Anticipated needs and worries about maintaining independence of rural/remote older adults: Opportunities for technology development in the context of the double digital divide

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Understanding user needs is fundamental to the development of useful technology. Rural/remote older adults are vulnerable due to restricted access to local supports and services and are, therefore, the quintessential end-users for assistive technology development. A sample of 337 older adults (M = 69.5; SD = 6.89; range 60-87 years old) was recruited from randomly selected telephone numbers (land lines and cell phones) listed for persons residing outside metropolitan areas of a mid-west region in Canada. Participants responded to an open-ended question regarding a time when they needed assistance, and data were thematically analyzed (with NVIVO for support). Most described needing physical assistance due to strength limitations or various medical conditions, and many described needing help using technology (such as turning on a computer or burning a CD). An open-ended question was also asked regarding older adults' 'worries' about maintaining independence as they advanced in age. Although almost one third of the sample denied any worries associated with aging, almost a quarter of the sample reported worries were related to aging in the context of geographic isolation and lack of accessible services. Additional worries were characterized as general anxiety about independence, taking care of their home, and moving into assisted or residential living. These data suggest technology developed to augment physical tasks will be critical for rural/remote older adults but also highlights the need for intuitive and useable technologies that mitigate geographic isolation and increases accessibility of services. We discuss these findings in the context of a rural adaptation to the technology acceptance model.

Keywords: rural, remote, older adults, user needs, technology acceptance model

Understanding user needs is fundamental to the development of technology that individuals will attempt to use and will continue to use[1,2]. Technology-based interventions might be particularly useful for older adults who reside in rural/remote geographic locations. To do this, however, technology engagement to support health, quality of life, and independence in aging requires some augmentation to overcome geographic barriers for rural/remote older adults[3,4]. Rural/remote dwelling older adults face barriers to healthcare, due to limited services and specialist access[5-10]. Geographic barriers will also pose feasibility challenges for provision of end-user or technical support for any stand-alone assistive device4. Rural/remote user needs will likely include device interfaces that are not merely user friendly but are also simple and intuitive to learn since remote support will be the only viable support method[11].

Some technologies, such as telehealth technology, offer opportunities to mitigate these challenges. For example, telehealth technologies have been successfully used in dementia care for cognitive assessments, patient management, and caregiver support[6,12-14]. Rural/remote older adults are vulnerable due to restricted access to local supports and services and are, therefore, the quintessential end-users for assistive technology[3,15]. In fact, in their conclusion from a systematic review of rural information communication technology (ICT) use, Salemink and colleagues refer to this as a rural paradox: Those most in need have the least access to ICT[4].

Telehealth has been used effectively in rural communities, but while many telehealth systems in use are generally successful in aiding management of chronic diseases, the technologies were often developed without assessing the usability for patients and caregivers[1]. This lack of careful consideration of the needs of users also underlies challenges in the sustained use of technologies in Indigenous populations: users must be meaningfully involved in the creation of technologies for health[2]. Scherer's matching person and technology model suggests that only when people are properly matched with their technology do they accept and use and, consequently, maximize benefit from that technology[16]. In the process of matching a person with appropriate technology, this matching person and technology model considers "a user's needs and goals, barriers that may exist to optimal technology use, areas to target for training for optimal use, and the type of additional support that may enhance use."[16] The IT world shares a similar, and well-established concept referred to as the 'context of use,' which is the foundation of their definition for technology usability (ISO 9241-11, 1998). Similar to Scherer's matching model, the ISO definition of usability recognizes the importance of the context of use through the extent to which technology can be used by specified users to attain their goals in an effective, efficient, and satisfying manner (ISO 9241-11, 1998)[16]. The context of use demonstrates the importance of considering the combination of unique "users, goals, tasks, resources, and technical, physical, social, and cultural environments" of the users (see ISO/IEC 25010, 2011).

Indeed, considering the context of use, there are many specific barriers to technology use by older adults, such a perceived lack of benefit, lack of interest or motivation, lack of knowledge, lack of access, cost, fear of hardware being outdated quickly, perceived barriers due to physical limitations, format or user friendliness, lack of social and technical support, experience, and confidence[17-20]. Familiarity with common technologies and cognitive status are known to be important factors underlying older adults' user needs[21]. Price, internet availability, education (or lack thereof) are additional barriers to technology use[22,23], as are age-related physical and cognitive declines as barriers to using technology[24,25]. Likewise, research from the Pew Research Center highlights three areas of obstacles: physical challenges to using technology, skeptical attitudes about the benefits of technology, and difficulties learning to use new technologies. In a survey of American older adults, they found that those with physical challenges (around two in five seniors) are significantly less likely than others to go online, to have broadband at home, and to own most major digital devices. In addition, 77% of older adults surveyed indicate that they would need someone to help them learn to use a new technology device, such as a smartphone, and 56% of internet users thought they would need assistance to use social networking sites[25].

Wagner and colleagues and Gitlow highlight research supporting the idea that while many believe the price to be a significant barrier to technology use, more important is a perceived lack of benefit or the converse perceived benefit for promoting use[17,22]. Melenhorst, Rogers, and Bouwhuis and Porter and Donthu also found the perceived benefit of technology drives older adults to accept and use technology, not merely the barriers of cost or access[26,27]. These findings reflect Fred Davis' technology acceptance model (TAM)[28], which raises two critical variables for the acceptance of technology: perceived ease of use and perceived usefulness. If a technology is considered easy to use and it meets a potential user's needs, they are more likely to accept and use that technology[28].

The TAM is a widely used, robust, and valid model of technology acceptance, with suffi-

cient explanatory power[20,29-34]. The TAM has also been frequently applied to examining older adults' interactions with technology. For example, Dogruel and colleagues used an expanded model of the TAM to evaluate seniors' use and acceptance of new media entertainment technology, finding perceived usefulness (in this case, enjoyment) as the primary reason for use and acceptance[35]. The TAM has also been used to describe online shopping participation by older adults and cross-culturally, for internet use by Chinese older adults, smartphone applications, game play, social applications, and acceptance of gerontechnology1[8,36-40].

Another well-recognized model of technology acceptance is the Unified Theory of Acceptance and Use of Technology (UTAUT), and more recently, an updated UTAUT2, which includes dimensions such as price value, hedonistic motivations, and habit. Unlike TAM which arose from Theory of Reasoned Action, UTAUT was a product of unification of several technology acceptance models, including TAM[41-44]. While UTAUT is comparably a strong and robust model, in studies on intention to use technology, TAM outperformed UTAUT, thus illustrating the variability in performance based on context (or a technology in question)[41,45]. Another study, comparing the of the TAM, UTAUT, and a third model, the Theory of Planned Behavior (TPB), in predicting driver acceptance of behavioral intention to use Advanced Driver Assistance Systems (program designed to improve driver performance), found that TAM performed best in predicting driver acceptance, followed by TBP and UTAUT[45]. These studies emphasize the variability in performance of one model of acceptance over another, based on contextual factors such as the technology in question, and user demographics such as age[35,45].

These studies and models also emphasize how critical it is to understand user needs and preferences, in predicting technology acceptance. This field of assessing user needs for the development of useful technology is especially relevant for underserved populations. Montague and Perchonok conducted a systematic review of the use of technology by historically underserved populations, which includes older adults, and they found that technology can be valuable in improving the health of these populations, but this technology must be tailored to the group it is intended for[46]. It is notable, however, that the review of underserved populations did not include individuals residing in rural/remote geographic areas[46].

Older adults in a rural/remote town used technology differently than their more urban counterparts[47]. Moreover, due to infrastructure challenges in rural/remote and northern locales where broad band internet access is limited, those residing in rural/remote geographic locations experience the 'digital divide': restricted access to technology relative to those residing in more urban geographic regions[3]. The digital divide, which impacts accessibility for rural/remote older adults clearly contributes to reduced exposure to technology[48]. Differential comfort with, and exposure to, technology, has been

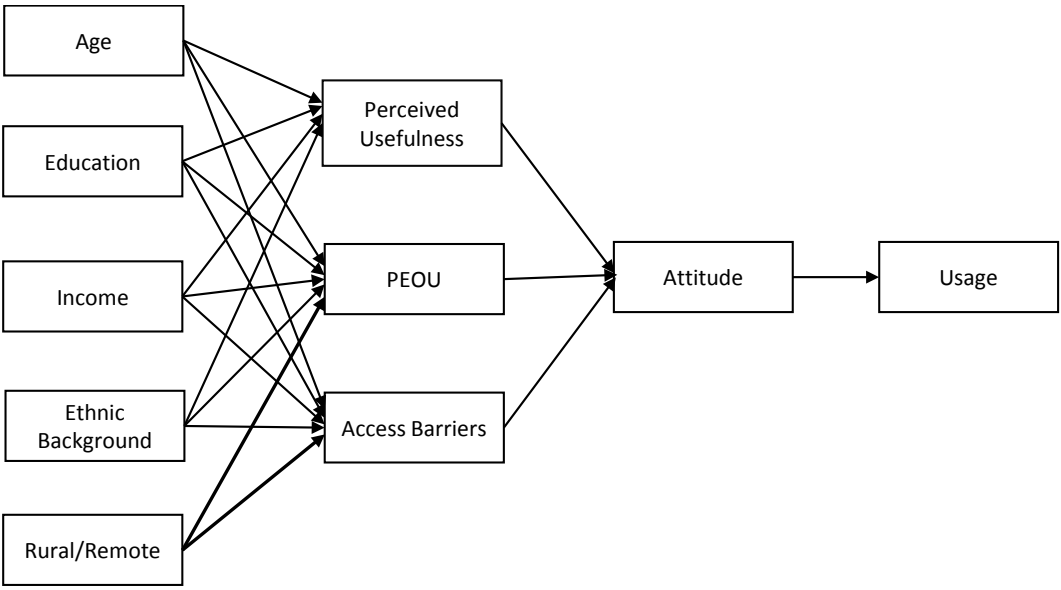

Figure 1. The TAM as modified by Porter and Donthu (2006) with the addition of rural/remote as a contextual factor

referred to as the second digital divide[49]. Rural/remote older adults, therefore, experience a double digital divide, similar to the 'double disparity' described for rural health providers or to the 'double jeopardy' describing the social exclusion for rural adults[23,50,51]. We argue that the TAM should be adapted to account for how this double digital divide impacts multiple levels. A review of research with the TAM up to the year 2013 did not describe any adaptations for rural/remote older adults[28]. An adaptation to the TAM by Porter and Donthu (*Figure 1*), however, included demographic factors such as age, education, income, and racial background as important for perceived ease of use, perceived usefulness, and perceived access barriers to technology[27]. These variables, in turn, impact attitudes toward technology and usage of technology as per the prototypic TAM. We argue that the TAM as modified by Porter and Donthu should include rural/remote geography as a contextual factor[27]. The double digital divide is an important contextual factor in technology acceptance for rural seniors. Rural/remote, we propose, underlies access barriers, both perceived and real via the first digital divide, and impacts perceived ease of use via the second digital divide.

Peoples' intended use for technology is supported as a critical factor in the model predicting attitudes toward technology and subsequent usage of technology[27,35,36]. Perceived needs which include antecedents and barriers to technology use have an important impact on intention to use[31]. Examining the antecedents and barriers will help to better understand the double digital divide, as well as demonstrate its contextual value in TAM[31,52]. To fill a notable gap in the research of rural/remote dwelling older adults and to explore the effects of rural living on the double digital divide, we decided to explore the anticipated needs experienced by rural/remote older adults. Technology developed to meet these needs would be high in matching the peoples' intended use, thus facilitating sustained usage of this technology by rural/remote older adults. We focussed our exploration of anticipated needs by focussing on needs to maintain independence, which is one important factor in the multifaceted concept of successful aging[53].

Method

For the current study, anticipated needs of rural/remote dwelling older adults in relation to independence were explored by a brief interview with 337 adults, aged 60 years and older. In addition, differences in anticipated needs were explored within the sample based on age range. The sample was recruited from randomly selected telephone numbers (land lines and cell phones) listed for persons residing outside metropolitan areas of Saskatchewan, a mid-west province in Canada. We called these randomly selected households and asked to speak with a resident who was 60 years old or older. If there was no such resident we terminated the phone call. For households with residents 60 years old or older, we obtained verbal consent to ask a few questions (below) and obtained verbal consent to contact them about a future study that would involve approximately an hour for participation (a substantially smaller proportion of the sample agreed to be contacted at a future date). Participants were asked a series of open-ended questions regarding a time when they needed assistance and their 'worries' about maintaining independence as they age. Participants' responses were recorded and transcribed, and then data were thematically analyzed using QSR International's NVivo 11 qualitative data analysis software for support[54,55].

The thematic analysis was data-driven and inductive[54,55]. After reading and re-reading the data, a researcher created a coding frame for the thematic analysis. The coding frame listed types of difficulties they needed help with (question one) and worries they had about aging independently (question two). Because we were interested in the difficulties seniors face, we did not code the causes of those difficulties. For example, a statement like 'I couldn't clean because I had cancer" was coded under 'Home and yard duties and/or maintenance', with no code specific to cancer. Additionally, for coding the units of analysis were ideas expressed, not participants or sentences, meaning that one participant could contribute multiple codes. Two researchers coded the data using the established coding frame. Both reviewers coded all the data, with a Cohen's kappa of .77. Once coding was complete, categories were combined to create larger themes. Due to the unique circumstances within the rural/remote context of use user group, it is important to ensure that the specification of the goals of a technology are tightened, making it easier for future usability evaluations by accounting for the context of use at both a group and individual level (ISO/IEC 25010, 2011). For this purpose, we include a list of all specific themes in addition to the most common themes.

Results

The resulting sample of 337 participants was predominantly rural/remote (most were from smaller centers, largest 5,500); however, some participants were categorized as urban, as they lived in or close to cities with a population over 10,000. These participants were excluded from the analysis, for a final sample of 273 rural participants. The average age of the rural/remote sample was 69.5 (SD = 6.89, range 60-87 years old).

Table 1. Health-related theme names and definitions for the open-ended question regarding difficulties performing a task

Name	Definition	Example code
Addiction	Difficulties due to addiction	"I have a hard time dealing with alcohol. I'm having a hard time staying away from the stuff…"
Cognitive tasks	Difficulties associated with cognitive tasks, such as memory or wayfinding problems	"Reading directions and following directions is a problem."
Hearing	Unspecified difficulties due to lack of hearing	"Well, one of my biggest issues is hearing."
Mental health	Difficulties due to mental health concerns	"That was when I felt very depressed and didn't have anyone to help me."
Mobility	Difficulty walking, climbing stairs, etc. Any mention of a walker or wheelchair use	"I had lots of trouble walking, I had to get a walker."
Physical tasks	Difficulty performing physical tasks	"I can't lift heavy objects. I'm not good at lifting. I don't shovel walks very well."
Reaching and bending	Difficulties performing tasks that require reaching above the head or bending down low. These tasks could include changing light bulbs, reaching items on high shelves, bending to access low cupboards, etc.	"I got down on my knees to go to cupboards and get something and it was very uncomfortable. I have not yet been able to get to the bottom of the cupboard…"
Vision	Difficulties due to vision problems	"I'm visually impaired and the other day I lost the sight in my one eye for a couple hours so that was tricky."

Question 1

Of the rural sample, 237 rural/remote seniors responded to an open-ended question regarding a time when they needed assistance, "Can you tell me a story about a time when you had difficulties performing a task without any help?" with 79 responding to a follow-up question, "Is there anything else you'd like to add?" Participants were not restricted in the number of tasks they described; consequently, some participants' responses entailed multiple tasks and difficulties, and thus contributed to the formation of numerous themes. From these open-ended questions, 22 themes emerged from participants' answers. *Table 1* displays 8 themes that were related to physical or mental health. *Table 2* displays the 14 remaining themes not directly related to health.

Frequency analyses across the sample resulted in commonly reported themes, with the five most common themes reported in *Table 3*. Participants were not restricted in their responses and some participants reported multiple themes regarding difficulties.

Just under 20% of participants reported that they faced no difficulties. These participants talked about feeling self-sufficient and independent, with many continuing to do farm work. Some participants mentioned that, while they could still do everything they wanted, sometimes they were a bit slower, or they felt that soon they would face more difficulties due to declining health. For example, one participant said, "I can do most anything, it just takes a bit of time to do things because my lower back is sore. Little by little I do what I have to do. I can still do the garden, do my cleaning and cooking."

As can be seen in *Table 3*, 16% of participants expressed difficulties with physical tasks. These difficulties were often due to a lack of strength, arthritis, illness or injury, or surgery. The physical tasks participants talked about ranged from opening jars to moving heavy farm machinery. It is important to note this large divergence between these the different user needs, which supports the importance of the context of use at both a general and specific level.

Some participants also made comments about difficulties with instrumental activities of daily living (13% of participants). Most participants talked about these difficulties in the context of a previous surgery, injury or illness that they had since recovered from, but some did talk about a current illness that was impeding their daily life.

Mobility was also a point of difficulty for participants, with 14% of participants mentioning it. Participants talked about feeling stiff, having difficulty walking up and down stairs, or facing temporary difficulties while they recovered from surgery.

Finally, 12% of participants expressed difficulties with technology, mainly cell phones, and computers. The participants seemed to use technology semi-regularly but expressed difficulty initially learning how to use different devices, and later often forgetting how to do things like print or access certain programs. These problems made some participants feel "stressed" and "crazy." Sources of support and troubleshooting were primarily children, with a few participants relying on customer support from telecommunications companies.

Question 2

Of the rural sample, 247 rural seniors responded to the second open-ended question regarding their

Table 2. Other theme names and definitions for the open-ended question regarding difficulties performing a task

Name	Definition	Example code
Access to services	Difficulty accessing healthcare and non-healthcare services	"We have to go a long distance to see any medical specialists…" "I drive a VW Jetta and discovered… We don't have any help for service in our area."
Basic Activities of Daily Living (ADL)	Difficulty with ADL: eating, bathing, dressing, toileting, transferring (functional mobility)	"I just recently cracked one of my hips and I couldn't do very much without help. I had lots of trouble walking, I had to get a walker. For a while, I couldn't put my clothes on… Getting in and out of bed was even tough…"
Car & home repair	Difficulties with car and/or home repairs	"Difficulties with mechanical failure at home like furnace or plumbing" "Can't deal with a flat tire."
Caring for another individual	Difficulties associated with caring for another individual	"My husband became ill… Caring for him is the biggest thing because he is a relatively big man so he has mobility issues…" "I do have an autistic grandson and I could use a caregiver to help me take care of my grandson"
Driving	Difficulty due to inability to drive	"When we have to go into Regina I have no one to drive us"
Farm duties & maintenance	Difficulties with farm duties and/or maintenance	"When my husband passed away I was left alone at the farm, removing snow, hauling water, can't change the oil for the car. It has been quite the adjustment to live by myself, moved to town."
Home and yard duties & maintenance	Difficulties with tasks around the home, such as cleaning, etc.	"I have someone come in and clean my house because I'm just not able to do it anymore. I have someone shovel the snow. All the outdoor work my husband does."
Instrumental Activities of Daily Living (IADL)	Difficulties with multiple tasks such as shopping, housework, food and medicine preparation, telephone use, and transportation. Also used when participant says things like "I couldn't do anything"	"I injured my shoulder… I could not cook, clean, use my computer. I even had trouble driving." "I couldn't basically do anything but eat and go to the bathroom."
No difficulties	No difficulties	"I have no troubles."
No difficulties – have assistance with difficulties	Participant felt they had no difficulties, as they could rely on the help of others	"So far I am able to do everything and I get help when I need it. Our son lives in the local town and we have a good neighborhood and we now rent the farm out and keep living there."
Not sure	Participant's answer is unclear or they are unsure	"There is always difficulties."
Social situations	Difficulties in social situations	"Getting up in front of people and talking. I need help for that."
Technology	Difficulties with technology	"On the computer I have problems."
Work responsibilities	Difficulties with work responsibilities	"I train as a mechanic--I could use an extra hand for some of the work…"

'worries' about maintaining independence as they age, "Can you tell me any worries you have about maintaining your independence as you get older?" with 87 responding to a follow-up question, "Is there anything else you'd like to add?"

21 themes emerged from participants' answers to these questions, and because responses were not restricted, some participants reported multiple answers. *Table 4* displays 7 health-related themes that arose from these open-ended questions. *Table 5* displays the 14 remaining themes not directly related to health.

As can be seen in *Table 6*, 23% of participants expressed not feeling worried about their future. Most participants expressed not feeling worried because they currently had assistance, either from family members or community support. Others did not feel worried because they currently were independent and healthy. Others cited a trust in God, feeling prepared for the future, or a feeling of resignation as reasons for not dwelling on their worries.

A further 13% of participants expressed a general worry about maintaining independence, which is a category that overlapped with those from the previous question where assistance was needed for numerous daily tasks. Many participants talked about the possible need to move away from their farm and into a city if they lost some of their independence. Participants did not want to feel dependent on others or face a loss of freedom.

Another 13% of participants worried about access to services, both healthcare and non-healthcare based. Many of these participants anticipated needing more intense health care in the future but were worried about how they would find transportation to services. One par-

Table 3. Five most common themes for the open-ended question regarding difficulties performing a task

Theme	Count of comments	Percentage
No difficulties	61	19%
Physical tasks	50	16%
Instrumental Activities of Daily Living (IADL)	41	13%
Mobility	40	14%
Technology	39	12%

ticipant summarized their worries, "Access to services, medical services or anything. Living in a rural area, right now we have fairly limited access in small communities, required to go to the city, becoming a longer time to get to these services." Another participant said, "It would sure be nice for an extensive homecare service that you could call when we need it. We probably wouldn't need it much but might need assistance with medical issues and we have to start doing things different. My parents in northern Ontario have access to rural remote diagnostics, but we don't have that here."

Declining physical health was a worry for 12% of participants. Participants were particularly worried about heart problems, strokes, cancer, arthritis, and knee and hip problems. Potential surgeries due to these problems were concerning to participants.

Next, 10% of participants worried about either their current or their future living situation. Many were worried that one day they would have to leave their home where they currently live independently. Others expressed concern about moving into assisted living facilities and the quality of these facilities. One participant said, "I do worry a lot. If conditions get worse for me, I am going to have to rely on institutions to take care of me. I live in a small rural community and there are no facilities here so I would have to move to the city 50 kilometres away."

Finally, we explored whether younger versus older age group resulted in clear thematic differences in worries about aging independently, but no age-related differences were apparent.

Discussion

Older adults residing in rural/remote geographic locations experience a double digital divide. The first digital divide is due to infrastructure challenges in rural/remote and northern locales where broadband internet access is limited and cellular access is variable[3,56]. Reduced accessibility for rural/remote older adults older adults is clearly related to reduced exposure to technology, which creates second digital divide, which includes not only exposure to technology, but also the reciprocally related comfort with technology[48,49]. Within a commonly supported theoretical framework predicting technology use, the technology acceptance model (TAM), we argue that rural/remote geography underlies access barriers, both perceived and real via the first digital divide, and impacts perceived ease of use via the second digital divide (rural TAM). The double digital divide may be an important contextual factor for TAM. Investigation of the context of use for the needs experienced by rural/remote older adults helps make a "systematic specification" (p. 458) of the characteristics of the rural/remote users, the unique tasks they will complete, and the circumstances of their intended use[40].

The specified needs illuminate some of the important antecedents and barriers to technology use for rural populations. In previous literature, some noted barriers were worries, lack of access, barriers due to physical limitations, and access to social and technical support[17-20]. In our rural sample, we noted some similarities such as anxiety related to learning about

Table 4. Health-related theme names and definitions of themes for open-ended question on worries about independence

Name	Definition	Example code
Declining physical health	Worries about declining physical health	"I'm sort of worried about my bones wearing out."
Dementia and Alzheimer Disease	Worries about dementia/ Alzheimer Disease	"That my mind will be clear as long as it can be."
Falling	Worries about falling and being injured	"My greatest fear is falling…"
Mobility	Worries about maintaining mobility	"And walking around. Loss of mobility."
Quality of health services	Worries about the quality of health services	"Health concerns. We are about 30 miles away and I am not sure about the quality of care."
Surgery	Worries about surgeries	"Well I am due for another hip surgery and I don't know how I will recover from that."
Vision	Worries about declining vision	"I worry about losing even more of my sight."

Table 5. Other theme names and definitions of themes for open-ended question on worries about independence

Name	Definition	Example Code
Caring for another individual	Worries about caring for another individual	"I live with my daughter and look after my granddaughter at the moment, so that sort of thing."
Driving due to rural living	Worries about the driving required from living in a rural area	"I guess just with us being farther away. If we lost our ability to drive we'd have to move into the city or something like that."
Family, companionship, community contact and support	Worries about not having companionship, family/community contact and/or support	"Just not having my kids." "The only thing that worries me is not having a mate…" "My biggest concern would be losing my dog and my cat. They are what keeps me going."
Farm maintenance	Worries about maintaining the farm	"We just moved off the farm into town--so that was a big challenge for us. The farm was getting too difficult for us."
Finances	Worries about financial issues	"The finances worry me."
Living situation	Worries about where to live in the future; with children, in assisted living, being able to stay at home, etc.	"And then I think what do I want to do when I get older? Do I want to live in a home? Do my children have to put up with me? So I do have some concerns." "I guess to be able to stay in my own home--that's the biggest thing."
Home and yard maintenance	Worries about maintaining the home and/or yard	"Doing outside work and keeping up the yard."
Maintaining independence	Worries about maintaining independence	"I want to keep my independence as long as I can…"
Not worried	Not worried, either presently have assistance, currently independent and healthy, participant feels prepared or resigned, trusts in God, or other unspecified reasons	"I am not really worried. I living in a community where I can get around, I have family to help me." "Not right now, no. I'm in good health right now so off hand I can't think of anything." "I don't worry about it. I trust God--don't worry."
Political or world issues	Worries about the 'state of the world', current events, etc.	"I am concerned about my grandchildren, things are changing fast."
Rural living	Worries about living on a farm as one ages	"I don't want to be here when I'm 80 because living out here on the farm you have to start depending on other people… I want to move into a town."
Staying involved with life	Worries about finding things to do, staying involved with life, etc.	"Our challenge is finding things to do. On the farm there were chores. We both want to be involved with things, and there's nothing…"
Telephone access	Worries about the telephone not working, not being able to access the phone, not being able to get help	"When you are living alone and living in an independent unit, you don't know whether you can get to my telephone if I need to."
Unspecified worries	Worries about unspecified concerns	"Don't know what is ahead of you."

Table 6. Five most common themes for the open-ended questions on worries about independence

Theme	Count of comments	Percentage
Not worried	77	23%
Maintaining independence	43	13%
Access to services	42	13%
Declining physical health	40	12%
Living situation (current or future)	35	10%

technological devices and reliance on external supports to assist with use. We were, however, able to identify some additional aspects, unique to a rural population which contributes to the double digital divide. For example, physical tasks and mobility were identified as sources of difficulty. While physical tasks and mobility are barriers for some older adults, these factors are unique for our sample, in that they may entail difficulty operating and maintaining farming machinery, walking across large distances around a rural property, caring for animals, and traveling extensive distances to health services. These unique aspects contribute an important novel contextual factor for TAM, unique to rural populations. Technology typically developed with user input and specialized user needs has been noted to increase acceptance and use[31,39,52]. This investigation provides opportunities for technology to be developed that meets these needs, which would be high in perceived usefulness, thus facilitating sustained usage of this newly developed technology by rural/remote older adults. Analysing the context of use for rural/remote users provides the benefits of understanding the circumstances of the technologies to be used/developed, understanding the users' requirements for specific technologies, understanding and tackling issues associated with the technology, and ensuring contextual validity for future evaluations of technology utility[57].

In terms of specificity of the context of use, these present data suggest needs include augmentation of physical tasks is important to rural/remote older adults, which is an opportunity for technology development. These data also highlight the need for the development of technologies that are intuitive and easy to use. Further, these data suggest that new technology that mitigates geographic isolation and increases accessibility of services will be critical for rural/remote older adults. Some of these needs and worries provide opportunities for technology development, most notably the need for technology to augment physical daily tasks and maintain social connectedness. The other needs such as easy to use technology and need to remotely access healthcare, however, highlight the context in which new technology should be developed for rural/remote dwelling older adults.

Technology development has potential to reduce the well replicated healthcare disparities in rural communities[5-10]. Not only does technology development aimed at increasing rural/remote residents' access to health have the potential to be of great impact, this technology would address the needs/worries of rural/remote older adults. Technology developed could be aimed directly at rural/remote older adults to increase their access to healthcare but would also be helpful at reducing the disparity of digital access experienced by rural health providers[50,51].

Within the current limitations to rural/remote connectivity, technology developers will have to be cognizant of the training and installation needs that rural/remote older adults would require. Due to the differential access to technology, rural/remote older adults are likely to be less familiar with technology in general and, therefore, have less comfort[4,23]. From a context of use perspective, and in consideration of user groups, ISO 9241-210 (2010) leads to the recognition that within the rural/remote user groups, there lies a range of secondary groups (e.g., caregivers, technology maintenance personnel, etc.) who impact, or are influenced by, technology. Training protocols will need to be adaptive with technology and the needs of the particular older adult and other relevant persons being trained to use any newly developed technology. It is also important to note that the context of use in technology development places an emphasis on the tasks required to meet the desired goals of the users (ISO 9241-11, 1998). The activities needed to reach the desired goals, such as training protocols, will require broadband or cellular access, and remote training involves different techniques than are needed for in-person training[58]. The importance of recognizing the need for remote training is reflected in our data where many rural/remote older adults reported needing help using technology. New technology developed for rural/remote older adults should be intuitive and user friendly, but this would need to be tested with older adults with varying exposure to, and comfort with, technology.

Technology should be developed that does not rely on high speed broadband access due to vast rural/remote geographic distances and sparse populations creating an exorbitant cost of digging fiber optic lines or cable internet, for example. Telecommunication companies do not

experience an adequate profit margin when providing high quality broadband access to rural residents due to the long distances[4]. If broadband is necessary, however, innovation is required to connect rural/remote areas with broadband. Long-distance wireless broadband networks have been recently proposed for rural areas, including leveraging of the white space spectrum that is the unused portion of the television spectrum[56]. Satellite broadband access remains expensive, and lower socioeconomic status is one factor that perpetuates the double digital divide for rural residents[23]. Alternatively, reliance on cellular data to provide broadband access would likely be feasible in rural/remote areas. Cellular towers are less costly to install than digging lines over these large expanses. Moreover, market pressures for mobile carriers exist for expanded coverage of mobile networks. Technology development for rural/remote seniors should leverage these existing market pressures and focus on technology that can be delivered using cellular data. Nevertheless, cellular data plans in Canada remain expensive, which does not address rural sociodemographic concerns[23]. Until new generation communications technology are considered a public utility, governments do not have a mandate for ensuring universal access, which continues to perpetuate the rural infrastructure of digital divide[4]. In fact, Salemink and colleagues predict that new generation technologies will continue to be developed predominantly for urban populations where infrastructure costs are less, thereby "perpetuating the rural penalty" (p. 367) for access to and exposure to newly developed technologies[4]. We must advocate for policies to be created that reduce the double digital divide and enhance ICT access for rural/remote residents. Salemink and colleagues call for a community-based approach to create customized policies for rural communities to transverse the digital divide[4]. Although ideal, community-based approaches are costly and time consuming and are therefore less likely to be entertained by resource strapped governments[59]. Instead, policies aimed at one target, such as the provision of broadband over cellular data could be helpful. If federal and local governments cannot support rural/remote residents by developing the needed infrastructure for traditional broadband access or novel (referred to as next generation) access technology, they could provide rural/remote residents with financial subsidies or income tax breaks for cellular data access thereby mitigating the rural double digital divide.

Some of the limitations of the present research include mode of communication with participants (via telephone), physical limitations, and accessibility. The semi-structured interviews were carried out via telephone. As noted earlier, one limitation to technology use is physical ability[17]. It is possible that some of the participants had hearing issues and could not partake in the interview (thus a relatively younger older adult sample). Lastly, communication via telephone can be perceived as impersonal, and in some cases suspicious. Older individuals are a frequent target of fraudulent activities, some of which are carried out via telephone[60]. It is possible that some participants felt uneasy about providing information via telephone and thus decided to refuse participation.

The present project revealed the perceived barriers that rural/remote individuals have in terms of accessing appropriate services in a way that allows them to maintain a sense of independence, which is an important part of aging well. Technology services have the opportunity to address many of these challenges and thereby narrow the double digital divide between rural/remote and urban residents[4]. This research, however, has shown careful consideration of the target users' context of use (i.e., life circumstances, environment, intended use, etc.) is an important requirement in ensuring the appropriate development, usefulness, and training by the intended users. In particular, we argue that rural/remote geography is an important factor in the TAM, and any newly developed technology needs to be aware of the multifaceted challenges faced by rural/remote residents due to the double digital divide.

References

1. Foster MV, Sethares KA. Facilitators and barriers to the adoption of telehealth in older adults: An integrative review. Comput Inform Nurs. 2014;32(11):523-533; https://doi.org/10.1097/CIN.0000000000000105
2. Jones L, Jacklin K, O'Connell ME. Development and use of health-related technologies in indigenous communities: Critical review. J Med Internet Res. 2017;19(7):e256; http://doi.org/10.2196/jmir.7520
3. Steele R, Lo A. Telehealth and ubiquitous computing for bandwidth-constrained rural and remote areas. Pers Ubiquitous Comput. 2012;17(3):533-543'; https://doi.org/10.1007/s00779-012-0506-5
4. Salemink K, Strijker D, Bosworth G. Rural development in the digital age: A systematic literature review on unequal ICT availability, adoption, and use in rural areas. J Rural Stud. 2017;54:360-371; https://doi.org/10.1016/j.jrurstud.2015.09.001
5. Morgan DG, Walls-Ingram S, Cammer A, O'Connell ME, Crossley M, Dal Bello-Haas V, Forbes D, Innes A, Kirk A, Stewart N. Informal caregivers' hopes and expectations of a referral to a memory clinic. Soc Sci Med. 2014;102:111-118; https://doi.org/10.1016/j.socscimed.2013.11.023
6. O'Connell ME, Crossley M, Cammer A, Morgan

D, Allingham W, Cheavins B, Dalziel D, Lemire M, Mitchell S, Morgan E. Development and evaluation of a telehealth videoconferenced support group for rural spouses of individuals diagnosed with atypical early-onset dementias. Dementia. 2014;13(3):382-395; https://doi.org/10.1177/1471301212474143
7. Kosteniuk J, Morgan D, Innes A, Keady J, Stewart N, D'Arcy C, Kirk A. Who steers the ship? Rural family physicians' views on collaborative care models for patients with dementia. Prim Health Care Res Dev. 2014;15(1):104-110; https://doi.org/10.1017/S146342361300011X
8. Innes A, Szymczynska P, Stark C. Dementia diagnosis and post-diagnostic support in Scottish rural communities: Experiences of people with dementia and their families. Dementia. 2014;13(2):233-247; https://doi.org/10.1177/1471301212460608
9. Szymczynska P, Innes A, Mason A, Stark C. A review of diagnostic process and postdiagnostic support for people with dementia in rural areas. J Prim Care Community Health. 2011;2(4):262-276; https://doi.org/10.1177/2150131911404705; PubMed PMID: 23804844
10. Greenway-Crombie A, Snow P, Disler P, Davis S, Pond D. Influence of rurality on diagnosing dementia in Australian general practice. Aust J Prim Health. 2012;18(3):178-184; https://doi.org/10.1071/PY12008
11. Lai AM, Kaufman DR, Starren J, Shea S, The IDEATel Consortium. Evaluation of a remote training approach for teaching seniors to use a telehealth system. Int J Med Inform. 2009;78(11):732-744; https://doi.org/10.1016/j.ijmedinf.2009.06.005
12. Azad N, Amos S, Milne K, Power B. Telemedicine in a rural memory disorder clinic—remote management of patients with dementia. Can Geriatr J. 2012;15(4):96-100; http://doi.org/10.5770/cgj.15.28; PubMed Central PMCID: PMCPMC3516357
13. Kim H, Jhoo JH, Jang J-W. The effect of telemedicine on cognitive decline in patients with dementia. J Telemed Telecare. 2017;23(1):149-154; https://doi.org/10.1177/1357633X15615049
14. Bowes A, Dawson A, McCabe L. RemoDem: Delivering support for people with dementia in remote areas. Dementia [Internet]. 2016. http://journals.sagepub.com/doi/abs/10.1177/1471301216643848; retrieved May 31, 2018
15. Maar M, Seymour A, Sanderson B, Boesch L. Reaching agreement for an Aboriginal e-health research agenda: The Aboriginal telehealth knowledge circle consensus method. Rural Remote Health [Internet]. 2010; 10(1):[1299 p.]. https://www.rrh.org.au/journal/article/1299; retrieved May 31, 2018
16. Scherer MJ. Connecting to learn: Educational and assistive technology for people with disabilities. Washington, DC: American Psychological Association; 2004.
17. Wagner N, Hassanein K, Head M. Computer use by older adults: A multi-disciplinary review. Comput Human Behav. 2010;26(5):870-882; https://doi.org/10.1016/j.chb.2010.03.029
18. Ma Q, Chan AHS, Chen K. Personal and other factors affecting acceptance of smartphone technology by older Chinese adults. Applied Ergonomics. 2016; 54: 62-71; https://dx.doi.org/10.1016/j.apergo.2015.11.015
19. Preusse KC, Mitzner TL, Fausset CB, Rogers WA. Older adults' acceptance of activity trackers. 2017; 36(2): 127-155; https://doi.org/10.1177/0733464815624151
20. Lee C, Coughlin J. Perspective: older adults' adoption of technology: an integrated approach to identifying determinants and barriers. J Prod Innov Manag. 2015; 32(5): 747-759; https://doi.org/10.1111/jpim.12176
21. Reddy GR, Blackler A, Popovic V, Mahar D. Intuitive use of complex interface structure, anxiety and older users. Lecture Notes in Computer Science (LNCS). 2013:564-581
22. Gitlow L. Technology use by older adults and barriers to using technology. Phys Occup Ther Geriatr. 2014;32(3):271-280. https://doi.org/10.3109/02703181.2014.946640
23. Park S. Digital inequalities in rural Australia: A double jeopardy of remoteness and social exclusion. J Rural Stud. 2017;54:399-407. https://doi.org/10.1016/j.jrurstud.2015.12.018
24. Czaja SJ, Sharit J. Designing training and instructional programs for older adults. Boca Raton, FL: CRC Press; 2012
25. Pew Research Center. Older adults and technology use2014 January 30, 2018. http://www.pewinternet.org/2014/04/03/older-adults-and-technology-use/; retrieved May 31, 2018
26. Melenhorst A-S, Rogers WA, Bouwhuis DG. Older adults' motivated choice for technological innovation: evidence for benefit-driven selectivity. Psychol Aging. 2006;21(1):190-195.https://doi.org/10.1037/0882-7974.21.1.190
27. Porter CE, Donthu N. Using the technology acceptance model to explain how attitudes determine internet usage: The role of perceived access barriers and demographics. J Bus Res. 2006;59(9):999-1007. https://doi.org/10.1016/j.jbusres.2006.06.003
28. Marangunic N, Granic A. Technology acceptance model: A literature review from 1986 to 2013. Universal Access in the Information Society. 2015;14(1):81-95; https://doi.org/10.1007/s10209-014-0348-1
29. Hidayanto AN, Febriawan D, Sucahyo YG, Purwandari B. (2014). Factors influencing the use of E-Class. Journal of Industrial and Intelligent Information. 2014;2(2): 121-125; http://dx.doi.org/10.12720/jiii.2.2.121-125
30. Hsia J, Chang C, Tseng A. Effects of individuals' locus of control and computer Self-Efficacy on their e-learning acceptance in high-tech companies. Behaviour & Information Technology. 2014; 33(1): 51-64; http://dx.doi.org/10.1080/0144929X.2012.702284
31. Abdullah F, Ward R. Developing a general extended technology acceptance model for e-learning (GETAMEL) by analysing commonly used external factors. Computers in Human Behavior. 2015; 56: 238-256; http://dx.doi.org/10.1016/j.chb.2015.11.036.
32. Al-Gahtani SS. Empirical investigation of e-learning

acceptance and assimilation: a structural equation model. Applied Computing and Informatics.2014;12(1): 27-50; http://dx.doi.org/10.1016/j.aci.2014.09.001
33. Lee YH, Hsiao C, Purnomo SH.An empirical examination of individual and system characteristics on enhancing e-learning acceptance. Australasian Journal of Educational Technology, 2014; 30(5): 561-579.http://ascilite.org.au/ajet/submission/index.php/AJET/article/view/381/1080; retrieved May 31, 2018
34. Šumak B, Hericko, M., & Pušnik, M. A meta-analysis of e-learning technology acceptance: the role of user types and e-learning technology types. Computers in Human Behavior, 2011; 27(6): 2067-2077. https://library3.hud.ac.uk/summon/; retrieved May 31, 2018
35. Dogruel L, Joeckel S, Bowman ND. The use and acceptance of new media entertainment technology by elderly users: Development of an expanded technology acceptance model. Behav Inf Technol. 2015;34(11):1052-1063; https://doi.org/10.1080/0144929X.2015.1077890
36. McCloskey DW. The importance of ease of use, usefulness, and trust to online consumers: An examination of the technology acceptance model with older consumers. J Organ End User Comput. 2006;18(3):47-65; https://doi.org/10.4018/joeuc.2006070103
37. Pan S, Jordan-Marsh M. Internet use intention and adoption among Chinese older adults: From the expanded technology acceptance model perspective. Comput Human Behav. 2010;26(5):1111-1119; https://doi.org/10.1016/j.chb.2010.03.015
38. Cota TT, Ishitani L, Vieira N. Mobile game design for the elderly: a study with focus on the motivation to play. Computer in Human Behavior. 2015; 51: 96-105; http://dx.doi.org/10.1016/j.chb.2015.04.026
39. Tsai T, Chang H, Chen Y, Chang Y. Determinants of user acceptance of a specific social platform for older adults: an empirical examination of user interface characteristis and behavioral intention. PLOS ONE. 2017; 12(8): e0180102; https://doi.org/10.1371/journal.pone.0180102
40. Chen K, Chan AHS. Gerontechnology acceptance by elderly Hong Kong Chinese: A senior technology acceptance model (STAM). Ergonomics. 2014;57(5):635-652; https://doi.org/10.1080/00140139.2014.895855
41. Macedo IM. Predicting the acceptance and use of information and communication technology by older adults: An empirical examination of the revised UTAUT2. Computers in Human Behavior. 2017; 75: 935-948; https://doi.org/10.1016/j.chb.2017.06.013
42. Song ZX, Cheung MF, Prud'Homme S. Theoretical Frameworks and Research Methods in the Study of MOOC/e-Learning Behaviors: A Theoretical and Empirical Review. In New Ecology for Education—Communication X Learning (pp. 47-65). 2017: Springer, Singapore
43. Venkatesh V, Morris MG, Davis GB, Davis FD. User acceptance of information technology: Toward a unified view. MIS Quarterly. 2003: 425-478; https://doi.org/10.2307/30036540
44. Venkatesh V, Thong JYL, Xu X. Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology.(Report). MIS Quarterly. 2012; 36(1): 157-178
45. Rahman MM, Lesch MF, Horrey WJ, Strawderman L. Assessing the utility of TAM, TPB, and UTAUT for advanced driver assistance systems. Accident Analysis & Prevention. 2017; 108: 361-373; https://doi.org/10.1016/j.aap.2017.09.011
46. Montague E, Perchonok J. Health and wellness technology use by historically underserved health consumers: Systematic review. J Med Internet Res [Internet]. 2012 PMC3799608]; 14(3):[e78 p.]. https://www.jmir.org/2012/3/e78/; retrieved May 31, 2018
47. Collins JL, Wellman B. Small town in the internet society: Chapleau is no longer an island. Am Behav Sci. 2010;53(9):1344-1366; https://doi.org/10.1177/0002764210361689
48. Haight M, Quan-Haase A, Corbett BA. Revisiting the digital divide in Canada: The impact of demographic factors on access to the internet, level of online activity, and social networking site usage. Inf Commun Soc. 2014;17(4):503-519; https://doi.org/10.1080/1369118X.2014.891633
49. Crompton S. Off-reserve Aboriginal internet users. Canadian Social Trends [Internet]. 2004; 8:[10-7 pp.]. http://www5.statcan.gc.ca/olc-cel/olc.action?objId=11-008-X20040037732&objType=47&lang=en&limit=0
50. Harris JK, Beatty K, Leider J, Knudson A, Anderson BL, Meit M. The double disparity facing rural local health departments. Annu Rev Public Health. 2016;37:167-184; https://doi.org/10.1146/annurev-publhealth-031914-122755
51. Heisey-Grove DM. Variation in rural health information technology adoption and use. Health Aff (Millwood). 2016;35(2):365-370; https://doi.org/10.1377/hlthaff.2015.0861
52. Brandon-Jones A, Kauppi K. Examining the antecedents of technology acceptanle model within e-procurement. International Journal of Operations & Production Management. 2018; 38(1): 22-42; https://doi.org/10.1108/IJOPM-06-2015-0346
53. Lowry KA, Vallejo AN, Studenski SA. Successful aging as a continuum of functional independence: Lessons from physical disability models of aging. Aging Dis. 2012;3(1):5-15
54. Braun V, Clarke V. Using thematic analysis in psychology. Qual Res Psychol. 2006;3(2):77-101; https://doi.org/10.1191/1478088706qp063oa
55. Braun V, Clarke V. What can "thematic analysis" offer health and wellbeing researchers? Int J Qual Stud Health Well-being. 2014;9:26152; http://doi.org/10.3402/qhw.v9.26152
56. Zegura E, Grinter B, Belding E, Nahrstedt K. A Rural Lens on a Research Agenda for Intelligent Infrastructure, January 29, 2018. https://arxiv.org/abs/1705.02004; retrieved May 31, 2018
57. Maguire M. Context of use within usability activities. Int J Hum Comput Stud. 2001;55(4):453-483; https://doi.org/10.1006/ijhc.2001.0486
58. Burton R, O'Connell ME. Cognitive rehabilitation with Telehealth: A randomized controlled feasibility trial of in-person versus videoconferenced delivery across the continuum of subjective cognitive impair-

ment to dementia. JMIR Res Protoc. In Press
59. Morgan D, Crossley M, Stewart N, Kirk A, Forbes D, D'Arcy C, et al. Evolution of a community-based participatory approach in a rural and remote dementia care research program. Prog Community Health Partnersh. 2014;8(3):337-345; http://doi.org/10.1353/cpr.2014.0040
60. For Elderly Fraud Victims, Biggest Toll Is Emotional. ThinkAdvisor. 2015, June 23. http://link.galegroup.com.cyber.usask.ca/apps/doc/A419005926/ITOF?u=usaskmain&sid=ITOF&xid=878fba3f; retrieved May 31, 2018