly divided among high school or less, some college, and college and beyond. A comprehensive list of sample characteristics by frequency of Internet use is presented in Table 2.

ICT Usage

Fifty-six percent of participants reported being frequent Internet users. The mean number of Internet-enabled devices per household was 5.175 (SD = 3.64). A Smartphone was the most frequently used device used to access the Internet (49%) followed by laptop computer, desktop computer, and tablet computer (19%, 17%, and 12%, respectively). Forty-four percent of participants reported using the Android Smartphone platform while 34% reported using an iPhone. Seventy-six percent of participants reported using a PC as opposed to Macintosh computer platforms. Ninety-five percent of participants reported having access to the Internet in their homes. Just over 90% of participants reported that they could get on the Internet often or always, and 19% said there were times when they could not get on the Internet because someone else in the household was using it. Overall, 35% of participants expressed a desire to use the Internet more including 30% of those over 40 years of age. However, those older than 40 years were less likely to report being comfortable with using the Internet (m = 2.86, SD = 0.10 vs m = 3.65, SD = 0.08, $P = 0.0001$).

X^2 tests of independence were performed to examine the relationship between frequency of Internet use and actively searching the Internet for information about kidney transplantation and general health information. The relationship between these variables in both models was significant, X^2 (2, N = 219) = 10.51, $P = 0.001$ and X^2 (2, N = 219) = 5.329, $P = 0.021$ respectively. Frequent Internet users were more likely to search the Internet for information related to kidney transplantation and general health information than were infrequent Internet users. In addition, 75% of those who reported owning a Smartphone also reported using the Internet to search for general health information and transplant-specific information.

Facilitators and Barriers to Frequent Internet Use

Logistic regression modeling was used to determine patient characteristics that predicted frequency of Internet

TABLE 2.

Demographic and disease characteristics of frequent versus not frequent Internet users

	Total (n = 240)	Frequent internet user (n = 135)	Not frequent internet user (n = 105)	*P*
Sex, n (%)				
Male	160 (67)	84 (53)	76 (48)	0.098
Female	80 (33)	51 (64)	29 (36)	
Race/ethnicity, n (%)				
White	74 (31)	54 (73)	20 (27)	0.005
African American	126 (56)	66 (49)	60 (51)	
Hispanic	21 (9)	15 (48)	15 (52)	
Other	10 (4)	4 (2)	6 (3)	
Education, n (%)				
High school or less	74 (31)	26 (35)	48 (65)	<0.001
Some college	86 (36)	49 (57)	37 (43)	
College and beyond	80 (33)	60 (75)	20 (25)	
Age, n (%)				
18-39	53 (22)	44 (85)	8 (15)	<0.001
40-54	87 (36)	54 (62)	33 (38)	
55-64	58 (24)	26 (45)	32 (67)	
>65	43 (18)	11 (26)	32 (74)	
Income n (%)				
<US $25,000	5 (2)	3 (1)	2 (1)	0.135
US $25,000-$39,999	85 (35)	45 (19)	40 (17)	
US $40,000-75,000	110 (46)	41 (17)	69 (29)	
US $75,000 and up	40 (17)	16 (7)	24 (10)	
Dialysis type, n (%)				
Not yet on dialysis	34 (14)	23 (68)	11 (32)	0.046
Hemodialysis	160 (67)	81 (51)	79 (49)	
Peritoneal dialysis	46 (19)	31 (67)	15 (33)	
Years of kidney disease, n (%)				
Less than 3 y	44 (18)	25 (56)	19 (43)	0.754
3-5 y	17 (7)	11 (65)	6 (35)	
Greater than 5 y	179 (75)	99 (55)	80 (45)	
Dialysis status, n (%)				
Yes	207 (86)	113 (56)	94 (45)	0.194
No	33 (14)	22 (67)	11 (33)	
Transplant status, n (%)				
Pretransplant	65 (27)	30 (46)	35 (54)	0.114
On the waiting list	30 (13)	20 (67)	10 (33)	
Posttransplant	145 (60)	85 (59)	60 (41)	
Smartphone ownership, n (%)				
Yes	174 (73)	105 (44)	118 (49)	<0.001
No	66 (27)	17 (7)	56 (23)	
No. people in home, mean (SD)	2.7 (0.1)	2.7 (0.1)	2.8 (0.1)	0.547
Under 55 y old	3.1 (0.1)	3.2 (0.3)	3.0 (0.1)	0.072 [a]
55 y old and over	2.3 (0.1)	2.3 (0.1)	2.2 (0.1)	
No. internet users in home, mean (SD)	2.4 (0.1)	2.1 (0.1)	2.6 (0.1)	0.002
Proportion of internet users in home, n (%)				
Not everyone in house is internet user	58 (24.2)	44 (76.0)	14 (24.1)	<0.001
Everyone in house is internet users	182 (75.8)	61 (33.5)	121 (66.5)	

[a] *P* value with age adjustment.

Totals may not equal 100% due to rounding.

usage (Table 3). In bivariate analysis, there were no statistically significant differences seen in frequency of Internet use by sex, income, dialysis status, or transplant status. African Americans and Hispanics/Latinos were significantly less likely to report being frequent Internet users compared to whites. Those who reported an education of college and beyond were more likely to be frequent Internet users compared with those with an education of high school or less. As age increased, reports of frequent Internet use decreased. Those who reported owning a Smartphone had 6 times the odds of being a frequent Internet user compared with those who did not. The number of people in the household was not

TABLE 3.

Determinants of frequent internet use among prekidney and postkidney transplant patients (n = 240)

	Unadjusted OR (95% CI), *P* value	Adjusted OR (95% CI), *P*
Race/ethnicity (relative to white, non-Hispanic		
African American	0.35 (0.19-0.65), 0.001	0.26 (0.10-0.65), 0.004
Hispanic/Latino	0.28 (0.10-0.76), 0.012	0.24 (0.06-0.91), 0.035
Other (Asian, Pacific Islander)	0.55 (0.14-2.18), 0.399	0.54 (0.10-3.04), 0.503
Sex (relative to male)	1.59 (0.92-2.76), 0.099	1.68 (0.80-3.50), 0.170
Education (relative to high school or less)		
Some college	2.44 (1.30-4.64), 0.006	2.14 (0.95-4.81), 0.065
College and beyond	5.54 (2.76-11.10), <0.001	4.88 (2.03-11.74), <0.001
Age (relative to 18-39 y)		
40-54 y	0.30 (0.12-0.71), 0.006	0.25 (0.10-0.70), 0.009
55-64 y	0.14 (0.06-0.37), <0.001	0.15 (0.49-0.44), 0.001
65 y and older	0.06 (0.02-0.17), <0.001	0.08 (0.02-0.28), <0.001
Income (relative to < $25,000/y)		
US $25 000-39 999	1.33 (0.22-8.39), 0.759	1.47 (0.89-16.26), 0.751
US $40 000-74 999	2.52 (0.40-15.74), 0.321	1.40 (0.13-15.47), 0.783
US $75 000 and up	2.25 (0.34-15.01), 0.402	0.38 (0.29-4.87), 0.456
Dialysis status (relative to not yet on dialysis)		
Hemodialysis	0.49 (0.22-1.07), 0.074	0.52 (0.19-1.45), 0.211
Peritoneal dialysis	0.99 (0.22-2.54), 0.981	1.50 (0.26-3.17), 0.88
Transplant status (relative to pretransplant)	1.24 (0.93-1.67), 0.138	0.96 (0.49-1.87), 0.905
Smartphone ownership (relative to no Smartphone)	6.07 (3.21-11.48), <0.001	4.94 (2.32-10.52), <0.001
No. people in the household (continuous)	1.10 (0.88-1.27), 0.546	0.52 (0.29-0.92), 0.026
No. Internet users in the household (continuous)	1.36 (1.12-1.657), 0.002	2.00 (1.11-3.62), 0.022

Post hoc tests showed that sensitivity, specificity, and rate of correct classification were 82.22%, 72.38%, and 72.08%, respectively. Logistic regression X^2 = 104.96. McFadden R^2 = 0.3191, area under receiver operating characteristic curve = 0.8568. Hosmer-Lemeshow goodness of fit, *P* = 0.4100.

95% CI, 95% confidence interval.

significant in unadjusted analyses. In contrast, for each additional *Internet user* in the household, the odds of being a frequent Internet user increased 36%.

In multivariable analysis, African Americans and Hispanic/Latinos were still significantly less likely to be frequent Internet users compared with whites. Those who reported an education of college and beyond were more likely to be frequent Internet users compared with those with an education of high school or less. Those who reported owning a Smartphone had nearly 5 times greater odds of being a frequent Internet user compared to those who did not. After adjusting for covariates, the number of people in the household was shown to significantly decrease the likelihood of frequent Internet usage. This is partially due to controlling for the effect of age in the model (see number of people in household listed by age in Table 2). For each additional *Internet user* in the household, holding all other variables constant, the odds of being a frequent Internet user increased twofold. This increase in the odds ratio (OR) was largely related to controlling for the number of people in the household. However, the number of Internet users in the household was also modeled as a proportion (all members are Internet users versus not all member are Internet users), and the proportion of internet users in a household was also found to significantly increase frequent internet use (OR, 3.48; 95% CI, 1.48, 8.19; *P* = 0.004).

Technology Use Over Time (2012 vs 2016)

Figure 1 demonstrates comparisons between the current technology assessment and a previous technology assessment conducted in 2012, both samples derived from the same population. Overall self-reported frequent Internet use increased 18% in 4 years. There was a 17% increase in frequent Internet use among whites, a 21% increase among African Americans, and a 10% increase among Hispanic/Latinos. Though large disparities in frequent Internet use remain, compared with 2012, the African American-white disparity in frequent Internet use appears to have slightly decreased (from 28% to 24%), while the Hispanic-White disparity increased (from 17% to 21%). In addition, overall Smartphone ownership increased 23%, with the greatest gains occurring among whites and African Americans (32% and 31%, respectively).

DISCUSSION

Results from this technology assessment provide valuable information on in-home Internet use in a sample of participants who suffer from chronic illness—advanced chronic kidney disease. First, Smartphone ownership was the largest predictor of frequent Internet use. Consequently, Smartphone ownership may assist with using the Internet for health information, as most Smartphone owners were found to use the Internet to find health information. Second, when comparing our 2012 technology assessment to our 2016 assessment, we saw increases in Smartphone ownership and in the number of participants who reported being frequent Internet users.[13,14] Third, we also found that as the number of people in the household increased, likelihood of frequent Internet use decreased. In contrast, as the number of *Internet users* in the household increased the likelihood frequent Internet use increased. In addition, not surprisingly, we found that participants who reported being frequent Internet users were more

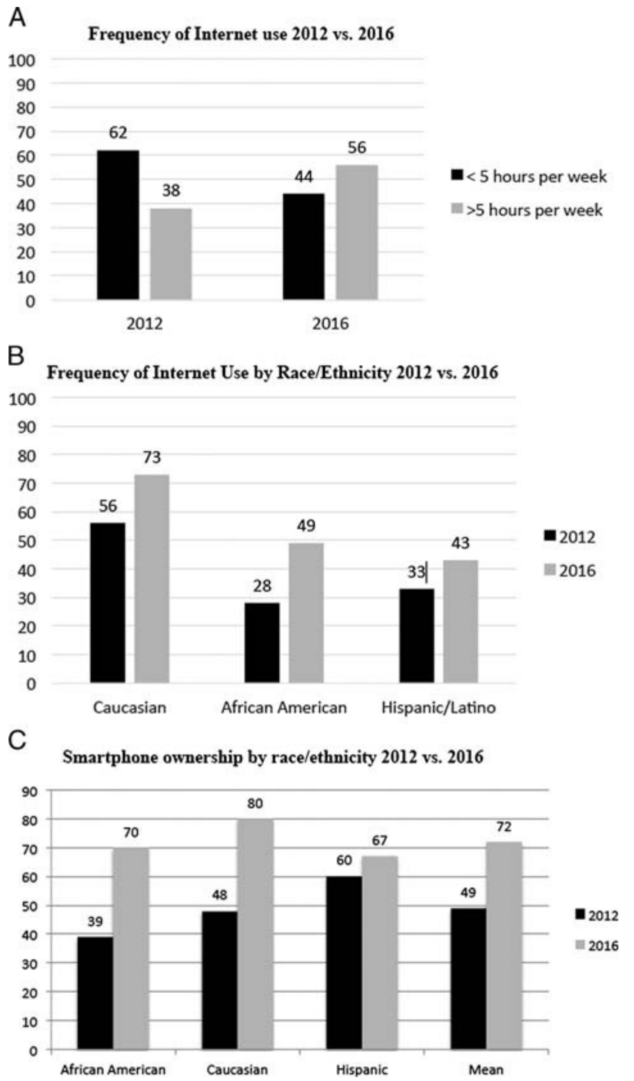

FIGURE 1. Changes in self-reported Internet use over time among prekidney and postkidney transplant patients at an urban transplant center in the United States taken in 2012 and 2016. It should be noted that these data are not longitudinal, but rather data collected from 2 different samples at 2 different timepoints, however, both samples were drawn from the same population. A, Overall change in self-reported frequent (>5 hours per week) Internet use taken in 2012 and 2016. B, Change in self-reported frequent Internet use by race/ethnicity. C, Smartphone data were collected from 2 different samples drawn from the same population of prekidney and postkidney transplant patients (2012, n = 256; 2016, n = 240). Sample characteristics from the 2012 assessment can be found elsewhere.[13,14]

likely to use of the Internet to search for health information. Finally, although we continued to see lower rates of frequent Internet use among African Americans and Hispanics/Latinos compared with their white counterparts, the disparity is slowly decreasing for African Americans, but increasing for Hispanic/Latinos.

Over the last decade, use of Web-based educational interventions has been increasing.[1,17,18] These Web-based educational interventions have generally shown positive results; however, many studies of technology suffer from significant selection bias by including technologically savvy participants.[19,20] Data from this technology assessment support developing targeted patient-centered strategies for nontechnologically savvy patients including an individualized technology assessment at each clinic visit to assess the most appropriate patient-specific communication strategy, vetting health-related educational websites and providing this information to patients to ensure they are receiving health educational information from a reliable source, and leveraging the patient's social support network to facilitate Internet/electronic health information adoption.

Patient Information Champions

Engaging members of a patient's social support network to assist with patient education is not new to transplantation. In 2013, Garonzik-Wang et al[21] developed a program to promote live kidney donation via a living donor champion (LDC). In the study, investigators identified and trained a friend or family member to assist patients in identifying potential living donors. The LDC program used a variety of strategies including educating patients and LDCs on kidney disease and live donation, providing strategies on improving communication, demonstrating success stories of patients who had donated or received a live kidney transplant, and using social media to spread the word about the need for a kidney.[21] Of interest, the authors also conclude that patients expressed a strong desire to use Web-based education, similar to the findings of our 2012 technology survey.[13,14,19] Though the sample of the single-center study was small, participants in the LDC group were significantly more successful at identifying potential donors than matched controls.

These results of the LDC study are encouraging; however, expanding this concept more broadly, potentially as a patient information champion (PIC), may have a more global impact on efforts to engage patients and their social support networks particularly when considered in the context of low general health literacy that is well documented among prekidney and postkidney transplant patients.[22-30] The LDC by its very definition is limited to the context of live donation. Expanding this concept may allow researchers to develop comprehensive education-information-communication programs designed to train champions on more than just solicitation of organs, but also how to find quality Web-based educational materials designed to optimize health in the prekidney and postkidney transplant setting. In addition, creating programs to identify and train a support person may aid in improving health literacy and engaging patients and their support system in self-care.

Use of a PIC may be most effective for those who continue to face substantial barriers to technology use/adoption including ethnic and racial minorities.[2,9,29,30] A recent study by Rodrigue et al[31] showed that using culturally sensitive education materials and leveraging a patient's social network through home-based education had a positive effect on the number of living donor evaluations and living donor transplants for African Americans. Thus, leveraging the patient's social network through the use of PICs may help patients reduce or eliminate many long standing inequities though the adoption of technology. Future research targeting Internet adoption to improve health education might consider this dyadic approach.

Age and Frequent Internet Use

As with our 2012 technology assessment, we found that age exerts significant influence over Internet adoption. We also found that this trend toward less frequent Internet use began in the 40- to 54-year-old age group as it did in our 2012 assessment. In contrast to our findings that Internet use increases as the number of *Internet users* in the home increase, after adjusting for covariates in our logistic regression model we found that the total number of people in the household became a statistically significant barrier to frequent Internet use. Although we did not assess the age of the people living in the household, this finding could result from families with young children in the household. The demands of caring for young children may negatively impact the participant's ability to find time to use the Internet. Older participants had fewer people per household and may be less likely to have younger Internet savvy people in their household. These findings suggest alternatives to the patient's social support system should be explored for older patients when developing strategies to increase Internet adoption. In addition, we did not assess other potential age-related barriers to Internet use including: fear of spam or unwanted emails, lack of online security, and fear of online predators. Thus, further research is needed to address the technology informational needs of patients over the age of 40.

Disparities by Race/Ethnicity

Although we continued to see significant disparities between Whites and racial/ethnic minorities we did observe a narrowing of this gap for African Americans, and a slight widening of the gap for Hispanics/Latinos. The narrowing seen in the African American community is likely the result of increased access to the Internet and the rise of Smartphone use. In contrast, although overall Internet and Smartphone use increased among Hispanic/Latinos from 2012 to 2016, the gap associated in frequent Internet use between Hispanics/Latinos and White increased by 7%. These findings could be related to the fact that Hispanic/Latinos were under represented in both samples. It should be noted that Hispanics/Latinos were the highest users of Smartphones in our 2012 assessment, and made fewer gains in this area compared to other groups in the 2016 assessment. Thus, future research is needed to gain a better understanding of technology trends in Hispanic/Latino communities.

LIMITATIONS

This study is not without limitations. First, the study was conducted at an urban transplant center and serves a large percentage of socioeconomically disadvantaged patients (low health literacy, low SES). Although our sample may not be representative of the end-stage renal disease population as a whole, end-stage renal disease disproportionately affects individuals who are racial and ethnic minorities and with low SES.[31-33] Other patient populations may not benefit equally from additional support from friends/family or a PIC to assist in health-related Internet use. Second, though steps were taken to reduce the potential of social desirability bias, it is possible that these estimates may be over inflated. However, we feel this is unlikely, as the proportions of device ownership and access to the Internet are consistent with reports in large national databases on technology use in the United States. In addition, by including participants who were not technologically savvy in both the 2012 and 2016 surveys we have increased the rigor of the study by reducing selection bias. Further research into potential facilitators and barriers to technology use in chronically ill populations is warranted, as digitization of healthcare will only continue, increasing the possibility of worsening existing disparities.

CONCLUSIONS

Low reported rates of frequent Internet use among African Americans and Hispanics/Latinos in urban areas in the United States remains a problem despite a significant increase in frequent Internet use and Smartphone ownership. The finding that Internet use increases as the number of Internet users in the household increases indicates that further dyadic research utilizing technologically proficient members of the patients' social support network and/or a PIC who can assist the patient with electronic educational resources is warranted. Identifying PICs may aid with patients' adoption of health technology, increase health literacy, and promote patient engagement in self-care.

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