Journal of Nursing and Occupational Health
JNOH, 3(1): 230-239
www.scitcentral.com

Original Research Article: Open Access

Perceptions of Informal Caregivers Use of Smart Technology in Caring for an Older Adult

Maurine Parzen*, Sheila O'Keefe-McCarthy, Jenn Salfi and Karyn Taplay

*Department of Nursing Brock University, Sir Isaac Brock Way St. Catharine's, Ontario Canada

Received November 30, 2020; Revised December 15, 2020; Accepted December 17, 2020

ABSTRACT

Smart technology has shown promising outcomes in supporting older adults living independently. Informal caregivers play a substantial role as older adults age in place. These caregivers often have multiple responsibilities with 60% working, while caring for both their own children and their older adult family member [1]. Using smart technology to alleviate some of the stress and burden could be extremely helpful for the caregivers. Little is known about how caregivers are using smart technology and what the benefits are in their care giving role. Through qualitative inquiry, this study explored how informal caregivers of older adults are utilizing existing technology to sustain their care giving role. The themes that emerged were: keeping their loved one safe, staying independent, and stimulation and socialization. Caregivers in this study emphasized the greatest barrier to using smart technology was their knowledge gap and limited technological literacy. Knowledge dissemination on technologies that can support aging in place to caregivers who are providing essential care is an urgent area of focus. Future opportunities to design and evaluate educational programs to increase technological literacy warrants inclusion of the caregivers to decrease the knowledge gap and maximize uptake of technology use in care of the older adults remaining at home.

Keywords: Informal caregiver, smart technology, aging in place, older adult, user experience, technology literacy

INTRODUCTION

The aging population is going to double over the next 20 years and currently, the older adult population outnumbers the younger population. As people age, the challenge is that they naturally become susceptible to failing health in varying degrees which presents challenges in their daily activities of life. This reality leads to older adults needing to count on a family member or friend to provide support. According to the 2012 General Social Survey, over six million Canadians took on an unpaid caregiver role for an older adult who had health challenges [1]. The psychological and physiological well-being of an unpaid caregiver is essential to prevent negative health outcomes associated with increased and often unrelieved stress brought on by the burden of caregiving [2, 3]. The average age of unpaid caregivers Is between the ages of 40 to 59 which means they are likely working, possibly caring for their own children, in addition to assuming the caregiver role of an older adult [3-5]. A literature review by Goodman et al. [6], suggest that the negative consequences associated with informal caregiving is so compelling that there is a recommendation to advocate that it be deemed as a priority public health issue. There are formal supports available for caregivers however, there has been little research focused on how caregivers' access or receive information about these supports such as financial, home care, emotional, respite, and or community services [5]. Wiles [7] explored use of formal supports provided for caregivers in Canada and noted that accessing support for informal unpaid caregivers is "fragmented" and consists of "arbitrary collection of services" which has created "frustration and exhaustion" in already burdened caregiver (p. 205). With the continued aging population and constraints on health care dollars, more individuals will be taking on the role of unpaid caregiver. As our population ages at an expediential rate, so too, is the rapid emergence and uptake of technology, with many new digitally enhanced supports available to assist with aging in place. Employing the benefits of technology may be of value to unpaid caregivers to assist with caring for their loved one who is aging in place. Czaja [8, 9]and Wild et al. [10] assert

Corresponding author: Maurine Parzen, Department of NursingBrock University1812 Sir Isaac Brock WaySt. Catharine's, Ontario Canada, Tel: 905-928-4225; E-mail: mparzen@brocku.ca

Citation: Parzen M, O'Keefe-McCarthy S, Salfi J & Taplay K. (2022) Perceptions of Informal Caregivers Use of Smart Technology in Caring for an Older Adult. J Nurs Occup Health, 3(1): 230-239.

that current and future technologies have tremendous potential to assist both caregivers and the older adult to age healthy in place and decrease some of the burden of caregiving. Through accessing supports or health information on the internet, monitoring health status, and maintaining social connectivity, technology if used, can potentially alleviate some of the stressors of informal caregiving. Other scholars discuss advantages that technology can provide to prevent social isolation [11], enhance communication with family members [12], and provide safety and monitor health status [13]. Research has rapidly arisen with the focus on creating smart technologies to support aging in place, especially with the establishment of AGE-WELL, Canada's technology and aging network launched in 2015 [14].

BACKGROUND LITERATURE

Existing and new innovative technology applications and devices to assist older adults to age in place safely have demonstrated benefits for those who have participated in research. For example, Demiris et al. [15] discussed specific smart technology projects such as SMATBo in Sweden and PORSAFE, a project in the Netherlands, in which apartments were fully fitted with sensor devices to monitor safety and promote independent living of older adults. They implemented a similar project called Tiger Place in the US in which apartments were built with technology imbedded in the design. They conducted focus groups with older adults who lived in these apartments, and their perceptions of living with technology yielded positive feedback. Wild et al. [10] conducted focus groups with older adults who also perceived the advantages of technology, including monitoring for safety and cognitive decline, keeping their family informed, and ultimately enhancing continued independence. Other researchers also found encouraging feedback from older adults on feasibility and usability of specific technology to assist with activities of daily living, such as reminders, cameras for surveillance, fall detection systems, and socialization [4,16-20]. Another recent system being explored in Florida is called Home Sense a technology system that was built into the homes of older adults to provide safety and enhance their health while aging in place. Incredibly detailed data is collected through technology and shared with selected users on several activities of daily living such as eating, bathing, sleeping, taking medication, watching TV, moving around, and vital signs [21]. Zulas et al. [22] explored user perspectives on a smart home technology comprehensive monitoring system as part of the Center for Advanced Studies in Adaptive Systems (CASAS) research group. Their research has previously explored the benefits of data produced by smart technology such as "sensor events, activity models and metrics on quality of daily activities such as sleep or medication compliance" (p. 634) with older adults living independently. Their work has focused on gaining insight from older adult and health care providers to assist technology developers in revisions on the visualization of assistive smart home data. They also sought the perspective of smart home technology in ease of use and willingness to learn how to use the technology. Nine informal caregivers were involved and overall, felt that the data they would want to receive from the smart technology would be about their care recipients sleeping, eating, socialization, mobility, medication, daily care routines, and information about safety issues. Cotton [22] discussed in length, the benefits of cellphones and their GPS capabilities in tracking older adults' whereabouts, which have potential to ease caregiver stress. Demiris et al. [13] conducted a systematic review of smart home technology that had been created to monitor and improve the health of older adults worldwide. Technology that exists to date has been built to assess physiological and functional monitoring, safety and security, promote social interactions, and assist with cognitive decline via reminders. A more recent literature review by Fischer et al. [23] also emulated the benefits of technology such as video monitoring, remote health monitoring, fall detectors, and safety sensors have the ability to improve quality of life for older adults living in their homes. Although the literature reviewed is not exhaustive, it highlights that technology software and hardware is rapidly being explored to facilitated older adults aging in place safely and has shown promising outcomes. Informal caregivers of older adults play a substantial role as family members age in place, however, have played a minimal role in the research addressing this topic. Considering caregivers have multiple responsibilities with 60% working while caring for both their own children and their older adult family member [1], alleviating some of the stress and burden by utilizing smart technology could be extremely helpful for the caregiver. Yet, little is known about how caregivers are using smart technology currently in their caregiving role. Reeder et al. [24] conducted a systematic review of the literature on the topic of smart technology and use by older adults and found only five research papers that included family members in the studies. Other authors have also highlighted the lack of focus on caregivers' perspectives as end users of smart technology in caring for an older adult gaining in place [9,22,23,25]. With the need to gain understanding of caregivers' experience with existing technology, the goal of this study was to explore, using qualitative inquiry, how informal caregivers of older adults are utilizing exiting technology (e.g., smart phone, iPad, Google home/Alexa, cell phones, security cameras, or the internet) to care for an older adult aging in place.

RESEARCH METHODS

Design

The study design chosen for this project was a qualitative descriptive methodology. This method was chosen with the intent to draw upon a naturalistic inquiry to discover the personal stories of the participants without having to be committed to any one theoretical view such as grounded

theory or phenomenology [26-28]. In addition, qualitative descriptive studies are appropriate when exploring a poorly understood concept when a simple forthright description from participants is the goal of the research [29, 30]. Colorafi et al. [31] also emphasize that qualitative descriptive design is an especially informative tool when seeking genuine answers to specific questions and seeking accurate responses to inquiries on how, why, and what the barriers are to the topic of interest.

Sample

This study employed convenient purposeful sampling to recruit informal unpaid caregivers to gain a diverse sample and broad information [30]. After receiving ethical approval from the academic institution, the research team created a paid Facebook advertisement using recommendations from Fenner et al. [32], in which the targeted user profile was individuals who were 45-65 years old and located in the Greater Toronto-Hamilton areas. The advertisement briefly stated: "seeking unpaid caregivers to participate in a study who are between the ages of 45 to 65 years old who are caring for an older adult and using technology to support your caregiver role." Targeted Facebook users who clicked on the advertisement were redirected to the study website (https://www.unpaidcaregiver.com/) which provided more details about the study and participant involvement. On the website, potential participants were given the option of directly contacting the research assistant or principal investigator by way of email or telephone. All potential participants chose to email the research assistant, who then followed up with them by email to ensure that they were still interested in participating. A copy of the letter of information was then forwarded to them for review, and consent to participate in the study was obtained. Participants were also provided more details around the definition of the caregiving role which was "individuals within the age of 45-65 years old and who are providing a variety of caregiving duties that help the older adult who may be a family member or close friend, remain in their homes. The definition of caregiving remained general and broad deliberately because of the complex nature of informal caregiving [4]. Each interview lasted from 30 to 40 minutes.

Data Collection and Analysis

After receiving Institutional Ethics approval, data collection was conducted through telephone, one-on-one interviews using moderately structured interview guides which is consistent with qualitative descriptive methodology [31]. The primary questions were:

1. Please share with me some background about your caregiving role. Who you are caring for, how often, and what type of roles do you carry out? What type(s) of technology are you using in your caregiving role?
2. What type(s) of technology is/are working well?
3. What are the challenges/barriers?
4. What recommendations do you have related to your caregiving role and use of technological devices?

The digital audio recordings were transcribed verbatim and content analysis was performed. Prior to analysis for themes, transcripts were returned to the participants for member checking. None of the caregivers required any changes to the transcripts. Following this, the transcripts were read and categorized following a line-by-line review by each of the researchers. The research team discussed themes and defined labels for coding on an illiterate loop until agreement was achieved by all four researchers. Data we reanalyzed at a higher level staying close to the words [27] used by the caregivers, and factual responses to the questions were preserved to provide a rich, straightforward descriptive summary [30]. Coding schemes were developed based upon the four research questions that drove this study, which resulted in four themes: (1) Staying safe, (2) Staying independent, (3) Social Engagement and Stimulation, and (4) Knowledge Gap.

FINDINGS

Demographics

Fourteen caregivers in South Eastern Ontario participated in the telephone interviews over the months of June and July of 2019. There were 11 females and two males whose average age was 53.7 years of age, with the youngest being 42 and oldest 62 years old. Seven of the caregivers shared that they were caring for more than one family member, and the others were providing care for one person. The caregiving experiences shared by the participants were consistent with literature on the topic [4, 5], which included roles such as grocery shopping, banking, driving to medical appointments, interpreting for English as a second language, assisting with activities of daily living, and supporting socialization with family and friends. Health challenges of the aging care recipients were memory, visual and hearing loss, frailty, and mobility decline. Through the narratives of caregivers, this study discovered the types of smart technology unpaid caregivers are using, what is working well, and recommendations for use of technology that would be helpful. These fell within the themes (1) Staying safe, (2) Staying independent, (3) Social Engagement and Stimulation, and (4) Knowledge Gap

THEMES

Staying Safe

A number of caregivers expressed the importance of keeping their care recipient safe by considering security cameras, smart home hubs, cell phone with GPS for tracking, lifeline, automatic locking doors, being able to always know where they are, a doorbell that is motion activated, with speakers and camera to know who is at the door. These technologies were perceived as providing them piece of mind, knowing their loved ones were safe. "…I was talking about in terms

of security. Even on some of…there's two doors…you could have some device that makes a noise if it's open." (C2) "So from here [his home] I can see and make sure the doors are locked. I can look at the cameras to see if he's okay. I've got a bunch of these lights all on timers…on lamps in the living room I turn on at 4'oclock and turn them off at ten." (C5) "I have security cameras in my yard, my brother does, and we've suggested to my parents…we could put one in the kitchen." (C10). "I have my alarms on my phone. All his appointments are on my phone because if I don't…if I just write it down, I would lose it, at least this way I track everything." (C12) One caregiver explained that getting her mother a cellphone provided sense of comfort "I can't not know were [she is], Like if [she] is stepping out for even just a quick walk…or sitting outside, I need to know where she is." (C4) Another caregiver expressed "we're not too far beyond trying to at least get my mother a new phone and put GPS tracking so we always know where she is." (C10) Caregiver 2 explored using cameras for her mom as she is concerned about her safety "safety's an issue, because there's so many break ins these days in the middle of the day and they prey on seniors." Caregiver 12 who lives with her care recipient has security alarms on the doors "because we don't want him to wander off, especially and night…so now like the alarm company is calling and oh my goodness, yeah and it happened at one 'o'clock in the morning."

Staying Independent

Caregivers expressed the benefit of having technology that could provide reminders, ensure quick communication when needed, monitor health status, and ensure care recipient is regularly completing activities of living. These types of remote monitoring supported their loved one remaining independent and in their own home. Caregivers felt that the technology would provide a sense of comfort knowing that there was something in place to allow continued independent living. Technology such as home hubs, cellphones, iPad, tablet, security cameras in the home, sensors technology to monitor movement, technology to monitor health status such as lifeline, iWatch, Fitbit, shared calendar of appointments, online grocery shopping and online banking were either used by some or contemplated the use of.

"It would be amazing if there was, like some way for her to go to the appointments…if there was some way of me being able to physically hear what he's [doctor] is saying versus, her telling me. [and] there's two technologies…it's a necklace that they wear and it'll automatically call if there's any sudden change in, um, like if they suddenly fall…it'll automatically signal 911, and it will could call me." (C4) "So I have got three different ways to get a hold of him, cellphone, panic button, and Alexa [home hub]. (C5) "It would be nice to have more online services that I could sort of access that would affect her. An example is, um, in the wintertime, she couldn't really get out to the store…so I called [a store] and had them deliver it to her which was helpful with confirmation of it's been delivered." (C8) "Electronic shared calendar I used this option with my sister so we always knew when doctors' appointments were, and we could figure out which one of us could take them. [and] I bought a mini google home and set up medication reminders. [and] highly recommend nest cam because provides a way to check up on them." (C14) Caregiver 1 shared the benefits of technology for reminders for "a senior living alone, to remind them to lock a door, like, those type of things. A reminder to, to turn off the, the stove. Like, things like that. "Caregiver 5 had fully programed Alexa home hub with reminders for his dad "my dad's case he's got 20 different reminders on Alexa that come up every day, that says what time it is and what we're doing. It tells him at 6 o'clock it's time for a shower, it tells him at 7:30 if you're not doing anything put your teeth in to the denture cleaner for overnight, it tells him in the morning at 9 o'clock don't forget to put your teeth back in."

Social Engagement and Stimulation

The other common use of technology devices that caregivers found helpful were those that facilitated engagement with others or entertainment for their loved ones using systems such as Facetime, Facebook, and Skype. The ability to stay connected, communicate and maintain relationships were important features of smart technology that were perceived as being beneficial by the caregivers. Caregiver 3 shared how they set her dad up on Facebook on an iPad "just to get him connected with people and friends" and "he uses it to check stocks in the news". Caregiver 6 who was caring for his grandmother talked about how she has had Facebook for 2 years and "likes looking at pictures, news feeds, likes to press the "like button" and keeps her mind occupied". Caregiver 13 set up "facetime calls for [her dad with relatives in Italy] and it was wonderful. It was wonderful [and now] they do that quite regularly [and] he facetimes with cousins and their children so they're very attached to them" because of the ability to connect using facetime." Caregiver 1 shared that she never thought of using any type of technology before, but her care recipient's personal support worker introduced an iPad and he is loving it for entertainment. She originally thought it would be "a waste of money" but was so surprised by "how very good he is with it." Even her mother-in-law now has a google mini and again she "wondered if she would like it? [and] she absolutely adores it, she is 89. We just bought her a google mini last year…She says, "I get up every morning and talk to it." She asks what the weather is. She has certain, um, symphonies and things that she likes from Europe, and it'll play them or then it'll give her a list of similar symphonies. So, she loves her Google!" (C1)

Knowledge Gap

Several caregivers expressed interest in using technology and were contemplating what might work. They showed a beginning awareness and intention of getting started with

technology. However, their comfort and knowledge of smart technology determined how much caregivers were adopting its use. If the caregiver did have that knowledge, they were already using smart technology because they were comfortable with choosing types and setting them up. Several caregivers talked about contemplating different types of technology but just had not decided on what would work for them, or just had not followed through yet. Caregiver 8 explained that "I was hoping to get her an iPad so that we could Skype or something, but I, I really should have probably done that?" and Caregiver 1 shared "we were gonna get that [lifeline] when my mom fell but then it's kind of, just kind of fizzled out." As well, Caregiver 13 said "So I have not used technology like not to watch them. At one point we thought we were going to set up the iPhone camera in the bedroom downstairs, because my sister sleeps upstairs and couldn't hear…but we didn't end up doing that." Caregiver 5 had an extensive background in computer programming and had completely embraced several smart technologies to care for his dad who lives independently. He began with setting up smart technologies in his own home first, then began introducing technology into his father's home. He based this upon what he saw as being needed to help his Dad remain independent safely. Well, I like I set up my own house up…probably eight years ago. I started playing around with this stuff [technology] at my own place." He originally started with using technology because of his father's memory loss "Like there's little things such as his pills, he was always pretty good with his pills and then he started getting screwed up with these pills [and] my dad, he couldn't figure out which pill is which [even in his bubble pack] so he purchased an automatic pill dispenser. "So now it's to the point where he's getting a little bit wobbly and I needed to keep track of oh him in order to visually make sure he wasn't falling down. So…I put in Wi-Fi cameras…I've got one camera generally in all the different areas of the house…I got one in the front door so I'm making sure who's coming in [and] my notifications [on my phone] goes off that says there's motion." [and] "So I found when [Meals on Wheels] were coming in he was closing the door, but he wasn't locking the door. So, I changed the locks with electronic locks…So from here [his house] I can see and make sure the doors are locked. I can look at the cameras see if he's okay. The most common challenge identified by the caregivers were knowledge gaps and ability to acquire knowledge. This is heard from Caregiver 3 who stated, "lack of awareness of the resources, like I have to do a lot of digging myself." And Caregiver 4 who emphasized "So it's very difficult when you don't, when you don't actually know what you're looking for, it's not an easy route. So, I've really been just asking coworkers who have older parents what they are using. It seems like unless you know of a technology…it's really-really difficult. Like even just as simple as a cellphone. Unless you sort of Google each and every single cell phone, there isn't some resource out there to help you decide…and there's nobody who specialized in that realm" to help us." This was corroborated by Caregiver 13 as well, who said "the challenge of navigating the system and just trying to find information…you don't necessarily have the time [as a caregiver] to sit and do some of these searches." A couple of caregivers admitted that the challenge is that they lack confidence using technology themselves which prevents them from thinking about its potential in the caregiving role. Caregiver 9 shared "if I was more familiar with it, probably but my TV gets stuck on a station and I have to call my son. Like I am really bad! I'm not kidding!". A few caregivers felt that their loved one was resistant to the use of technology; therefore, using it was a barrier. Caregiver 13 highlighted the lack of acceptance on behalf of the care recipient to using technology, "we were going to get that [lifeline] when my mom fell but you know they said they didn't need it, I didn't want to keep pushing them …they're very resistant." A couple of caregivers were using a bit of technology such as Facebook to keep in touch, however felt that moving to other types of technology would be too complicated for care recipient to use. "Using skype, google home, or nest camera is too high tech." (C6) "There isn't much electronically that she would be capable [of using], I don't think, of managing." (C8) "We think [google home hub] is too intrusive" (C10).

Recommendations on Introducing Technology

In addition to using technology for safety, staying independent, socializing and stimulation, a couple of caregivers shared helpful tips on how they introduced technology slowly to their care recipient as to not overwhelm them with new learning. For example, Caregiver 4 said, "so we are slowly moving forward [with introducing an iPad]. It's just a matter of I'm sort of really being systematic in my approach. So, I'm talking baby steps, we're really taking it slow and simple. For example, I think skyping is really a great tool especially with the kids. I'm kind of getting her more comfortable with all those things. Another caregiver shared how he was introducing technology slowly "But first introducing the technology as we go so– so the first thing we're going to get into is Alexa because her memory's [poor]. Start slow because if you can catch them while they're still…I'll say it this way and it's a very poor way I'm going to say it. If you can do it while they're still coherent of what's going on…they get a chance to play with it, it's a lot easier" (C5). Caregiver 10 emphasized early introduction to technology with a slow increase in exposure so that technology was not too overwhelming for them. "It's like, how to help them where it's not so much last minute. It's being highly proactive." And Caregiver 14 supported the idea of starting sooner than later, "if I had thought about it sooner [before care recipient went into nursing home with dementia] I would have used it [cellphone] for the tracking piece, [and] "my parents started too late using technology and was not comfortable nor could learn the new skills due to advanced dementia." Caregiver 4

was very passionate in explaining the need to have either a "tool kit" or a "resource person" that caregivers can access to get help on deciding on what technology is available, and help with choosing what would work for their specific care needs. "Whether it's that resource took kit. Or you know, getting somewhere to sort of house this information specifically around technology, and what apps are helpful. You know what portals would be helpful. And what would be amazing is to have, like, a couple of people who would specialize in that, or at least even having people comment about how they use that technology incorporated somehow into it would be fantastic! "Caregiver 5 who had tremendous amount of knowledge and experience with technology provided some details about setting up smart technology. "I got one app– everything gets put through that one window and then that way I can create rules and-routines based off that one rule. You can kind of do the same thing with Google Home and the Alexa…I would recommend to anybody if they're looking at any of this stuff is get nothing that's Bluetooth. Bluetooth has very- it's very limited on what it can do. Like- like it- it's nice because you're doing it in the house but once you leave the house you're screwed. WIFI is better, anything IP based is really great. Um, like- like- for argument's sake if you didn't know what you're doing here Except- except for trying to find the devices. That's where- that's were knowing a little bit about it helps So, as an example if you were thinking, "oh I need to get a camera in there." You might just look at a WIFI camera that you can put to your phone but you'd have to make it just a little bit bigger because you have to make sure the WIFI camera has a cloud base…and you can see it from anywhere. If it has no cloud base and that means it's basically storing it locally [then] you can't get access to it. It- there's little idiosyncrasies but like I said if you don't care how many apps you have. You- you know you could have one for the locks, one for the windows, one for the doors, on for the, uh, lights, one for the sockets. You know you could have as many apps as you need." A few caregivers were able to articulate recommendations on potentially using technology in their caregiver role. Easing into using technology slowly and adding on more technology as their care recipient needed it, was advised. As well, one caregiver suggested a "tool kit" of resources that caregivers could access to better understand what technology is available and how to use or access it. In summary, trial and error with using and exploring types of technology that met caregivers and care recipients' needs was proposed.

DISCUSSION

This study sought to find out how caregivers of an older adult are using or contemplating the use of smart technology in their role. Overall, technology was viewed as a supportive strategy that fell within four realms: (1) Staying safe, (2) Staying independent, (3) Social Engagement and Stimulation, and (4) Knowledge Gaps. Unpaid caregivers articulated that their use of technology assisted with their caregiving role if they had the knowledge to use it. It provided a sense of security and level of comfort, as well as a sense of assurance that their loved one was being cared for. Technology, when used, provided some level of peace of mind. Utilizing smart technology such as cellphones, security cameras, shared calendars, lifeline, home hubs to connect to smart devices such as lights, reminders, on-off switches, iPads, and computers can provide a sense of comfort and connection with care recipients to provide safety, independence, stimulation, and keep older adults independent in their homes. This is consistent with the literature that explores specific technology being developed and piloted for older adults to remain living independently [9, 13,22,33]. Most of the research, however, focusses on the needs of older adults, their perceptions, and the use of smart technology to maintain independence (without consideration of family members who typically play a significant role in older adult lives). It is well documented that caregivers of older adult family members are at risk for negative stress related outcomes as they take on this role [2,3,34]. Therefore, this research extends the current knowledge base to include caregivers in elder care, and highlights the important role they have with implementing/adopting technology for older adults. Even though caregivers in this study identified ways in which smart technology would be useful in their caregiving role, the most predominant barrier was lack of knowledge on what, how, and where to find such technology, or even information about the technology that exists. Liu et al. [20] supported this finding in their systematic review noting that readiness and uptake of such technology remains low because most studies are taking place in laboratories or academic settings outside of the public domain in which end users, such as caregivers, are not privy to the information. Czaja [8] likewise identified lack of awareness, lack of training, and lack of expert support as common barriers to caregivers utilizing technology. In this study, many of the caregivers lacked complete information about what technology could be helpful. As a result of this lack of knowledge, they did not fully comprehend how smart technology might have assisted them in their caregiving roles, and therefore had not fully adopted any technology devices into their caregiving. It is possible, that if they had the resources and technological literacy, like Caregiver 5, who had fully integrated technology in his father's home, that they might have adopted technology to assist them with caring for their loved one. In their systematic review, Reeder et al. [24] identified the lack of knowledge translation as a huge barrier to stakeholders such as caregivers when considering types of technology that would benefit them in their role. This was felt to be a result of the lack of communication between researchers and technology researchers who tend to have different foci when conducting research on this topic. As well, they noted that once a smart technology concept goes to market, they focus on commercial vendors and not on individuals; that is, the ultimate end user of the technology.

Czaja [9], Fischer et al. [23] and Schulz et al. [25] substantiated these challenges saying a major barrier is the need to make the technology available to end users and the critical need for support and training for those who will be using it. Lee et al. [35] argued that while several technologies have been created to assist older adults to stay in their homes as they age, the rate of acceptance and use remains low. Gaugler et al. [4] emphasized that the lack of use stems from the absence of tailored dissemination and engagement with individual consumers. This, along with the lack of educated providers who specialize in providing support in this area, is scarce and warrants further operationalized focus. Delello et al. [12] also noted the digital divide seen with older adults and technology use stems from the lack of awareness of technology's potential in assisting with activities in daily lives. This research contributes to the literature by supporting these claims, revealing that many participants did not know what type of technology is available, where to find it, or where to get support to use it. This disconnect requires immediate targeted knowledge translation to the end user stakeholders to potentiate meaningful uptake of the technological benefits that smart innovations can provide. Several caregivers in this study who began using a bit of technology (Caregiver 1, 2, & 3) expressed their amazement in how their care recipient enjoyed their iPad for stimulation and social connection with family. This suggests positive regard to the potential benefits in using technology by caregivers, but this occurred by chance, as opposed to explicitly choosing technology for the purpose of assisting their care recipient. If caregivers at large gained knowledge on types of technology and its potential benefits, they may embrace it more readily in their caregiving. The gap in knowledge that was expressed by the caregivers in this study is potentially further widened by the extra time it took each caregiver to research the technologies available. Caregivers have little extra time to explore on their own other supports for their caregiving role and learning about technology and deciding on whether to use it adds one more aspect of extra work. Reducing this perceived barrier on using technology could enhance uptake. Ways to do this would be to explicitly disseminate types and uses of technology in a format, such as a website, that could be quickly and easily accessed. Gradual entrance into the world of technology is a process that needs to be integrated slowly to older adult care recipients, and this was emphasized by two of the caregivers. Watkins et al. [36] noted in their systematic review on health literacy, that study results have shown that as one ages, the ability to process information slows and cognitive impairment may become a challenge when learning something new. The strategies chosen and advocated by a few caregivers in this study emulate the need to introduce technology to their care recipient gradually and in baby steps, as to not overwhelm and push them away from accepting the benefits of technology. Certainly, progression of increased assistance with daily living and care needs moves caregivers closer to considering technology and its benefits. This was articulated by caregivers who talked about decreasing vision and mobility, falls, memory loss, increased needs to attend appointments, as well as noticing their care recipients were unable to accomplish other activities of daily living. These were the reasons that moved them to consider being adopters of technology to ease some of their caregiving duties. Again, if they could readily find information about the capabilities of technology, how to access it and get support for its use, the more likely they would be to use it to enhance their caregiving role.

IMPLICATIONS FOR PRACTICE

There are several implications for practice that transpired from this research. Explicitly, there is the need for knowledge translation and a "train the trainer approach" to education [24,36]. Educating health care providers on potential uses of technology for aging in place which they could then share with informal caregivers is a viable knowledge translation strategy. Health care providers are frequently in contact with older adults for health-related challenges and during these visits, caregivers are often present. During the appointment, a discussion on smart technology that can support aging in place and assist in caregiving role could ensue. Another suggestion is to include grandchildren of older adults to introduce types of smart technology as the likelihood of their influence and knowledge of technology use increases the uptake [23,37]. Health care providers can also encourage technology to exchange health care information as some studies have shown the older adults would set aside privacy concerns if the data were used by their physicians [23], and if data reduced any perceived burden on their family caregivers [38]. An example would be to use virtual technology to include caregivers in appointments with older adults. Another knowledge dissemination option is to create a website that collates information on smart technology in caring for an older adult. Many caregivers have limited time and, in this study, mentioned that they do not know where to look, or find information on technology. A number of large projects are currently being explored such as Home Sense in the US [21] yet caregivers are unaware of such projects that could be extremely relevant as their care recipient continues to age and requires increased care. A website that contains information on smart technology that that specifically assisted caregiving needs, resources for training and technical support, and what new technology is on the horizon for aging in place would be extremely helpful [8,9,15,22,23]. This research indicated that the willingness to learn is high and aligns with others if support and education is provided [23,35,37,39,40]. Caregivers need to be empowered with the knowledge to explore technology uses in their role. Lastly, making financial resources or tax credit available would facilitate uptake of technology for aging in place. Some participants mentioned the financial barrier of buying technology [8,9,11,15,24,39,40]. It is

estimated that 25 billion health care dollars is being saved by informal caregivers providing essential care for older adults in Canada [41]. The amount of savings on caregivers caring for older adults aging in place could be used to support grants and funding for caregivers to provide incentives and alleviate this barrier.

LIMITATIONS

The participants in this study represent a very small portion of caregivers in Ontario, therefore generalization to the larger population of caregivers is needed. The study was completely voluntary, and participants used social media, thus only caregivers that had access to the social media platform would have even seen the recruitment advertisement. These further limits the type of caregiver that could have participated. Access to a more diverse population of caregivers is needed to gain more insight into what types of technology caregivers are utilizing in their caregiving role. All the participants also spoke English, which eliminates non-English-speaking caregivers which could provide a vastly different perspective on the topic. As well, the participants were in an urban area with access to different resources than individuals living in a rural area.

FUTURE RESEARCH

Although smart technology shows promise in assisting caregivers in their caregiving needs, further research should focus on the specific benefits it provides. Kerssens et al. [17] noted that even though caregivers in their study embrace technology in their caregiving role, it did not necessarily free up extra time for themselves. In this study, caregivers spoke more about the potential of technology in providing "peace of mind" which was noted in the Reeder et al. [19, 40] studies as well. This needs to be taken into consideration in future research to see if technology can lessen the workload in terms of time, or if it's more about the sense of reassurance that eases the stress associated with caregiving. Research specifically focused on the usability and feasibility in decreasing caregiver burden needs to be completed. The other area that was not explored in this study involves privacy and ethical issues, that have been noted in the literature [4,13,15,23,24]. Most of these studies have raised ethical and privacy concerns from the older adults' perspective and not the essential caregiver. As informal caregivers are providing a large portion of essential care, further research needs to address these topics with caregivers. Health care providers are in a unique position as they care for older adults whose health is declining. In this position, they could support and provide advice to caregivers around the topic of smart technology. However, it is unknown how much knowledge nurses, doctors, social workers, and other health care practitioners have on this topic. Studies that explore their knowledge of technology and how they can translate that knowledge to caregivers is also recommended.

CONCLUSION

Smart technology continues to grow substantially and quickly. Large amounts of financial and human resources are being put into finding ways to help older adults age in place. Informal caregivers play a significant role in older adults aging at home. However, there is also the burden and stress that is associated with this caregiving role. Smart technology to assist the caregiver in their role does exist and can provide a peace of mind for the caregiver. In this study, caregivers shared how technology that promoted safety, independent living, social engagement and stimulation offered a sense of comfort for them. The central barrier identified was the technology knowledge gap - not knowing what is available and how to use the technology to their advantage. This was emulated in a number of stories shared by the caregivers. Technology can be overwhelming, however caregivers still considered technology to enhance the safety of their loved ones, to support the independence of their loved ones, and enhance their socialization and stimulation, all the while providing the caregivers with a little peace of mind.

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