Signing Off: Predicting Discontinued ICT Usage Among Older Adults in Assisted and Independent Living

A Survival Analysis

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Abstract. While previous research examining digital inequality among older adults has exposed factors that prevent older adults from using information and communication technologies (ICTs), less has been done focusing on factors that may contribute to ICT discontinuation. This investigation uses data from a randomized controlled intervention study to examine possible predictors of discontinued ICT usage among older adults in assisted and independent living communities. Survival analysis shows that participating in a non-technology activities intervention can increase the odds of stopping the use of ICTs over time. In addition, an increase in the number of instrumental activities of daily living (IADLs) an individual needs assistance with was associated with increased odds of discontinuing ICT use. Results suggest that those promoting continued usage of ICTs among older adults in assisted and independent living need to address the social activities that may prevent use and account for the increasing frailty of residents over time.

Keywords: ICTs · Aging · Assisted living · Independent living · Digital divide

1 Introduction

With the increase in prevalence of information and communication technologies (ICTs), such as Internet-connected computers and smartphones, in everyday life as well as the increase in research that suggests ICTs may benefit individual users with regards to health [1–4], researchers have turned their attention to addressing the so-called "digital divide" – the inequalities in access and use of ICTs. By addressing multiple levels of the digital divide, applied researchers can ensure that all populations will be able to reap the potential benefits of using ICTs. One particular population that is at risk of experiencing the negative consequences of the divide is that of older adults aged 65+ [5]. Although the number of older adults who are using ICTs is increasing [6], their usage levels pale in comparison to younger groups. While research examining the digital divide has focused on the factors that prevent older adults from using ICTs or the attitudes that may dissuade initial use [7–15], less has focused on the factors that

influence a previously using older adult to discontinue ICT use, particularly older adults who reside in continuing care retirement communities (CCRCs) such as assisted and independent living communities. Using data from a longitudinal study that centered on examining ICT use in older adults in CCRCs, the purpose of this investigation is to identify predictors of discontinued ICT use for this special population. Results may provide insight on measures applied researchers and CCRC staff may take in promoting continued ICT use so that older adults in these communities can continue to reap the benefits of their use.

1.1   Background

ICTs have the potential to enhance the health of users. Applications provide users with tools to help manage, cope with, or even treat a variety of physical and mental health issues such as diabetes, asthma, weight control, smoking cessation, and depression [1, 2, 16]. In addition to providing tools to assist in managing health, ICTs have also been found to have a more direct impact on health and quality of life. For older adults, ICT use has been found to have a significant association with decreased depression [3] and decreased loneliness [17]. Yet while older adults may potentially benefit from ICT use with regards to health and quality of life, the percentage of older adults who report using ICTs is much lower compared to other cohorts. The Pew Research Center reports that while the percentage of older adults who go online has increased between 2001 and 2013 from 15 % to 59 %, it trails in comparison to the general population where 86 % report using the Internet [6, 18].

Researchers of digital inequality have identified various facets of the "digital divide" that help to explain why older adults are less likely to use ICTs despite the potential benefits of use. These go beyond simple explanations of access and also focus on attitudes towards technology and aging. A sample of the reasons older adults do not use ICTs include perceived lack of relevance, perceptions of being too old to learn, embarrassment of abilities, cognitive declines, and issues with vision/hand dexterity [7–15]. As such, some applied researchers looking to explore and potentially decrease the digital divide and enhance the well-being of older populations have attempted to address these through the use of intervention-based investigations [19, 20].

While a considerable amount of literature is devoted to the training of older adults to use ICTs and examining trends in usage, less has focused on examining discontinued ICT use. What motivates an older adult ICT user to stop using a computer and/or the Internet? Previous work suggests that attitudes towards computers such as interest, utility, and control have a significant relationship with discontinuation of ICT use [21] as well as demographic characteristics, as those with low incomes and racial/ethnic minorities are more likely to stop using ICTs [20]. However, to our knowledge no study has examined trends in ICT discontinuation and possible predictors of discontinuation in the context of CCRCs. Residents of CCRCs, specifically assisted and independent living, are a unique subset of the older adult population in that they are typically more physically and cognitively impaired than the general older adult population [22] and they are at risk of lower levels of social support and higher levels of loneliness and social isolation [23, 24].

The focus of this investigation is to determine what factors may predict discontinued ICT use among older adults in assisted and independent living. We focus our attention on factors that are especially salient to residents of these communities: social support and relationships (as residents are at a risk for decreased social contact) and health and functional limitations (as residents tend to have increased physical and cognitive impairments) [22–24]. We hypothesize that individuals in assisted and independent living with decreased levels of support and worse health will be more likely to stop using ICTs over time. We also hypothesize that individuals who take part in a technology-based intervention designed to teach assisted and independent living residents the basics of using a computer and the Internet will be less likely to stop using computers over time.

2 Method

Data for this investigation come from the ICTs and Quality of Life Study, a multi-site randomized controlled intervention study designed to assess the effect of ICT use on the quality of life of older adults residing in assisted and independent living. Nineteen CCRCs located in a medium-sized metropolitan city within the Deep South of the US were randomized into one of three study arms: an ICT arm wherein study participants were given an 8-week training course in the basics of using desktop/laptop computers and the Internet; an Activities Control (AC) arm wherein participants engaged in recreational activities with study personnel such as musical sing-alongs and trivia games; and a True Control (TC) arm wherein no intervention was conducted at the CCRC. Potential participants were screened for cognitive impairment using the Mini-Mental State Examination [25]. Initial recruitment yielded a sample of 313 participants: 101 in the ICT arm, 112 in the AC arm, and 93 in the TC arm.

Participants in the ICT arm engaged in an 8-week introductory course of using computers and the Internet. Two 90-minute classes were held in the CCRC each week using a portable computer lab, along with an additional optional 90-minute "office hours" session where participants could receive more one-on-one instruction with the instructors. The ICT classes started with the basics of using a computer – how to turn one on and off, how to use the keyboard, how to use the mouse, how to open a program – and increased in difficulty over time to cover topics like using email, searching for information online, using social networking sites (e.g. Facebook, Twitter), and using video/recreational websites (e.g., Hulu, Youtube). Each class was led by a graduate student instructor who was assisted by at least one additional graduate student, oftentimes two or three depending on the size of the class. Instruction was supplemented with a custom-made training manual that contained all the lessons covered in the classes that participants could keep. Desktop computers were provided at each CCRC and installed in common areas for participants to use once the classes were complete should they not own or have access to a personal computer (one desktop computer per every five participants).

Both qualitative and quantitative data were collected over the course of the study, although for the purposes of this investigation the analysis is limited to the quantitative data. Quantitative data were derived from a series of surveys conducted with each

participant in-person with a member of the study team. Five surveys were administered over the course of approximately 14 months. After baseline, a survey was administered after the intervention (in the case of the ICT and AC arms) or approximately eight weeks after the initial (in the case of the TC arm) and then at 3-, 6-, and 12-month post-intervention follow-ups. Survey questions covered a number of topics, including participant health and well-being, social support and social life in and outside of the CCRC, ICT use, and basic demographics, among others.

2.1 Analytic Technique

The purpose of this investigation is to determine what factors may contribute to an older adult's decision to stop using ICTs. We employ survival analysis as an analytic technique to track ICT usage and identify these factors among the participants of the study. Survival analysis was designed for longitudinal data on the occurrence of an event or a discrete change from one state to another [26, 27]. In general, longitudinal data cannot be analyzed using conventional multivariate methods such as linear regression. The endpoint of the time period of interest or duration is usually right-censored for the occurrence of an event; in other words, the event of interest has not occurred during the period of observation and all that is known about the duration is that it exceeds the observation period [28]. Given the design of the ICTs and Quality of Life Study, the survival analysis examines when the participant stopped using ICTs and what predicts the event of interest.

Cox proportional hazards regression is commonly employed to model survival data. However, the introduction of time-dependent covariates into a Cox regression model will result in non-proportional hazards. Moreover, there are further concerns about the complexity involved in the practical interpretation of the resulting coefficients and in the robustness of the models. Therefore, we employ the flexible parametric model estimation procedure in Stata developed by Lambert & Royston [29]. The advantages of the flexible parametric model estimation over the Cox model are the ease with which smooth predictions can be made, the modeling of complex time-dependent effects, investigation of absolute as well as relative effects, and the incorporation of the expected event for relative survival models [29, 30].

2.2 Measures

Event of Interest. Responses to two questions were used to create the event indicator that a participant stopped using an ICT device. First, participants were asked if they ever use a computer at least occasionally (response options were "yes" or "no"). The value of the response options were recoded to a dichotomous indicator (0 = yes, 1 = no). Second, participants were asked how many times in the past week they used a computer/Internet to search for information. A response value of zero (0) was recoded to a value of one (1) and all response values greater than zero were collapsed and recoded as zero (0). The dichotomous response values for both items were cross tabulated to correctly assign whether the participant continued to use an ICT device (i.e., 0) or if the participant stopped using ICT devices (i.e., 1) for the five time periods.

Independent Variables. The study arm (i.e., ICT, AC, and TC) variable was recoded into three separate variables with dichotomous indicators (i.e., 1/0). In the analyses, the TC group is the excluded or comparison category. The social support measure uses a modified version of the MOS Social Support Survey [31] but without the items assessing help with meals and support with chores as these are addressed elsewhere. Response values were averaged across 18 items and higher average values indicate a higher level of social support. The participant's age was recorded at her/his last birthday. Participants were asked marital status and the response options include: currently married, widowed, divorced, separated, and never married. Marital status was recoded into a dichotomous indicator for either currently married or not (i.e., 1 = currently married, 0 = widowed, divorced, separated, and never married). Participants

Table 1. Descriptive statistics

	Mean	S.D.	Minimum	Maximum
ICT Group	0.33	0.47	0.00	1.00
AC Group	0.37	0.48	0.00	1.00
TC Group	0.30	0.46	0.00	1.00
Age	81.96	8.38	51.00	102.00
Social Support Scale				
Time 1	3.72	0.80	0.94	4.72
Time 2	3.75	0.77	1.17	4.72
Time 3	3.74	0.80	0.94	4.72
Time 4	3.78	0.78	0.94	4.72
Time 5	3.80	0.83	0.22	4.72
Currently Married				
Time 1	0.14	0.35	0.00	1.00
Time 2	0.13	0.33	0.00	1.00
Time 3	0.13	0.33	0.00	1.00
Time 4	0.12	0.33	0.00	1.00
Time 5	0.11	0.31	0.00	1.00
Self-Reported Health Status				
Time 1	3.11	1.04	1.00	5.00
Time 2	3.08	1.02	1.00	5.00
Time 3	2.98	1.00	1.00	5.00
Time 4	2.94	0.99	1.00	5.00
Time 5	2.99	0.98	1.00	5.00
IADLs Scale				
Time 1	3.33	1.34	0.00	8.00
Time 2	3.33	1.37	0.00	6.00
Time 3	3.38	1.22	0.00	8.00
Time 4	3.06	1.32	0.00	7.00
Time 5	3.22	1.29	0.00	7.00

Source: ICTs and Quality of Life Study. N = 313

were asked to rate their health with the response options: excellent, very good, good, fair, and poor. The corresponding response values were recoded so that the highest value indicates an excellent level of self-reported health. To assess the participants Instrumental Activities of Daily Living (IADLs), participants were asked if they received eight types of assistance at their living facility. The eight types of assistance include: medicine management, transportation, meal preparation, household chores, sitting services, financial assistance, shopping, or other not listed. Responses were recoded into a dichotomous indicator (i.e., 1/0) for each type of assistance. Affirmative responses to the eight types were summed so that higher values indicate a higher level of assistance needed.

3   Results

3.1   Descriptive Statistics

Table 1 displays the descriptive statistics for all predictors in the analysis. At baseline there were a total of 313 participants who began the study. Approximately 33, 37, and 30 percent of participants were assigned to the ICT, AC, and TC arms, respectively. On average, participants were 82 years of age. The average value of the social support scale increased from 3.72 at Time 1 to 3.80 at Time 5. The percent of respondents currently married decreased from 14 percent to 11 percent over the course of the study. The average value of participants self-reported health status decreased during the course of the study, although the score was relatively high as the range of 2.94-3.11

Table 2. Flexible parametric survival analysis. Hazard ratios for stopped using ICT devices

	Model 1		Model 2		Model 3	
ICT Group	0.731		0.857		0.792	
	(0.153)		(.180)		(0.169)	
AC Group	1.351		1.644	**	1.471	*
	(0.253)		(0.312)		(0.284)	
Social Support			0.835		0.908	
			(0.083)		(0.095)	
Age					1.012	
					(0.009)	
Currently Married					0.853	
					(0.209)	
Self-Reported Health Status					0.944	
					(0.077)	
IADLs					1.269	***
					(0.078)	
LR chi-square	10.44	*	14.72	**	34.49	***

Source: ICTs and Quality of Life Study. * $p < 0.05$, ** $p < 0.001$, *** $p < 0.0001$. Standard errors reported in parentheses.

corresponds with good/very good health. While self-reported health declined, the average number of IADLs residents reported needing assistance with was relatively stable over the five points in time.

A series of flexible parametric regression models are presented in Table 2. The coefficient for each predictor is the hazard ratio or rate that a participant stopped using an ICT device during the 14 months. Therefore, a significant positive coefficient increases the hazard rate that a participant stopped using ICT devices, while a negative coefficient decreases the hazard rate and increases expected duration that the participant will continue to use an ICT device. In Model 1, the ICT and AC study arm groups are not significant. The social support measure enters Model 2 and the hazard rate for the AC group is significant. Participants in the AC group have a 64 % higher rate that they will stop using ICT devices compared to the TC group. Model 3 adds the participants' age, current marital status, self-reported health status, and IADLs scale measures. Participants in the AC group have a 47 % higher rate that they will stop using ICT devices compared to the TC group. Moreover, as IADL level increases participants have a 27 % higher rate that they will stop using ICT devices.

4   Conclusion

While research examining the digital divide has explored the factors that may contribute to preventing an older adult from using ICTs [7–15], far less has focused on the factors associated with discontinuing the use of ICTs over time, particularly in the context of CCRCs. This investigation sought to identify factors that could potentially predict whether or not an individual living in assisted or independent living would cease using ICTs. We hypothesized that social support and relationships as well as health considerations may contribute to a resident's decision to stop using a computer or the Internet. Our results suggest that while health in the form of functional limitations may motivate residents to discontinue ICT usage, social support may have less of an impact than we thought. Moreover, we had an unexpected finding in that residents in the AC group of the study had increased odds of discontinuing ICT use.

Regarding the unexpected finding, it is possible that the significantly higher rate that a participant in the AC group will stop using ICT devices is a result of engaging in activities with other participants. AC group participants engaged in recreational activities with study personnel such as musical sing-alongs and trivia games. Therefore, AC group members may have lost interest in using ICT devices given the level of other activities they engage in. A previous investigation using data from this study found that participating in any activity, regardless of whether it was an ICT activity or a recreational activity, was associated with increased quality of life [32]; as such, participants in the AC group may have been taking advantage of the benefits of participation (whether these benefits were social or psychological in nature) to the point that they did not perceive a need or simply did not want to engage with ICTs.

Self-rated health was not found to be a significant predictor of discontinuing the use of ICTs. However, as a respondent's number of IADLs that required assistance increased, so too did the likelihood that the respondent would stop using ICTs. This shows that while a subjective measure of health (self-reported health) did not serve as a

significant predictor, a more objective measure of functional limitations did. This indicates that while an individual residing in assisted or independent living may feel healthy, limitations that prevent them from being able to carry out IADLs without assistance may also be contributing to their inability to use ICTs. It could be that these increased limitations translate into a direct physical or cognitive complication of using ICTs (e.g., an individual who requires assistance with household chores may also find it difficult to use a keyboard or a mouse), or it could be that the limitations suggest that the respondent refocuses their energies on activities they find more important to their daily life.

Research has shown that there is potential for older adults to use ICTs to better their health and well-being [1–3], [16, 17], and thus it is important for applied researchers to not only identify what factors are preventing older adults from getting online initially but also what factors may motivate them to sign off. The investigation using data from a longitudinal intervention-based study suggests that participating in recreational/ non-technology-related activities and increased functional limitations may contribute to discontinued ICT use among older adults in assisted and independent living. As such, applied researchers and CCRC staff looking to bridge the digital divide and keep these residents online will need to account for these factors.

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