



Remote patient monitoring acceptance trends among older adults residing in a frontier state



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ABSTRACT

This pilot study aims to present a methodological approach for investigating remote patient monitoring system acceptance trends for older adults residing in a frontier state. For this purpose, extended Technology Acceptance Model (TAM) variables, which included *subjective norm*, *perceived usefulness*, *perceived ease of use*, and *behavioral intention* were investigated using growth curve methods and modern resampling techniques. Results revealed our methodological and analytical approach shows promise for investigating technology acceptance over time on subjects where little literature exists and where recruiting adequate sample sizes for statistical power purposes may be challenging. Results of the data analysis showed there was a significant and reliable linear trend on subjective norm. Time did not predict perceived usefulness, perceived ease of use, or behavioral intention, indicating the levels of these factors were high and stable over the course of the study. Older adults accepted remote patient monitoring, and family and friends may influence technology acceptance promoting behaviors. The longer participants used the technology, the more they perceived those important to them would want them to use it. Attention to social influence to optimize the implementation of in-home health monitoring among this population is warranted. Recommendations for future research are provided.

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1. Introduction

Approximately 22% of U.S. older adults reside in rural regions. A commonly accepted definition of rural is an area with a population of <50,000 (U.S. Census Bureau, 2011). Frontier states are a particular strata of rural regions. The Patient Protection and Affordable Care Act of 2010's (ACA, 2010) defines a 'frontier state' as a state with at least 50% of the counties that have an average population density of six or fewer people per square mile. These states include South Dakota, North Dakota, Montana, Wyoming, and Nevada. Data indicates older adults residing in four of the five frontier states are approximately two times more likely to live in a rural region than the national average. The exception to this trend is Nevada, where only 8.2% of older adults reside in rural regions (U.S. Census Bureau, 2011).

Rural areas have a greatest proportion of adults over the age of 85, and compared with urban older adults, rural elderly individuals engage in preventative medical care less often and have an increased likelihood of multiple chronic conditions (Hutchison, Hawes, & Williams, 2005). Prevalence of chronic diseases such as diabetes, cancers, arthritis, and heart disease is higher among rural residents than among other segments of the population (Murray et al., 2006; Wingo et al., 2008). Factors that are highly correlated with poor health outcomes such as lower educational attainment and lower incomes are also more widespread in rural areas of the U.S. (Behringer & Friedell, 2006). Additional burdens for rural older adults living with chronic conditions include decreased access to physicians, hospitals and routine medical care.

Just 10% of physicians in America practice in rural areas even though 25% of the U.S. population lives in these regions (Barley, Reeves, & O'Brien-Gonzales, 2001). Those living in rural communities are often geographically isolated, lack public transportation options, and have to travel long distances to access health and social services (Hartley, 2004; Krout, 1998). In the Rural Healthy

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People 2010 survey, access to quality health services (including access to primary care) was ranked as the top rural health priority with about 75% of respondents naming access as a priority (Gamm, Hutchinson, Bellamy, & Dabney, 2002). Social isolation and financial constraints further complicate rural older adults' health (Goins, Williams, Carter, Spencer, & Solovieva, 2005).

Remote patient monitoring (RPM) (Field & Grigsby, 2002) has been proposed as a creative option to increase access to rural areas (Nelson & Gingerich, 2010). Remote patient monitoring (RPM) has been defined as the use of information technology and electronic communication to allow interaction between patients and health care providers located in different geographical locations ([ATA]; American Telemedicine Association, 2013). RPM interactions can include two-way video consultations with a physician or health care provider, constant remote measurement of vital signs or automated or phone-based check-ups of mental and physical well-being. Health monitoring is a promising approach for improving access to care and improving health outcomes by making it possible to monitor patients remotely so health care providers can intervene promptly if there is evidence of health status deterioration (Chaudhry et al., 2010; Wang et al., 2009; Zhou et al., 2009).

Given the geographic isolation and health care disparities older adults residing in rural and frontier areas encounter, there is a critical need to put forth a methodology for investigating remote patient monitoring acceptance trends for geographically isolated older adult populations where recruiting adequate sample size for statistical power purposes may be difficult. For this purpose, a methodological model is presented which reflects the Technology Acceptance Model (TAM; Davis, 1986) and modern, robust statistical methods used to maximize the accuracy and power of imperfect sample sizes (Erceg-Hurn & Mirosevich, 2008).

2. Calculation

2.1. Limited data on frontier health monitoring acceptance

The use of telemedicine to provide care for rural patients is expected to increase given that physicians are generally concentrated in large metropolitan regions (American Medical Association, 2012). Prior studies have explored and reported positive health outcomes related to remote monitoring (ATA, 2013; Chaudhry et al., 2010; Varma, Michalski, Stambler, & Pavri, 2014) and reported older adults' perspectives on in-home health monitoring technology (Demiris, Oliver, Giger, Skubic, & Rantz, 2009; Demiris et al., 2004; Mann, Marchant, Tomita, Fraas, & Stanton, 2000; Wild, Boise, Lundell, & Foucek, 2008). Results from these studies have been positive and suggest older adults are willing to accept technology. Yet, there is no known research specifically investigating rural older adult acceptance of in-home health monitoring technology, let alone frontier older adult acceptance. This gap in literature is problematic as technology adoption rates among rural citizens in the U.S. are lower when compared to national averages (U.S. Department of Commerce, 2011).

2.2. Technology Acceptance Model

A theoretical extension of the Technology Acceptance Model (TAM) provided the conceptual framework for this study (Venkatesh & Davis, 2000). The original TAM (Davis, 1986, 1989) was adapted from the theory of reasoned action (Fishbein & Ajzen, 1975) and predicts why end-users accept or reject a technology innovation. The TAM is empirically supported by meta-analytical studies (King & He, 2006) and typically explains around 40% of the variance in technology usage intentions and behavior (Venkatesh & Davis, 2000).

The original model consisted of perceived usefulness (PU), perceived ease of use (PE), attitude toward using (ATT), behavioral intention (BI), and actual technology use (Davis, Bagozzi, & Warshaw, 1989). TAM theorizes a person's behavioral intention to use a technology is determined by two key beliefs, perceived usefulness and perceived ease of use. Building on the theoretical support for the TAM (Davis, Bagozzi, & Warshaw, 1992; Lee, Kozar, & Larsen, 2003), others have reported that subjective influences such as an individual's belief that those important to them or those influencing their behavior would want them to use a technology should be a focus of technology adoption (Taylor & Todd, 1995). More recently researchers found social influences improved the predictive ability of the TAM (Schepers & Wetzel, 2007; Venkatesh & Davis, 2000). Based on these findings, TAM was re-conceptualized as TAM2 (Wu, Chou, Weng, & Huang, 2008).

2.3. Hypotheses

Researchers have recently focused on factors that influence older adult adoption of technology (Braun, 2013; Lian & Yen, 2014; Pan & Jordan-Marsh, 2010; Ryu, Kim, & Lee, 2009). More specifically, they have been interested in assessing ephemeral states of subjective norm, usefulness, ease of use, and behavioral intention (see Chung, Park, Wang, Fulk, & McLaughlin, 2010). Since cross-sectional acceptance may not necessarily lead to acceptance over time (Lee et al., 2003), this study seeks to investigate the influence time has on acceptance. This study draws on both TAM as our theoretical framework and previous research which found older adults accept in-home monitoring technology and they tend to become more familiar with and confident using home health technology after prolonged participation with a technology (Demiris, Speedie, & Finkelstein, 2001; Veerle, Els, Joz, & Koen's, 2014). Therefore, we anticipate technology acceptance among our participants will increase in a linear trend over time. Extending the prior literature, we proposed the following hypotheses:

- H1.** There is a linear trend of subjective norm among older adults residing in a frontier state.
- H2.** There is a linear trend of perceived usefulness among older adults residing in a frontier state.
- H3.** There is a linear trend of perceived ease of use among older adults residing in a frontier state.
- H4.** There is a linear trend of behavioral intention among older adults residing in a frontier state.

3. Methods and materials

3.1. Procedure

Obstacles exist when using technology to collect patient health data (Haigh & Yanco, 2002). Due to the lack of research and the absence of a known methodological framework guiding researchers investigating frontier older adult acceptance trends, we were concerned our study approach might be perceived by community and organizational leaders and staff as too complex and risky. Our concern related to the contribution complexity and risk play in the diffusion of innovations in service organizations (Greenhalgh, Robert, Macfarlane, Bate, & Kyriakidou, 2004). Additionally, we were sensitive of the existing research that suggests a prevailing "rural culture", characterized by a strong sense of

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