Rural Older Adult Readiness to Adopt Mobile Health Technology: A Descriptive Study

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Abstract

Purpose: The purpose of this study was to gain insight into the readiness of rural older adults to accept mobile health technology. Results will be useful in the design and delivery of mobile health technology to assist with health management, wellness interventions, and aging in place.

Sample: Convenience sampling was used to recruit 30 participants from two rural Northern California multipurpose senior centers.

Methods: Participants attended a demonstration and participated in a blood pressure screening using a mobile health device followed by a survey. Mixed methods of data collection were used to capture categorical data as well as contextual, socio-cultural, and experiential factors for understanding the potential for future use of mobile health technology by older adults in rural communities.

Results: Participants indicated they wanted control over their health data by choosing when and where to share the information, with the exception of alerts sent in a crisis situation. Results were evenly split on the importance of using technology to connect with patient education and support groups on-line. Important facilitators that would promote adoption of mobile health technology include ease of use, convenience, and affordability. Barriers to adoption include moderate concern with risk to the privacy and security of their health information, and high cost.

Conclusion: Mobile health technologies that are easy and convenient to use, affordable, and a good fit for each individual have the potential to facilitate patient engagement, patient empowerment, and individual responsibility for health and wellness. Additional nursing research on innovative models of care is needed to validate and promote mobile health technology for the health and aging in place needs of rural older adults. Rural nurse leaders can take the lead to innovatively leverage mHealth technology solutions that impact rural health and wellness.

Keywords: mHealth, Rural, Older Adults, Age in Place

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With knowledge gained through research and advances in health care delivery, people are living longer with multiple chronic illnesses. Rural older adults are more likely than their urban counterparts to have chronic illnesses and face more barriers in accessing health care (Goins & Krout, 2006). Limited health care resources and the reduced availability of formal and informal caregivers, services and support for frail older adults living in rural communities, result in a multitude of pressing health care problems that need to be addressed (Milligan, 2009). Innovative programs incorporating remote and home-based care solutions, developed with a focus on the unique needs of the aging population of rural older adults to promote wellness, and prevent and manage chronic illness, are possible solutions.

Innovative health care approaches, such as mobile health technologies (mHealth), have the potential to increase access to care, reduce health care costs and assist older adults living in rural communities to "age in place," as appropriate. The Centers for Disease Control and Prevention define aging in place as "the ability to live in one's own home and community safely,

independently, and comfortably, regardless of age, income, or ability level" (Farber & Shinkle, 2011, p. 15). Technology to assist aging in place can be cost effective, enhance quality of life, and promote positive outcomes for older adults (Center for Technology and Aging, 2011). Mobile smartphones along with other mobile technologies offer a myriad of applications that measure, monitor, store, and share health information. Mobile monitoring devices enable individuals to record real-time health measures allowing timely exchange of health information with clinicians. Real-time monitoring can detect a problem and alert a health care provider regarding condition alterations before the patient deteriorates to the point of requiring emergency treatment and more costly care scenarios. Users can also get personalized feedback and health reminders with access to health information, social networking, and discussion forums to share and benefit from collective experience. Mobile health technologies can overcome the limitation of distance and local access to health care faced by older adults living in rural areas. The growing adoption of smartphones and mobile health technology offers a potentially practical solution to health management for rural older adults who strive to age in place.

Rural nurses can provide the technology link to health care delivery through research, assessment, planning, implementation, teaching, and evaluation of mobile health technology. The Institute of Medicine's Future of Nursing: Leading Change, Advancing Health report outlines expanding "opportunities for nurses to lead and diffuse collaborative efforts to improve health outcomes and reduce costs" (Institute of Medicine [IOM], 2011, p. 2). Recommendation #2 supports this goal by calling for private and public funders to collaborate on advancing models of care for innovative solutions that will enable nurses to improve health and health care. This recommendation also calls for health care organizations to support nurses in taking

the lead in developing and adopting innovative patient-centered care models. Furthermore, nursing education programs can provide entrepreneurial professional development that will enable nurses to initiate programs and businesses that will contribute to improved health and health care (IOM, 2011).

Nurses and other health care providers are needed to champion mHealth with their colleagues and patients. As nurse leaders, we are challenged to identify, develop, implement, and evaluate innovative solutions to assist with chronic disease management and aging in place.

Rural Health/Chronic Illness/Aging in Place

Rural older adults experience disproportionately high rates of chronic illness and limited access to adequate health care services. In a 2006 study, Sharkey and Bolin concluded that many factors, such as increased rates of poverty and limited availability of health care resources contribute to this problem. While the personal and financial consequences of chronic disease are greatest for those who become ill and their families, we as a society cannot ignore the impact that chronic disease has on all health care resources and expenditures.

The rising rate of chronic disease is a key contributor to the growth in health care expenditures. The Centers for Disease Control and Prevention [CDC] (2011) report that among the older adult population, “about 80% have at least one chronic condition, and 50% have at least two” (p. 2); accounting for over 75% of health care costs. The prevalence of chronic disease combined with the fact that 18% of the United States age 65 years or older live in areas designated as rural (National Rural Health Association, 2007), validates the need for studies of solutions that improve clinical outcomes and reduce chronic care costs. Added to this is the challenge of increasing access to adaptive technologies that can assist rural older adults to remain independent and living in their communities.

A 2011 report by the National Conference of State Legislatures and the American Association of Retired Persons (AARP) Public Policy Institute (Farber & Shinkle, 2011) stated that 90% of people age 65 and over want to age in their own homes as an alternative to long-term care. Safely aging in the familiar surroundings of home and community offers many benefits that support health and life satisfaction. However, the report also addressed the issue of isolation faced by many who choose to age in their own homes. Lack of available transportation is a significant barrier to needed services, and lack of contact with others may lead to depression and poor health outcomes. This is especially true for rural older adults who may not have the breadth of transportation options and support services that are available in metropolitan areas (Farber & Shinkle, 2011). The concept of 'aging in place' requires a system to support older adults so they may safely and comfortably remain in the environment of their choice with appropriate services (Rantz, Skubic, Miller & Krampe, 2008). Emerging mobile health technologies that improve on existing home monitoring methods offer promising solutions to increase access to care, lower health care costs, provide opportunities for socialization, and assist aging in place.

Remote Health Monitoring Technology

Modern technology presents an opportunity to enhance the quality of life and independence of older people and their caregivers. Home health monitoring, remote monitoring, telehealth, telecare, and mHealth technology are terms used to describe any technology that enables the health monitoring, evaluation, and management of an individual over distance through a remote interface (Center for Technology and Aging, 2011). Clinical data such as vital signs, medication management, physical and cognitive status, and environmental conditions can be transmitted by telecommunications technology to a health care provider for review,

management, and patient education. Ease of use is a concern of many emerging technologies and a potential barrier to adoption. Tablets, smartphones, and e-readers are relatively easy to use and age does not have to be a barrier. Many older adults are already accustomed to using everyday technology such as those incorporated into automobiles, various electrical appliances, and automated teller machines (ATMs).

A prime example of the use of technology to support chronic illness management has been developed by the Veterans Health Administration (VHA), the largest integrated health system in the United States. As part of the VHA's commitment to increase non-institutionalized care for aging veterans with chronic conditions, a national home telehealth program was introduced in 2003. The VHA piloted and subsequently instituted the Care Coordination/Home Telehealth (CCHT) program to support veterans with chronic care management using electronic monitoring in their homes. The program was implemented as an adjunct to its health information technology infrastructure, as they transitioned the majority of care from hospital-based to an outpatient focus. A key case report on the VHA CCHT program showed a significant decline in hospital utilization. Between 2003 and 2007 a total of 43,430 patients were enrolled in the program. Between 2006 and 2007 satisfaction surveys were administered to 42,460 participants every three months. Sixty percent of the CCHT population responded with a mean satisfaction score of 86%. Outcomes data were reported for 17,025 enrolled patients, including both rural and urban residents, between 2006 & 2007. Participants included in the outcomes study ranged in age from 20-98 (mean age 65), with the majority of patients (9,410), in the 50-69 age range. The results indicated that there was a 29.2% reduction in hospitalizations among the 9,880 urban patients, a 17% reduction among the 6,782 rural patients, and a 50.1% reduction among the 294 patients living in highly rural or frontier areas.

The cost of the program is $1,600 per patient per annum (Darkins, et al., 2008). The VHA attributed the success of this program to its comprehensive and systematic approach to the unique clinical needs of each patient, extensive education of care coordinators, integration into the VHA's existing computer based record system, and routine monitoring of quality and performance data. This innovative program provided a solution to the changing demographics of veterans who are living longer and choosing to live at home with chronic disease versus institutional care, including the 32% of the veteran population who are residing in rural areas (Darkins, et al., 2008). Although this landmark study included a significant number of rural participants (42%), the majority of participants (58%) lived in urban areas. Additionally, this study only addressed the veteran population; with an age range of 20 to 98, and 96% of the participants were male, which limits the generalizability of the study. This study also did not report how often care coordinators had direct contact with patients. Yet despite these limitations, there is currently no other study of this size and complexity for comparison.

However, the limited research to date suggests that the use of technology can "increase the time that older adults can live independently outside of institutions, relieve caregiver strain, and provide a cost effective means of providing care while reducing clinical visits" (Calvert, Kaye, Leahy, Hexem & Carlson, 2009, p.1). Overall, home care technology has the potential to enhance the diffusion and sharing of health information and health care (Gamm & Hutchison, 2004). This may be of particular significance to rural older adults provided that we can reduce the digital divide that exists between the urban-rural and young-old populations.

Digital Divide

The Rural Assistance Center is a national resource center for rural health and human services information (http://www.raconline.org) and provides a link to the report by Kruger and

Gilroy (2013) which defines “digital divide” as the disparity in effective access to digital and information technology among people of certain demographic groups such as rural dwellers, lower socioeconomic classes, older adults, and those with disabilities. This term also includes the differences in the ability and skills required to participate in using technology resources. Important findings from the Pew Internet and American Life Project indicate significant progress in closing the gap. Among a sample of 2,254 adults age 18 and over, data on digital differences indicate that as of April 2012, 53% of adults age 65 and older use the Internet. This is a marked increase from 41% in 2011, and 12% in 2000 using similar samples. According to the Pew research findings, a higher level of education and income correlates with higher adoption and use of technology (Zickuhr & Smith, 2012). Cellular phones, varying from basic handsets to smartphones, are the most popular mobile devices in use in the United States today. As of April 2012, results from the Pew Internet and American Life Project survey indicated that 69% of Americans age 65 and older own a cellular phone, an increase of 8% from May of 2010 (Zickuhr & Madden 2012). A subsequent Pew research survey of 3,014 adults 18 and older, including 29% of whom lived in rural areas, in 2012 indicated that 11% of adults age 65 and older (n=830) owned a smartphone. Fox and Duggan’s research (2012) indicated that 9% of those age 65 and older (n=599) reported using their cellphone to access health information, and 10% (n=105) report using health applications on their smartphone (Fox & Duggan, 2012). The number of people who access health information using their cellphones has nearly doubled in the past two years. The only groups that did not report a significant increase in this activity were those ages 65 and older and those who did not graduate high school. Other studies suggest that there has been a slow but steady increase in adoption of mobile technology among older adults, however, cellphone ownership is far more common among younger adults. Although great

strides have been made in closing the digital divide for rural residents and older adults, there are still some key challenges.

According to the 2010 U.S. Census only 61% of rural adults have mobile broadband or other Internet services in their homes as compared to 73% of urban adults (U.S. Department of Commerce, 2010). Data from the U.S. Census show that, of all rural Americans with Internet access, only 57% have high-speed (broadband) connections in their homes compared with 70% in urban households (National Telecommunications & Information Administration, 2011). Technology has the potential to strengthen support for rural older adults; but might not be a viable option for people in areas that lack technical infrastructure, or for those who are not computer literate, have sensory limitations or have marginal economic resources.

Acceptance of Health Technology

Perceived usefulness with direct benefits and proficiency in learning to use new technologies are fundamental predictors of user acceptance (Mahoney, 2011). A study conducted with 61 urban and suburban Australian older adults by Wade, Cartwright and Shaw (2012), found that perceived usefulness and ease of use of telehealth by frail older adults and caregivers correlated with their acceptance of these systems as a therapeutic tool. The investigators concluded that there is limited knowledge about other facilitators and barriers to telehealth compliance by this group, who are potentially a significant user group of health technology in the future. This study was conducted exclusively in Australia, did not include rural older adults, and was limited by its small sample size.

Over the past few decades there have been many studies conducted in an effort to gain knowledge of the factors that influence technology acceptance. A key systematic literature review funded by the National Library of Medicine was performed to identify factors promoting

consumer health information technology (CHIT) acceptance (Or & Karsh, 2009). The report highlighted the importance of considering user characteristics to predict patient acceptance and guide implementation. A total of 52 articles met five inclusion criteria of (1) determining characteristics associated with acceptance of CHIT, (2) the object of the CHIT was to promote health, well-being, or self-care, (3) individuals studied were patients, (4) the article was written in English, and (5) the article was published in a peer-reviewed journal or research conference proceedings. Nineteen of 39 studies reported that higher age was a significant negative predictor of acceptance. Gender had no effect on acceptance in 84% of the studies that tested for this variable. Sixty-eight percent of 28 studies that examined education found acceptance to be positively associated with higher education levels. Fifteen of 20 studies found a positive correlation between prior experience with computer and/or health technology use. Only seven of the 52 studies tested for both perceived usefulness and perceived ease of use, and all reported these factors were reliable predictors of technology acceptance. The two studies that tested for self-efficacy reported this to be a significant positive predictor of acceptance. The review also reported on two studies that indicated physical, visual, and cognitive limitations to be possible negative predictors of acceptance. The authors acknowledged that indicators such as social influence, culture, and group norms were not examined in any study reviewed. These have been predictive factors in prior technology acceptance studies that did not include health care technology. The authors mention that patients may be more receptive to CHIT if their health care providers, children, or grandchildren urge them to use it (Or & Karsh, 2009). This systematic review is limited to general consumer computer-based systems for health information access and exchange; it did not specifically mention mobile health technology. The review did not address vulnerable or rural populations, and did not specify if any of the studies

examined older adults exclusively. Despite a thorough literature review, specific studies addressing the accessibility and use of mobile health technologies for rural older adults were not found. Studies that address the potential of mobile health technology to assist rural older adults using key theories to provide a framework for explaining and predicting phenomena that support and inform research are needed.

Conceptual Framework

Two conceptual models were used to inform this study, the Adoption of Technology Model (Mahoney, 2011), and Rural Nursing Theory (Long & Weinert, 1989). Each of these models will be described along with their application to the study.

The Adoption of Technology Model (Figure 1) was developed by nurse researcher, Diane Mahoney (Mahoney, 2011). This model is an adaptation of diffusion-of-innovation theory that suggests which factors determine whether an innovation is adopted or not (Rogers, 1995); with integrated aspects from the trans-theoretical behavioral change model (Prochaska, 1997), which outlines specific stages of readiness for change and assesses the processes of behavioral change affecting whether or not one adopts and uses an innovation. This model considers the factors that lead to adoption or rejection of technology-based interventions by frail and cognitively impaired older adults and their family caregivers. The model identifies socio-demographic characteristics as pre-disposing factors; and enablers and barriers as mediating factors leading to proximal outcomes of adoption or rejection. If the technology is adopted it leads to distal outcomes variables such a peace of mind, security, and well-being. The keys to adoption of technology, according to the model, are an individual's willingness to learn about and use the product, and their ability to perceive direct benefits. Another key to adoption of intervention technology is a product tailored to the individual needs of older adults and their caregivers.

Other considerations of this model include affordability, the issue of safety versus independence, privacy, security, and whether or not the individual views the technology as dehumanizing. Enabling factors must be able to overcome perceived barriers including loss of privacy and intrusiveness concerns, and information overload. Due to the recent development of this model it has not been tested in empirical research.

Long and Weinert's (1989) Rural Nursing Theory was also used to direct inquiry in this study. According to this theory, rural health care perspectives vary greatly from those in urban and suburban areas. Rural dwellers define health as the ability to work, be productive, and/or do usual tasks. This belief often leads rural dwellers to put work priorities ahead of health care needs. Time and distance to receive health care, as well as cost, are of concern to rural individuals. Many will self-treat to save time and money or will wait until their health is severely compromised before traveling for care. Rural dwellers tend to be self-reliant and resist services from those seen as outsiders. Health care recipients and health care providers in rural areas must also deal with a lack of anonymity. Due to limited rural health care resources and specialties, health care workers also experience much greater role diffusion than their urban and suburban counterparts (Long & Weinert, 1989).

A recent review of the current state of rural nursing science concluded that descriptive-correlational studies of disease management were the most common foci of research. The authors suggest that further testing of rural concepts as independent variables is needed to investigate how these concepts affect outcomes to develop evidence based knowledge and further develop the specialty of rural nursing (Williams, Andrews, Zanni & Fahs, 2012). Additional research related to health perceptions, health care needs, and technology for health in differing areas is needed to develop health programs and shape rural health policy.

Figure 1. Adoption of Technology Model

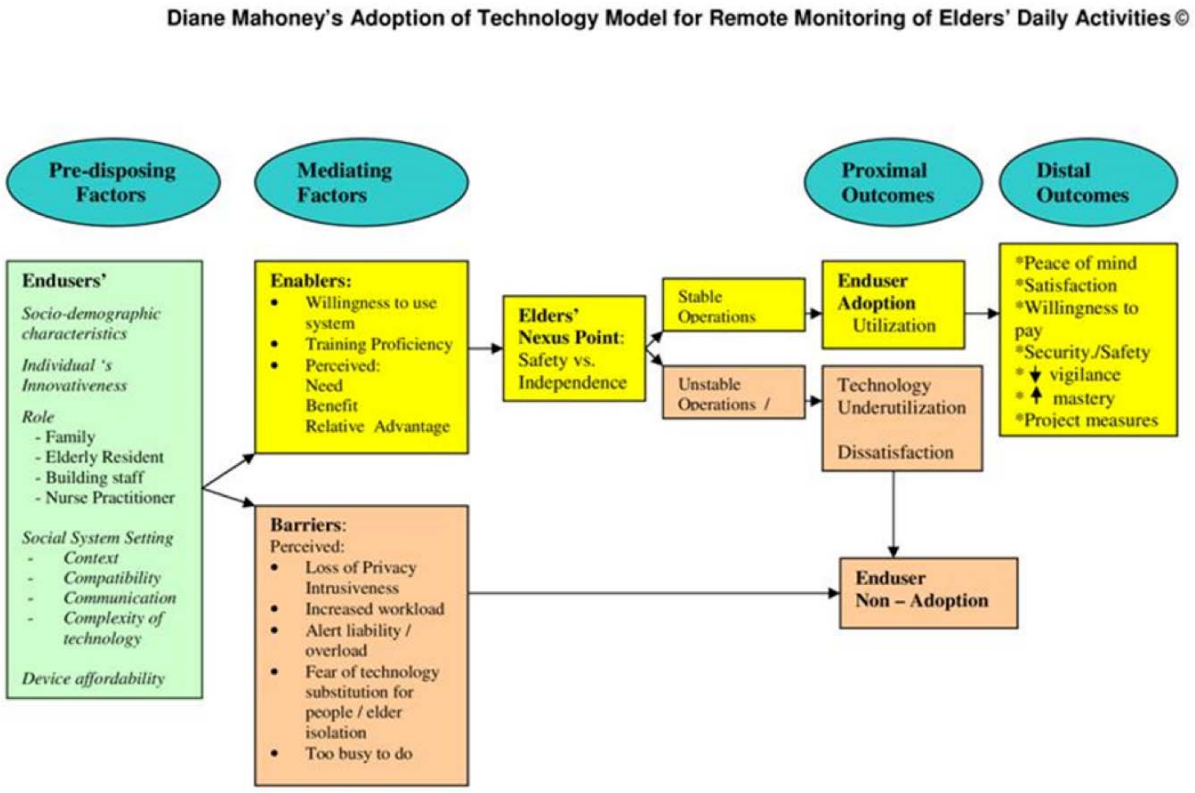

Figure 1. Details of the Adoption of Technology Model Copyright 2010 by D. Mahoney. Reprinted with permission.

Purpose

The purpose of this study was to identify facilitators and barriers to the use of mobile health technology among rural older adults. The following research questions were addressed:

1. What is the level of readiness for rural older adults to adopt mobile health technology?
2. What identified facilitators would promote adoption of mobile health technology?
3. What identified barriers would impede adoption of mobile health technology?

Methods

Design

A descriptive exploratory research design was used in this study. Quantitative and qualitative data collection by survey was used to capture categorical data, including the contextual, socio-cultural, and experiential factors for understanding the potential for future use of health technology by this population. The survey was designed to obtain information on demographics, technology and mobile device use, as well as opinions regarding how participants would like to use technology and mobile devices for health care.

Setting and Sample

This study took place in the fall of 2012 at two Northern California rural multipurpose senior centers serving the 60-plus population. Both senior centers are located within California's rural gold country at the foothills of the Sierra Nevada Mountains. The Calaveras Senior Center is located in San Andreas, California. According to the 2010 U.S. Census, the total county population is 45,578. With 1,020 square miles of land area, the population density is 44.7 people per square mile. Of this population total, 21% (n=9,565) are over the age of 65. Among those age 65 and older 10.3% (n=1,942) live alone. The majority of the population is white (92.6%), and 19.6 % of the population age 25 and above has attained a bachelor's degree or higher (United States Department of Commerce, 2010).

The Amador Senior Center is located in Jackson, California. The Amador County population is 38,091. With 595 square miles of land area, the population density is 64.1 people per square mile. Of this population total, 20.6% (n=7,865) are over the age of 65. Among those age 65 and older 10.5% (n=1,545) live alone. The majority of the population is white (87%) and

19% of the population age 25 and above has attained a bachelor's degree or higher (United States Department of Commerce, 2010).

Convenience sampling was used, recruiting participants before or after lunch at the senior centers. Inclusion criteria included adults age 60 years and older. Non-English speaking people were excluded from participation in the survey, as it was written in the English language only. Thirty participants chose to have the blood pressure screening and fill out the 16-question survey. A description of the sample demographics is included in the Results section that follows.

Procedures

This study was approved by the UC Davis Institutional Review Board protocol number 362813-1, prior to data collection. Participants were provided with an informational consent form describing the purpose of the study and contact information for further questions prior to the presentation, blood pressure screening, and data collection. A presentation on blood pressure measurement and monitoring using an iPad and iHealth blood pressure system and application was given. Participants were then given the option to have a free blood pressure screening using the system. The demonstration concluded with participants anonymously answering a 16-question survey directed at the three research questions. Participants were given the option to have the blood pressure screening without completing the survey, and were also given the option to complete the survey without having the blood pressure screening. All participants chose to have both the blood pressure screening and complete the survey.

The 16-question paper and pencil survey was developed after evaluating several similar surveys on older adults and technology use. Quantitative and qualitative questions were incorporated into the survey. Demographic data were collected including age, gender, level of

education, number of years living in the area, number of miles from a health care provider, and inquiry on experience with technology, mobile devices, and the Internet. Questions about technology use for health care were structured using a five point Likert scale. Demographics, technology, and mobile device use data were collected using quantitative inquiry to develop a profile of the participants. Qualitative inquiry was added to capture the rich detail of people's personal experiences of phenomena related to the local context. Questions on how participants would use technology and mobile devices were designed based on the Adoption of Technology Model and Rural Nursing Theory to address the three research questions. Institutional Review Board approval was obtained prior to commencement of the study and data collection. Data were entered into an Excel spreadsheet and descriptive statistics were generated for each survey question, including frequencies and percentages for categorical data. Ordinal data were analyzed for mean, standard deviation, and range. Qualitative data from the open ended questions were content analyzed by two nurse researchers to identify recurring themes.

Results

Description of the Sample

Table 1 summarizes the demographic data that were provided by the 30 participant convenience sample of the rural older adult population. All participants were 60 or older, and the majority of respondents (57%) were older than 73. Most (80%) of the participants were female. Educationally, (43%) reported some college, (17%) achieved a bachelor's degree, and (13%) completed a graduated level of education. Eighty percent reported living in the community for over 20 years, including two lifelong residents. Sixty-seven percent reported living within 15 miles or 30 minutes proximity to their health care provider.

Survey questions six through 10 provided further information regarding the sample by querying participants' current use of technology and mobile devices (Table 2). The majority of participants (67%) reported using a computer at least several times per week.

Table 1

Characteristics of Study Participants

Technology for Health Survey N = 30		
Variable	n	%
Q1. Gender		
Female	24	80
Male	6	20
Q2. Age		
53 to 62	1	3
63 to 72	12	40
73 to 92	6	20
83 to 92	8	27
93 and over	3	10
Q3. Level of Education		
Less than 12th Grade	1	3
High School Graduate	7	23
Some College	13	43
Bachelor's Degree	5	17
Graduate Degree	4	13
Q4. Length of Time Living in Community		
Less than 6 Months	0	0
Less than 1 Year	1	3
Less than 5 Years	2	7
Less than 10 Years	2	7
Less than 20 Years	7	23
Less than 30 Years	5	17
30 Years or More	10	33
Lifelong Resident	2	7
No Answer Provided	1	3
Q5. How Many Miles/Minutes from Health Care Provider		
Less than 15 Miles or 30 Minutes	20	67
More than 15 Miles or 30 Minutes	9	30
No Answer Provided	1	3

Seventy percent use the Internet, including 53% who use the Internet at home. Seventy percent, however, did not use a smartphone or tablet. Twenty-seven percent reported that they were currently using email or the Internet to communicate with their health care provider.

Table 2

Participants' Technology Experience

Technology for Health Survey N = 30		
Variable	n	%
Q6. Frequency of Computer Use		
Never	8	27
Less Than Once Per Month	0	0
About Once Per Month	0	0
Several Times Per Week	5	17
Daily	15	50
No Answer Provided	2	7
Q7. Internet Use		
Yes	21	70
No	7	23
No Answer Provided	2	7
Q8. Where the Internet is Used		
Home	16	53
Work	2	7
Home and Work	2	7
Community Location	1	3
No Answer Provided	9	30
Q9. Participants' use of Smartphone or Tablet		
Yes	7	23
No	21	70
No Answer Provided	2	7
Q10. Currently Using Email or the Internet to Communicate with Health Care Provider		
Yes	8	27
No	20	67
No Answer Provided	2	7
Q11. Comfort with Communicating with Health Care Provider Using Email or the Internet		
Not At All Comfortable	9	30
Somewhat Comfortable	4	13
Comfortable	7	23

Very Comfortable	3	10
Extremely Comfortable	3	10
No Answer Provided	4	13
Q12. Participants' Interest in Incorporating Using Email, iPads, Cellphones, Text Messages or Other Technology Into Daily Life for Health Tracking and Communication with a Health Care Professional		
I Am Not At All Interested	10	33
I Am Somewhat Uninterested	4	13
I Am Somewhat Interested	7	23
I Am Very Interested	3	10
I Already Use It Today	4	13
No Answer Provided	2	7

Readiness to Adopt Mobile Health Technology

The first research question, "What is the level of readiness for rural older adults to adopt mobile health technology?" was assessed through survey questions 11 and 12 (see Table 2), specifically measuring comfort and interest in using technology for health care. In Table 3, participants' responses related to how they would use mobile devices for health care are summarized. Participants' comfort level with using email or the Internet to communicate with a health care provider was evenly split. Forty-three percent reported either being somewhat comfortable or not at all comfortable communicating with a health care provider using email or the Internet, and 43% were comfortable to extremely comfortable on a scale of 1 to 5 with 1 being not at all comfortable and 5 being extremely comfortable. Responses to interest in incorporating email, iPads, cellphones, text messaging, or other technology into daily life for health tracking and communication with a health care professional indicated that 33% had no interest, 23% were somewhat interested, and 13% indicated that they already used this technology.

Survey questions 14a through 14g provided additional data related to readiness to adopt mobile health technology by measuring participants' level of importance ratings on features of

mobile health technology systems. Participants' responses as to how they would like to use mobile health technology are summarized in Table 3. Sixty-seven percent indicated that it would be moderately to extremely important to use technology to monitor their own health, but would not share this information with a health care provider. (SD = 1.51). Fifty-three percent indicated that it was somewhat or extremely important to monitor their own health and share the information with a health care provider at clinic visits (SD = 1.24). Forty-six percent indicated that it was somewhat or extremely important to monitor their own health and share it over the Internet with a health care provider (SD = 1.44). Fifty-seven percent indicated that it was somewhat or extremely important to monitor their health and send automatic alerts to health care providers and family members when a crisis is detected (SD = 1.35). Fifty-four percent indicated that it was somewhat or extremely important to receive health updates, appointment reminders, medication reminders, and motivational statements from health providers (SD = 1.35). Forty-four percent indicated that it was moderately, somewhat, or extremely important to use mobile health technology in conjunction with periodic in-home nurse visits, while 43% indicated that it was not very to not at all important (SD = 1.41). Forty percent indicated that it was somewhat or extremely important to connect with patient education and support groups on-line, and 37% indicated that it was not very important or not at all important (SD=1.60).

Facilitators of Mobile Health Technology Adoption

The second research question, "What identified facilitators would promote adoption of mobile health technology?" was assessed by survey questions 13a through 13d. Participants were asked to rate their level of agreement with four statements regarding the use of email, iPads, cellphones, text messaging, or other technology for monitoring health. Table 4 summarizes expressed facilitators of mobile health technology adoption. Seventy-four percent

agreed or strongly agreed that it must be easy to use (SD = 0.56). Seventy-six percent agreed or strongly agreed that it must be convenient to use. Eighty percent agreed or strongly agreed that it must be affordable. Seventy-seven percent agreed or strongly agreed that it must have a clear benefit to health and well-being.

Table 3

Readiness to Adopt Mobile Health Technology

Q14. Would Use Mobile Technology For

Technology for Health Survey N = 30		
Variable	Mean	SD
Q14a. To Monitor Health, but Not Share the Information with a Health Care Provider	2.88	1.51
Q14b. To Monitor Health and Share the Information with a Health Care Provider at Clinic Visits	2.17	1.24
Q14c. To Monitor Health and Share the Information with a Health Care Provider Over the Internet	2.48	1.44
Q14d. For Health Monitoring with Automatic Alerts Sent to Health Care Providers and Family Members When a Crisis is Detected	2.08	1.35
Q14e. To Receive Health Updates, Appointment Reminders, Medication Reminders & Motivational Statements From a Health Care Provider	2.20	1.35
Q14f. In Conjunction with Periodic In-Home Nurse Visits	3.22	1.41
Q14g. To Connect with Patient Education and Support Groups On-Line	2.96	1.60

Measured on Likert Scale 1-5, with 1 = Extremely Important & 5 = Not At All Important

It was interesting that one participant mentioned their insurance company as a facilitator, as insurance reimbursement may be the driving force that leads to widespread mobile health technology adoption. The participant stated:

"If my insurance company paid or someone gave me this device and paid for maintenance, I would use it."

Barriers to Mobile Health Technology Adoption

The third research question, "What identified barriers would impede adoption of mobile health technology?" was assessed through survey questions 15a through 15g. Participants were asked to rate their level of agreement with six statements that may discourage them from adopting mobile health technology.

Table 4

Facilitators of Mobile Health Technology Adoption Q13. using Email, iPads, Cellphones, Text Messaging, or other Technology for Monitoring Health.

Technology for Health Survey N = 30		
Variable	Mean	SD
Q13a. Ease of Use	1.30	0.56
Q13b. Convenient to Use	1.30	0.47
Q13c. Affordable	1.21	0.41
Q13d. Clear Benefit for Health and Well-Being	1.42	0.58

Measured on Likert Scale 1-5, with 1 = Strongly Agree & 5 = Strongly Disagree

Table 5 summarizes barriers to mobile health technology adoption. Twenty percent strongly agreed that using mobile devices for health technology is a risk to privacy, and 30% neither agreed nor disagreed with that statement. Thirty-four percent agreed or strongly agreed with concerns about security of health information on mobile devices, and 33% neither agreed nor disagreed.

Forty-seven percent disagreed or strongly disagreed that using health technology will make them look like they need help, while 30% neither agreed nor disagreed. Forty-three percent neither agreed nor disagreed that mobile health technology systems are not designed for

their individual needs. Cost stood out as a concern to many participants. Forty percent agreed or strongly agreed that mobile health technology costs too much to buy, while 37% neither agreed nor disagreed. One participant reflected on concerns by stating:

> "I enjoy technology, but I doubt I would spend any money on health technology. Benefit would have to be high and cost very reasonable."

The final question asked participants about their level of agreement with the statement "I don't like using computers and other technology." Forty-three disagreed or strongly disagreed with that statement, and 20% neither agreed nor disagreed.

Table 5

Barriers to Mobile Health Technology Adoption Q15. Factors that Would Prevent Participants from Adopting Mobile Health Technology.

Technology for Health Survey N = 30		
Variable	Mean	SD
Q15a. Risk to Privacy	2.88	1.33
Q15b. Concerns About Security of Health Information	2.73	1.19
Q15c. Using Health Technology Makes Participant Look Like They Need Help	3.73	1.15
Q15d. Systems Are Not Designed for Individual Needs	3.12	1.27
Q15e. Costs Too Much to Buy and Maintain	2.36	1.08
Q15f.Participant Does Not Like Using Computers and Technology	3.56	1.36

Measured on Likert Scale 1-5, with 1 = Strongly Agree & 5 = Strongly Disagree

In response to the inquiry regarding current use of email or the Internet to communicate with a health care provider, an interesting finding emerged indicating that some are waiting for their health care provider to take the lead in adopting technology and introducing it to them.

Participants responded with statements such as: “occasion has not risen,” “never proposed to me,” and “was not invited to do so.”

Discussion

This study addressed the important topic of health care delivery and chronic care management for frail older adults living in rural populations. This is the first known study to address the potential use of mobile health technology to help fill gaps in health care services and support for frail older adults living in rural communities. It is essential to identify this population’s level of readiness along with identified facilitators and barriers to ensure successful design, implementation, and adoption of mobile health technology solutions. The intent of this study was to explore these variables to better understand how this innovative new technology can best serve the needs of this population.

Summary of Major Findings

In relation to the first research question, “What is the level of readiness for rural older adults to adopt mobile health technology?,” participants were queried on their comfort level and interest in using mobile health technology. Given the majority (57%) of participants were older than 73 years of age, and 80% reported living in the rural community 20 years or more, the principal investigator expected to find that very few would be users of computers and technology. However, 67 % reported using a computer at least several times per week, and 70% reported using the Internet. These results are surprising considering that data collected by the Pew Internet and American Life project in April 2012 indicated that only 53% of adults age 65 and older use the Internet (Zickuhr & Madden, 2012). It was expected that the advanced age of the majority of the participants in this study combined with their rural location, would result in less use of computers and technology. Interestingly though, 30% reported that they use a

smartphone or tablet. These results may be related to the fact that 73% of the participants reported post-secondary education, and Pew reported that higher education is a positive indicator of technology adoption. The term "use" in this case may refer to the fact that they do not necessarily own a smartphone or tablet, but may use one owned by a family member or acquaintance. This finding is in line with data collected in the Pew Internet and American Life Project in August and September of 2012 that indicate 11% of adults 65 or older own a smartphone. Data collected in April 2012 indicate that 53% of seniors use the Internet and email (Zickuhr & Madden, 2012). Internet, email, and on-line social networks can be an important access to social connections and access to care for frail older adults who have difficulty with mobility and leaving their homes.

According to Choi and Wodarski (1996), social support or lack thereof is a significant factor in the health status of older adults. There was an even split in the results regarding the importance of using health technology to connect with patient education and support groups on-line. This may be an indication that rural older adults are adapting to accepting new technology and social media. Mobile health technology that incorporates social networking may be very useful for health and social connectedness of rural older adults. Some evidence suggests that men in rural culture may tend to find it difficult to ask for help. While rural women may rely on friends or family, men tend to rely solely on their wives for support. This leaves rural men at higher risk for social isolation and poor health if they are single or widowed (Weinert & Long, 1993).

Technology can provide the access link to information that helps to assess the seriousness of an illness or injury, and aid with formulating a plan of action for treatment at home or assist with the decision to seek care depending on the symptom-action-time-line concept outlined by

Buehler et al. (1998). Technology like mHealth could also provide a vital link to health tracking and socialization for rural dwellers.

Results regarding interest in using email, the Internet and technology for health tracking and communication with a health care provider were evenly split. This is in sharp contrast to the AARP study which indicated that only 11% of people age 50 and above are interested in using technology to track health measures. The trend in the data may indicate that rural older adults are beginning to adapt to the fact that technology for in-home health care is becoming much easier to use and as commonplace as everyday household appliances. It may also indicate that they recognize the potential of technology to break down the barriers of distance and access to service and view it as a vital link to care and the ability to age in place. The findings indicate that participants want to control their health data by tracking and choosing when and where to share the information. This may be a result of concerns with lack of anonymity and confidentiality that are prevalent in rural culture. There was, however a high level of interest in having automatic alerts sent out for help when a crisis is detected as well as receiving automated health information and reminders. A discussion of facilitators of mobile health technology acceptance in the next section will provide further understanding of acceptance by this population.

In relation to the second research question, “What identified facilitators would promote adoption of mobile health technology?” participants were queried on ease, convenience, affordability, and the benefit of using mobile health technology to health and well-being. Greater than 75% of participants agreed that mobile health technology must be easy and convenient to use, affordable, and must have a clear benefit to health and well-being. These results support the Adoption of Technology model which outlines the user’s perception of a

good fit with their needs and direct benefits as key factors in adoption of health monitoring technology (Mahoney, 2011). These results also support findings that correlate acceptance of technology to perceived usefulness and ease of use (Wade et al., 2012). The results also challenge the common myth stereotyping older adults as afraid of technology. As discussed in the study by Calvert et al. (2008) older adults have adopted many technologies such as microwave ovens and DVD players as they became affordable, easier to use, and provided a direct benefit to meet their needs. These positive results indicate the potential for acceptance of mHealth as a tool to support age- and/or health-related changes and improve quality of life if tailored to individual clinical and cognitive needs.

In relation to the third research question, "What identified barriers would impede adoption of mobile health technology?" participants were queried on factors such as privacy, security, design, and cost that may discourage them from adopting mobile health technology. Privacy and security concerns of governments, health care providers, insurance companies, and patients have been a major limitation in advancing mobile health technology. The study participants were moderately concerned with risk to privacy and the security of their health information while using mobile devices for health monitoring. This finding is consistent with Mahoney (2011) finding that 67% of the 60 participants expressed concerns about loss of privacy, and 50% perceived a sense of "big brother" watching over them. Concerns about privacy can also be linked to Long and Weinert's Rural Nursing Theory concept of insider/outsider and whether a mobile health technology system and the support services connected to it would be considered an intrusion by outsiders (Long & Weinert, 1989). It is interesting that a high percentage of survey respondents indicated the importance of periodic in-home nursing visits in conjunction with mobile health technology use. The survey question did not specify whether the nurse

would be known to the patient or not. Most disagreed that using health technology will make them look like they need help. This response may account for the fact that new technology such as iPads and iPhones and associated applications have many uses and cannot be distinguished exclusively as assistive devices. To reduce the possible stigma attached to relying on a device to remain safe and independent, commonplace technology devices such as cellphones and tablets can be customized to meet individual health and wellness needs. A surprising finding in this study was that the majority of participants responded with a neutral answer when asked if they thought mobile health technology system design did not consider individual needs. This is contrary to the European study findings that indicated the importance of considering the perspective of older adults in designing technology systems to meet their care needs (Milligan, Roberts & Mort, 2010). Systems design must take into account that some individual patients and families are no longer passive recipients of care, but crucial and active members of the care team involved in all aspects of the plan of care. Not surprising, were the number of participants who responded that technology costs are too high. This finding related to results of the VHA study which showed the value of home monitoring technology in reducing hospitalizations and ultimately reducing health care costs in urban as well as rural populations (Darkins, et al., 2008). This finding and the VHA study results also demonstrated the value to the insurer to take a vested interest in reducing the cost of health care. Until the costs of mobile health devices are covered by insurance, it will be up to rural older adults and their families to weigh the benefits versus risks and cost-effectiveness of adopting. Will strong ties to land and home be enough of a motivator? If it gives them the opportunity to age in place instead of long-term care, will they adopt? These questions, along with studies that determine outcomes and cost analysis, need to be addressed with further research.

Limitations

A number of limitations of this study should be noted, in particular its small sample size. The survey was written in the English language only as most of the population was presumed to be white and English speaking. The high level of education reported by study participants is not likely a true representative of rural older adults in general. For the purpose of obtaining a convenience sample of rural older adults age 60 and above, this study was conducted at two rural senior centers. Both senior centers were located within the county seat, which offers health services and other conveniences not typical of many rural communities. Further study and replication with varied rural populations is needed to confirm the findings.

Implications

The emergence of smartphones and tablets has transformed communications and changed the way in which we access information and perform everyday transactions such as banking and shopping. The time has come for this technology to transform how health care is delivered to empower the patient, increase access, and lower the cost of health care. Mobile health technologies are rapidly evolving as a means to track health measures and deliver interventions that can be tailored to the individual. mHealth has the potential to improve the practitioner-patient relationship by improving communication and providing more accurate data to providers while increasing the patient's participation in their own health care. Health care providers need to take the lead and encourage adoption as older adults tend to trust in and turn to their providers for the best advice on health care and health care devices, thus provider buy-in will play a pivotal role in patient-focused adoption of mobile health technology, especially in the rural setting. Additional nursing research on these innovative models of care is needed to validate and promote mobile health technology as a viable strategy for the health care and aging

in place needs of rural older adults. Further development and testing of theory such as the Acceptance of Technology Model is needed to provide a framework that outlines aspects of research inquiry for mobile health technology specifically. Nursing education programs can facilitate research and technology transformation by offering educational development and programs that empower nurses with skills that advance mobile health technologies to improve health and health care. Policy makers are challenged to coordinate infrastructure, regulatory, and reimbursement models to enhance and sustain emerging mobile health technologies.

Conclusion

This study addressed the important topic of health care delivery and chronic care management for older adults living in rural populations. There is a critical need for appropriate and cost-effective innovations that overcome geographical barriers to promote quality health care. Emerging mobile technologies with health care applications will alter the time and place of health care delivery, and potentially improve health care outcomes for those in underserved areas including older adults in rural populations. Mobile health technology that is easy and convenient to use, affordable, and a good fit for each individual has the potential to facilitate patient empowerment and individual responsibility in the areas of health and wellness. Utilizing technology requires an interprofessional team approach in which rural nurse leaders can take the lead to innovatively leverage mHealth technology solutions that impact rural health and wellness. If we can get programs into the community to help people better care for themselves, we can improve health and reduce the burden on the health care system that we have now. Innovative solutions such as mobile health technology have the potential to increase access to care, reduce health care costs and assist older adults living in rural communities to "age in place." The results of this study present important implications for the future use of mobile

health technology to help fill gaps and improve quality in health care delivery for rural older adults.

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