Predictors of Retention for Community-Based Telehealth Programs: A Study of the Telehealth Intervention Program for Seniors (TIPS)

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Abstract

Community-based telehealth programs (CTPs) allow patients to regularly monitor health at community-based facilities. Evidence from community-based telehealth programs is scarce. In this paper, we assess factors of retention—patients remaining active participants—in a CTP called the Telehealth Intervention Programs for Seniors (TIPS). We analyzed 5-years of data on social, demographic, and multiple chronic conditions among participants from 17 sites (N=1878). We modeled a stratified multivariable logistic regression to test the association between self-reported demographic factors, caregiver status, presence of multiple chronic conditions, and TIPS retention status by limited English proficient (LEP) status. Overall, 59.5% of participants (mean age: 75.8yrs, median 77yrs, SD 13.43) remained active. Significantly higher odds of retention were observed among LEP females, English-speaking diabetics, and English proficient (EP) participants without a caregiver. We discuss the impact of CTPs in the community, the role of caregiving, and recommendations for how to retain successfully recruited non-English speaking participants.

Introduction

Increasing demand for healthcare in response to the needs of a growing aging population, and more recently to the rapid adoption of telemedicine due to the COVID-19 (SARS-CoV-2) pandemic, has expedited the urgency to ensure telehealth that is safe, effective, efficient, patient-centered, timely and equitable. Access to high-quality care for aging populations is increasingly complex due to the unique needs of older adults as their diversity in race/ethnicity, socioeconomics, and complex health status demonstrates. This group accounts for the largest population affected by multiple chronic conditions (MCC) or having two or more chronic diseases. While 25% of all Americans live with an MCC, this figure increases to over 60% among older adults.[1] Treating MCCs in fragmented healthcare delivery systems creates higher costs overall, and results in poorer quality for older Americans. This risk is compounded for racially and ethnically diverse older adults and those who speak English less than "very well." They are considered limited English proficient (LEP) because they are more likely to experience care delays and communication barriers since their primary language is not English. Further, as older adults, they are also facing higher rates of cognitive impairment, dementia, reduced functional status and increased emergency visits among Medicare beneficiaries.[2]

Evidence underscoring the benefits of aging-in-place[3] for older adults who wish remain in their homes include better mobility, cognition, social status, and lower depression risk.[4-6] In response, innovations in telehealth and telemedicine interventions have become ubiquitous.[7, 8] This technology has enabled the delivery of safe and effective care for Americans who need to access care remotely or require constant monitoring.[9-11] Many telehealth technologies for older adults are home-based. Despite offering many benefits, home-based telehealth programs face great challenges in adoption and uptake due in part to the usability and cost issues of telehealth device.[12, 13] In recent years, community-based telehealth (CTPs) programs—offering telehealth services in community settings (e.g., congregate housing, community centers)—are gaining momentum, because 1) they are less equipment intensive, thus less cost is transferred to the patients, and 2) in-person support is available for immediate monitoring and feedback.[8, 14, 15]

However, issues persist among older Americans with complex needs that impede successful uptake related to the usability, tailoring, and feasibility make technology enabled healthcare inaccessible for many older adults and can be particularly prohibitive for low-income, diverse older adults who are LEP.[16, 17] This is in addition to the already significant barriers related to accessing healthcare due to language and communication.[18, 19]

Given the scarce evidence on CTPs, we analyzed 5-years of data on social, demographic, and multiple chronic conditions among participants in the community-based Telehealth Intervention Program for Seniors (TIPS) to provide insights to the feasibility of CTP implementation, particularly on retention. By examining TIPS program retention in a diverse, low-income population of older adults, our study contributes to understanding the roles of language

proficiency, multiple chronic conditions status, and the role of caregivers in retaining participants in CTPs and how informatics approach can address identified challenges.

Background

Telehealth is essential for monitoring high-risk aging populations with chronic conditions in the community in order to ensure timely and high-quality care, reduced care utilization and hospital readmissions, and improved outcomes.[20, 21] There are different types of telehealth programs designed to provide care to older adults. The most commonly and widely-adopted model is home-based telehealth interventions. Numerous studies have demonstrated the effectiveness of home-based telehealth.[7, 8, 10, 11, 22] Home-based telehealth is associated with improved self-management of multiple chronic conditions (MCC) among older adults[23, 24] and may benefit those that experience mobility and transportation barriers most.[25] Seminal work has focused on examining different aspects of this type of telehealth program, such as user acceptance,[12, 13] usability,[26] and effectiveness.[10] However, this approach has several barriers, hindering its uptake and adoption. For example, the usability of home-based telehealth systems for the aging population is problematic as many older adults may not be able to use and navigate the system as well as their younger counterparts.[27] Even more concerning is that current home-based telehealth technology requires installation of equipment in a user's home , regular maintenance, and individualized healthcare services, all of which pose significant financial burden on older adults.[28] Thus, home-based telehealth services are often not an optimal option for many older adults and less so for those with lower socioeconomic status.

To deliver remote monitoring to large-scale aging populations at a lower cost, an alternative approach—community-based telehealth programs (CTPs)—is increasingly being deployed in recent years.[8, 14, 15] Such programs are expected to provide unprecedented opportunities for low-income, high-risk older adults to play an active role in self-management, and in turn, reducing the rates of hospital visits in older adults and the burden of health and social care services.[15] A study assessing the benefits of a CTP in a senior-living facility described as "high-intensity" telemedicine found reductions in emergency visits and readmissions.[29] Despite the benefits, CTPs face salient challenges and barriers in engaging users because older adults may not necessarily know the potential benefits of these interventions and lack motivation to receive health services through CTPs over time.[30, 31] The lack of user engagement and retention with CTPs could negatively affect the effectiveness of delivering and promoting community-based healthcare self-management.

Literature evaluating home-based telehealth for LEP populations with MCC emphasized the need for language access,[32, 33] interventions included mobile interpreting apps, and texting-based self-management interventions.[34, 35] Our review found a lack of telehealth resources for LEP patients an issue that was highlighted early into the COVID-19 pandemic.[32] We found no evidence evaluating CTPs for older adults with LEP. Therefore, it is critical to examine the factors affecting vulnerable user retention in CTPs. Our study will contribute to bridging this research gap. TIPS brings affordable and easier-to-access telehealth to low-income older adults who often face barriers due to age, language, literacy, and costs.

TIPS Program Overview. TIPS is a CTP implemented in the U.S. Northeast that provides remote patient monitoring and wrap-around social services to financially vulnerable older adults living in congregate housing or who attend local community centers. Older adults were eligible to enroll in TIPS if they were over 55 years old and registered as a Medicare and/or a Medicaid beneficiary. Older adults access this program by visiting their local community center, or their own long-term care facility that is staffed weekly by trained Telehealth Technician Assistants (TTAs). TTAs are recruited and trained by TIPS to operate the telehealth devices and technologies (e.g., blood pressure cuffs, pulse oximeters, and tablet computers for data entry) and help older adults with onsite assessment of physiological measures (e.g., blood pressure. pulse oximetry, weight, etc.). TTAs also record details about each participant's evolving medical status (e.g., hospitalization, medication taken, fallen, and overall feeling). Such programs are responsive to the unique needs of older adults, often including social and technology support.

During the initial visit, each participant was asked to fill out an intake questionnaire, which assessed their socioeconomic status (e.g., income, living arrangement, caregiver), demographics (e.g., age, sex, primary language, ethnics), Medicaid/Medicare or other received benefits, medical history, and multiple chronic conditions. In addition to the questionnaire, TTAs also collected a set of physiological biomarkers (heart rate, blood oxygen saturation, blood pressure, and body weight) and self-reported incidence of (1) ER admission, (2) single hospitalizations, and (3) readmissions less than 30 days following hospital discharge, in the 12 months before enrollment. The intake information and initial monitoring data formed the baseline standards for each participant.

Following initial intake, participants were instructed to visit a TIPS site at least once per week, set-up was the same at every site. At each visit, TTAs used the devices to measure the participant's physiological biomarkers and record details about their recent medical history using a five-question survey: (1) Have you changed medications since your

last screening visit? (2) Have you changed your medication dosage since your last screening visit? (3) Have you fallen since your last screening visit? (4) Have you been hospitalized or had an ER visit since your last screening visit? (5) How are you feeling today? (response options include "very good", "good", "feeling OK", "feeling a little down", "not too well", or "terrible"). The results of the assessment were transmitted to a secure, HIPAA-compliant data server, and then reviewed by a team of TIPS nurses. When a participant was involved in the program, their visit frequency was tracked over time. Individuals who missed more than 4 consecutive weeks of TIPS monitoring were contacted by their designated TIPS nurse regarding why they had stopped using the telehealth service. The reason for the stopped use of TIPS service for each participant was recorded, such as deceased, moved away, or preferred to not continue with the TIPS service. This data indicated whether or not a participant stayed active in the program. Studies using these interventions have demonstrated successful monitoring of older adults with heart failure and MCC.[15, 22] However, a lack of user engagement with such programs has suggested variable implementation of CTPs. To address this problem, we assessed factors associated with older adults staying active in TIPS.

Methods

Dataset. Our study is an observational comparison of baseline characteristics of participants retained and not retained in the TIPS program since it was deployed. Data were collected by staff on-site and transmitted asynchronously (store-and-forward) for review by a team of Registered Nurses, who review the data and contact the participant if their health data triggered an alert during their visit. We merged baseline data from TIPS program sites across New York, New Jersey, Pennsylvania, and Connecticut (N=1878). These data include all baseline data for available sites at the time of sampling (November 2014~October 2019). All analyses and co-authors' data use agreements were approved by the Pace University IRB.

Variables. We developed a dichotomous outcome variable to represent patients who stayed active with TIPS at the time of analysis to equal "1" and those who were not active equal to "0". Independent factors included demographics: sex, age, language, caregiver status, MCC, and Medicaid eligibility. LEP participants were identified at enrollment by their self-reported primary language. If any language other than English was selected, they were classified as LEP="1". To assess caregiver status, participants were asked if someone (family member or not) took care of them, either living with them or not. If someone did have a caregiver, they were classified as CG="1"; the reference group for all of these variables was "0". MCC and other conditions reported at baseline were coded as "1" if yes and "0" if no. MCC and other conditions were self-reported as: hospitalization before TIPS enrollment in the last 12 months, obesity, falls, fractures in addition to self-reported diagnosis of depression, early-stage dementia/Alzheimer's disease (ADRD), congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), coronary artery disease (CAD), diabetes mellitus (type 1 or 2), hypoglycemia, liver disease, renal failure, stroke, hypertension, and hypotension. These data were collected at the intake and coded as "1" if selected to indicate yes and "0" if not. We created an additional dummy variable to account for data collection site closures to assess if this had any impact on the sample.

Analysis. We used chi-square analysis to compare group differences across select factors for model selection. We found a significant interaction between caregivers and English proficiency (p=0.0233) and thus presented all descriptive and inferential results stratified by English and non-English proficiency and whether they stayed active in the program (Table 1). Based on our findings and diagnostics, we modeled stratified multivariable logistic regressions to test the association between demographic and MCC factors and the odds of staying active in the TIPS program by language proficiency. All data management and analyses were conducted using SAS 9.4 (Cary, N.C).

Results

Overall, 59.7% of participants stayed active in the TIPS program for the study period. Retention among English speakers (62.6%) was significantly better than that of LEP respondents (47.3%, p<.0001). The average participant age was 75.8 years (median 77.0, SD 13.43), most were female (78%), and did not have a caregiver (95.3%). Also, 36.5% reported having Medicaid and 24.8% were LEP. Table 1 demonstrates comparisons by English proficiency. Over 50% of LEP participants were Medicaid recipients compared with EP (p<.0001), and LEP were significantly more likely to report having a caregiver compared with EP, 6.9% vs. 2.9% (p=0.0004). Both groups reported lacking a caregiver at over 90%.

Table 1. Select characteristics of TIPS program participants by English Proficiency (N=1878).

		Language Proficiency		
		English Proficient	LEP	p-value
	N	n (col%)	n (col%)	
Age Group				

<65 years	295	246(18.6)	49(11.2)	<.0001
65-74 years	428	310(23.4)	118(26.9)	
75-85 years	573	395(29.8)	178(40.6)	
85+ years	467	374(28.2)	93(21.2)	
Sex				
Female	1374	1046(78.9)	328(74.9)	0.0759
Male	389	279(21.1)	110(25.1)	
Medicaid Recipient				
Yes	676	438(33.1)	238(54.3)	<.0001
No	1087	887(66.9)	200(45.7)	
Caregiver (CG)				
CG	65	36(2.9)	29(6.8)	0.0004
No CG	1601	1201(97.1)	400(93.2)	
Study Site Status				
Data Collection On-going	932	711(53.7)	221(50.5)	0.2442
Site Closed	831	614(46.3)	217(49.5)	
Multiple Chronic Conditions (MCC)*				
No MCC	1240	920(69.4)	320(73.1)	0.1499
MCC	523	405(30.6)	118(26.9)	
Retention Status				
Participant stayed active	1037	830(62.6)	207(47.3)	<.0001
Participant not active	726	495(37.4)	231(52.7)	

*Notes: [1]Some values may not add up to full N=1878 due to missing values and/or rounding. *No MCC*=0-1 chronic conditions; MCC=2+ chronic conditions*

Table 2 compares retention status across EP and LEP participants. We observed that 65 to 85-year-old participants were most likely to report staying active in TIPS compared to other age groups, independent of language. Although not significant, findings suggest a trend among female participants being more likely to stay active in the program compared with males also across both EP and LEP. Retention was higher among EP participants on Medicaid (51.1%, p=0.0048) compared with LEP Medicaid recipients (41.6%, p=0.0096). Among EP participants, retention was significantly higher when no caregiver was reported (62.1%) compared to 38.9% of EP with a caregiver (P=.0048). Conversely, LEP participants did not hold the same pattern. Although not significant, LEP participants reported similar retention with (48.3%) or without (47.3%) a caregiver. Retention of LEP participants without an MCC was higher (50.3%) compared to 39% of LEP with an MCC (p=0.0351). Chronic conditions that were significantly associated with retention status for English participants were depression, history of fracture, hypoglycemia, and hypertension (Table 2). For LEP participants we found only COPD to be significant.

Results from the stratified multivariable model are in Table 3, showing that age was associated with greater odds of retention in TIPS among both EP and LEP participants. Adjusted odds of retention were 71% (AOR 1.71; 95CI 1.12-2.58) greater for English speaking adults age 65-74 and nearly 3-fold greater (AOR 2.60, 95CI 1.2105.60) for LEP participants in the same age group compared with the reference group (<65 years). English participants age 75-85 reported 65% greater odds (AOR 1.65; 95CI 1.11-2.45), compared with similar 3-fold greater odds for LEP participants (AOR 2.86; 95CI 1.37-5.96)

Table 2. Characteristics of *TIPS* program participants by English Proficiency and Retention Status (N=1878)[1]

	English Proficient				Limited English Proficient (LEP)			
	N	Stayed Active n (row%)	Not Active n (%)	Pvalue[3]	N	Stayed Active n (row%)	Not Active n (%)	Pvalue[3]
	1325	830(62.6)	495(37.4)		438	207(47.3)	231(52.7)	<.0001
Age Group								
<65 years	246	119 (48.4)	127(51.6)	**<.0001**	49	14(28.6)	35(71.4)	**0.0437**
65-74 years	310	222(71.6)	88(28.4)		118	56(47.5)	62(52.5)	
75-85 years	395	277(70.1)	118(29.9)		178	91(51.1)	87(48.9)	
85+ years	374	212(56.7)	162(43.3)		93	46(49.5)	47(50.5)	
Sex								
Female	1046	661(63.2)	385(36.8)	0.4216	328	162(49.4)	166(50.6)	0.1231
Male	279	169(60.6)	110(39.4)		110	46(40.9)	65(59.1)	
Medicaid Recipient								
Yes	438	224(51.1)	214(48.9)	**<.0001**	238	99(41.6)	139(58.4)	**0.0096**
No	887	606(68.3)	281(31.7)		200	108(54.0)	92(46.0)	
Caregiver (CG)								
CG	36	14(38.9)	22(61.1)	**0.0048**	29	14(48.3)	15(51.7)	0.9149
No CG	1201	746(62.1)	455(37.9)		400	189(47.3)	211(52.8)	
Study Site Status								
Site Open	711	404(56.8)	307(43.2)	**<.0001**	221	116(52.5)	105(47.5)	**0.0270**
Site Closed	614	426(69.4)	188(30.6)		217	91(41.9)	126(58.1)	
Chronic Conditions (MCC)								
No MCC	920	572(62.2)	348(37.8)	0.5959	320	161(50.3)	159(49.7)	**0.0351**
MCC	405	258(63.7)	147(36.3)		118	46(39.0)	72(61.0)	
Depression								
Yes	93	38(40.9)	55(59.1)	**<.0001**	11	5(45.5)	6(54.6)	1.0000
No	1232	792(64.3)	440(35.7)		427	202(47.3)	225(52.7)	
Hospitalized[2]								
Yes	326	194(59.5)	132(40.5)	0.1782	100	39(39.0)	61(61.0)	0.0596
No	999	636(63.7)	363(36.3)		338	168(49.7)	170(50.3)	
Falls								
Yes	42	21(50.0)	21(5.0)	0.0852	9	2(22.2)	7(77.8)	0.1811
No	1283	809(63.1)	474(36.9)		429	205(47.8)	224(52.2)	
Fracture								
Yes	20	6(30.0)	14(70.0)	**0.0024**	8	3(37.5)	5(62.5)	0.7274
No	1305	824(63.1)	481(36.9)		430	204(47.4)	226(52.6)	
Dementia/ADRD								
Yes	19	10(52.6)	9(47.4)	0.3636	7	3(42.9)	4(57.1)	1.0000
No	1306	820(62.8)	486(37.2)		431	204(47.3)	227(52.7)	
CHF								
Yes	45	28(62.2)	17(37.8)	0.9528	17	5(29.4)	12(70.6)	0.1460
No	1280	802(62.7)	478(37.3)		421	202(48.0)	219(52.0)	
COPD								
Yes	147	94(64.0)	53(36.1)	0.7289	28	7(25.0)	21(75.0)	**0.0147**
No	1178	736(62.5)	442(37.5)		410	200(48.8)	210(51.2)	

Table 2 (Continued). Characteristics of *TIPS* program participants by English Proficiency and Retention Status (N=1878)[1]

	English Proficient				Limited English Proficient (LEP)			
	N	Stayed Active n (row%)	Not Active n (%)	Pvalue[3]	N	Stayed Active n (row%)	Not Active n (%)	Pvalue[3]
Coronary Artery Disease								
Yes	128	89(69.5)	39(30.5)	0.0900	21	8(38.1)	13(61.9)	0.3886
No	1197	741(61.9)	456(38.1)		417	199(47.7)	218(5.3)	
Diabetic								
Yes	282	189(67.0)	93(33.0)	0.0866	121	56(46.3)	65(53.7)	0.7998
No	1043	641(61.5)	402(38.5)		317	151(47.6)	166(52.4)	
Hypoglycemia								
Yes	19	7(36.8)	12(63.2)	**0.0192**	2	1(50.0)	1(50.0)	1.0000
No	1306	823(63.0)	483(37.0)		436	206(47.3)	230(52.8)	
Hypertension								
Yes	679	444(54.4)	235(34.6)	**0.0340**	226	102(45.1)	124(54.9)	0.3571
No	646	386(59.8)	260(40.3)		212	105(49.5)	107(50.5)	
Liver Disease								
Yes	17	5(29.4)	12(70.6)	**0.0091**	3	1(33.3)	2(66.7)	1.0000
No	1308	825(63.1)	483(36.9)		435	206(47.4)	229(52.6)	
Obesity								
Yes	110	71(64.6)	39(35.5)	0.6664	16	6(37.5)	10(62.5)	0.4256
No	1215	759(62.5)	456(37.5)		422	201(47.6)	221(52.4)	
Hypotension								
Yes	33	24(72.7)	9(27.3)	0.2252	12	7(58.3)	5(41.7)	0.5611
No	1292	806(62.4)	486(37.6)		426	200(47.0)	226(53.1)	
Renal								
Yes	24	16(66.7)	8(33.3)	0.6808	8	3(37.5)	5(62.5)	0.7274
No	1301	814(62.6)	487(37.4)		430	204(47.4)	226(52.6)	
Stroke								
Yes	75	46(61.3)	29(38.7)	0.8095	13	5(38.5)	8(61.5)	0.5830
No	1250	784(62.7)	466(37.3)		425	202(47.5)	223(52.5)	

Notes: [1]Some values may not add up to full N=1878 due to missing values and/or rounding. [2]Hospitalized in the last 12 months prior to program participation. [3]. If cells value is n=5 or less, Fisher's Exact Two-sided P-value is reported. *MCC= sum(FallHX, ADRD, CHFHX, CorArtD, Diabetic, HypoglycemiaHx,HypertensionHx, LiverHx, ObeseHx, HypotensionHx, renalHx, StrokeHx)..*No MCC*=0-1 chronic conditions; MCC=2+ chronic conditions

Only LEP participants had persistent significantly greater odds of retention for adults over 85 years (AOR 2.63; 95CI 1.19-5.80). Sex was significantly associated with retention but only among LEP participants with females reporting 71% greater odds than males (AOR 1.71; 95CI 1.06-2.75). English proficient and LEP Medicaid recipients reported similar significantly lower odds of staying active (AOR 0.61 and AOR 0.60, $p<0.05$). Only English participants were associated with significant 3-fold greater odds of staying active if they report lacking a caregiver (AOR 2.53; 95CI. 1.23-5.22).

Discussion

The TIPS program demonstrated efficacy in reducing rehospitalizations[15]. However, retention is key to sustaining such benefits of the program. Our study provides evidence on retention in CTPs, which is lacking in the literature. Compared with available evidence on CTPs, our study population consisted of a higher proportion of participants who were LEP (1 in 4), a hard-to-reach population. Even with this vulnerable population, 47.2% participants stayed active in TIPS throughout the 5-year study period. Such long-term evidence is scarce in the literature, and other similar programs with less vulnerable population had faster rate of attrition (e.g., telehealth kiosks where 47% remained active after only 10 months).[36] Our findings from a diverse and geographically heterogenous sample of community-based older adults with MCC brings key implications to building knowledge on the predictive factors of retention in CTPs among vulnerable aging populations.

Table 3. Patient Demographic and Self-Reported Factors Associated with Retention in TIPS by English Proficiency Status (N=1878)[1]

	Stayed Active – English Proficient			Stayed Active – LEP		
Age Group	**AOR**	**(95% CI)**	*p-value*	**AOR**	**(95% CI)**	*p-value*
<65 years	Ref	-	-	Ref	-	-
65-74 years	**1.71**	**1.13-2.58**	**0.0105**	**2.60**	**1.21-5.60**	**0.0145**
75-85 years	**1.65**	**1.11-2.45**	**0.0140**	**2.86**	**1.37-5.96**	**0.0050**
85+ years	0.96	0.64-1.43	0.8248	**2.63**	**1.19-5.80**	**0.0169**
Sex						
Female (Ref: Male)	1.33	0.99-1.79	0.0575	**1.71**	**1.06-2.75**	**0.0270**
Medicaid Recipient						
Yes (Ref: No)	**0.61**	**0.46-0.81**	**0.0005**	**0.60**	**0.39-0.93**	**0.0215**
Caregiver (CG)						
No CG (Ref: CG)	**2.53**	**1.23 -5.22**	**0.0118**	0.55	0.23-1.29	0.1691
Study Site Status						
Site Open (Ref: Site Closed)	0.79	0.61-1.02	0.0666	1.40	0.91-2.16	0.1304
Multiple Chronic Conditions (MCC)						
MCC (Ref: No MCC*****)	0.66	0.40-1.08	0.1009	0.60	0.26-1.40	0.2349
Depression						
Yes (Ref: No)	**0.53**	**0.32-0.87**	**0.0123**	1.01	0.27-3.76	0.9926
Hospitalized[2]						
Yes (Ref: No)	0.95	0.71-1.26	0.7021	0.67	0.40-1.11	0.1203
Falls						
Yes (Ref: No)	0.6	0.32-1.31	0.2239	0.45	0.08-2.59	0.3676
Fracture						
Yes (Ref: No)	0.37	0.12-1.10	0.0732	0.45	0.07-2.93	0.4066
Dementia/ADRD						
Yes (Ref: No)	1.00	0.35-2.87	0.9992	0.81	0.15-4.35	0.8045
CHF						
Yes (Ref: No)	1.26	0.62-2.55	0.5164	0.59	0.18-1.97	0.3931
COPD						
Yes (Ref: No)	1.26	0.85-1.87	0.2562	0.44	0.17-1.15	0.0932
Coronary Artery Disease						
Yes (Ref: No)	1.59	0.98-2.59	0.0597	0.87	0.31-2.46	0.7926
Diabetic						
Yes (Ref: No)	**1.48**	**1.00-2.20**	**0.0490**	1.62	0.87-3.01	0.1303
Hypoglycemia						
Yes (Ref: No)	0.55	0.20-1.54	0.2522	1.84	0.10-34.01	0.6823
Hypertension						
Yes (Ref: No)	1.31	0.98-1.75	0.0693	0.94	0.58-1.53	0.8015
Liver Disease						
Yes (Ref: No)	0.34	0.11-1.05	0.0605	0.58	0.05-6.75	0.6636
Obesity						
Yes (Ref: No)	1.59	0.96-2.65	0.0734	0.89	0.25-3.10	0.8487
Hypotension						
Yes (Ref: No)	2.30	0.89-5.97	0.0872	3.16	0.82-12.22	0.0957
Renal						
Yes (Ref: No)	1.61	0.59-4.42	0.3546	0.64	0.13-3.21	0.5878
Stroke						
Yes (Ref: No)	1.12	0.63-1.97	0.7016	1.27	0.33-4.89	0.7302

*Notes: [1]Some values may not add up to full N=1878 due to missing values and/or rounding.*No MCC*=0-1 chronic conditions; MCC=2+ chronic conditions

Our study population comprised of a diverse sample of low-income older adults with LEP and chronic conditions, many of whom classified as having MCC. We found that, regardless of their chronic condition status, EP and other social-demographic factors were predictive of greater odds of retention in TIPS. Thus, it is the predisposing factors that participants have little control over (e.g., language, income) that may be a greater contributor to retention than

any physical element. Another factor is the health care delivery systems, as structured, struggles to support self-management change in vulnerable populations due to its inability to target well. CTPs appear to fill a critical need in this respect. It is imperative for participants with MCC to experience benefits from telehealth programs like TIPS. While our findings showed that LEP participants with MCC are less likely to be retained, significantly better odds of retention were observed among English proficient participants with select chronic conditions. Consideration for tailoring the socio-technical design structure of TIPS and other CTPs to language and culturally diverse populations may be an opportunity to retain high-risk participants. For instance, given the increased use of smartphones and agents embedded in mobile phones by these vulnerable population, additional monitoring or assistive devices can be appropriated to aid any shortcomings of current technical, clinical, and social infrastructure that TIPS provides. Being able to increase retention among those who need the resources the most will be critical in maximizing the benefits TIPS can provide to its participants.

The role of caregivers as facilitators of home-based telehealth is critical.[37] In community-based settings where the deployed telehealth system is multi-user and may be operated by support staff or a self-operated mobile unit (e.g., kiosk) we found greater retention when there was no caregiver, suggesting CTPs may support this critical role. Interestingly, our finding that participants without a caregiver reported greater odds of retention was limited to EP participants. LEP participants had inverse odds, though not significant, suggesting, they were not seeking a caregiver proxy. Rather, the significantly higher odds of LEP females remaining active in the program suggests, they are the caregivers. Accordingly, TIPS may serve as a great supportive mechanism for older adults who do not have caregivers, which consist the majority of Americans who are older adults. Furthermore, TIPS can be a supportive mechanism for LEP older adults who may have played multiple social roles in the household as caregiver, head of household, or women who have not had much support. TIPS recruited more LEP participants than most programs, but retained fewer LEP participants, demonstrating recruitment success but retention barriers. Previous studies suggest existing barriers to healthcare utilization among older LEP adults include health literacy and technology access (they don't have the smartphones).[16] These barriers also apply to CTPs, LEP participants struggle to engage in technology-based healthcare to the same extent of their non-LEP peers.[16] There is a lack of evidence on the efficacy and feasibility of CTP participants with LEP. Studies on the acceptance of telehealth systems show usability as one of the main barriers to successful adoption. [38] Specific to LEP populations are the lack of comprehensive usability and seamless integration into care delivery since language access is needed at every interaction, thus making accessibility a higher priority.[38] Some studies show navigators help mitigate some of these barriers similar to the role that TIPS on-site technical support.[39] On top of existing usability issues, the needs of LEP clients must be addressed to ensure their participation.

Pew Internet Research has shown older adults are increasingly using mobile phones and smartphones.[40] Furthermore, due to the COVID pandemic, older adults are increasingly adopting mobile and computing devices.[41] This rapidly changing technological adoption pattern encourages potential technological solutions that may ameliorate language barriers. Emerging studies show older adults' increased use of conversational or voice-based agents, which have become prevalent in everyday mobile devices, due to their ability to generate more natural user interaction than existing user interfaces.[42] These more accessible mobile applications specifically designed for low health and technological literacy and technological support for the TIPS staff to aid translation may generate solutions for the programs that lack resources around language interpretation and translation. Limitations of our study exist, starting with the larger proportion of female (N=1046) versus male participants (N=279). This gender difference, however, is not uncommon—the literature shows that older women are more likely than men to use technology and services.[43] Though there were no significant differences by gender across language or attrition, future work should strive for a balanced sample. Further, MCCs and hospitalization history were self-reported and may not be fully accurate. But there is sufficient evidence of good concordance between self-reported data and medical record review.[44, 45] Finally, retention is measured as a binary outcome, more detail such as time in program could improve understanding of individual behaviors.

Conclusion

The rapid deployment of telemedicine interventions and the changing social and technological environment due to the COVID-19 pandemic brings urgency to fulfilling the needs of all populations without leaving behind the populations that can most benefit from technological innovations. Leveraging technology and community engagement can contribute to community resilience, especially in the face of a public health emergency. By supporting social interactions, community connectivity, and strong system resilience, the probability of successful aging-in-place is more likely. Our study occurred in the areas hardest hit by the initial wave of COVID-19 cases. Our study brings demonstrated viable solution to engaging older adults, while discovering critical challenges that the informatics community can address to support all populations.

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