

# Barriers and Facilitators to Using Smart Home Technologies to Support Older Adults: Perspectives of Three Stakeholder Groups

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## ABSTRACT

This research explores the principal barriers to and facilitators of the use of smart home technology, telemonitoring, and telemedicine systems to support healthcare and enable older adults to maintain their independence. The research focuses on organizational rather than technological issues. Semi-structured interviews explored the perspectives of three populations of stakeholders (N = 17): managers of rest homes/retirement villages, technology developers in a university setting, and older adults (age 65 years and older). Key barriers to and facilitators of adoption are identified for the stakeholder groups. The results indicate that a lack of information about the capabilities and availability of the technologies is a key barrier to adoption. Other issues identified in previous studies are also found to be relevant, such as costs, platform management and infrastructure, and human issues such as privacy. The research provides practical recommendations for directions to be explored by developers and researchers in New Zealand and elsewhere.

## KEYWORDS

Age in Place, Barriers, eHealth, Facilitators, Older Adults, Smart Home Technologies, Stakeholders, Telehealth

## INTRODUCTION

A growing aging population in the developed world has brought a number of challenges, particularly in healthcare (New Zealand Government, 2013; Statistics New Zealand, 2013). For example, the number of New Zealanders who are age 65 years and older is expected to rise by 10 percent in the next 20 years. There are significant costs related to the care of an aging population and there is a trend by governments to encourage people to remain within the community and “age in place” (New Zealand Government, 2013; Statistics New Zealand, 2013). The costs of an aging population and this trend toward independent living have stimulated interest in supporting older people to live independently using Smart Home Technology, such as infrared motion detectors, sensors built into beds and chairs, and smart appliances, such as televisions, refrigerators and cooking appliances to monitor their health and daily activities and connect them with their support networks and healthcare providers. These

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technologies are not only useful in supporting independent living but can also be used to support adults living in aged-care facilities. Global interest in Smart Home Technology for the elderly has been driven by research and investments by governments and private companies (Coughlin et al., 2007). However, although these technologies have been the subject of much research and development for several years, they have not yet been widely adopted into new models of care (Ienca et al., 2018).

The aim of this research is to explore the reasons behind this lack of adoption. The study uses a qualitative exploratory approach to investigate the perceived challenges of developing and deploying these technologies from the perspective of three key stakeholder groups: managers of aged-care facilities, older adults and technology developers. In-depth semi-structured interviews were conducted with representatives of each of these groups to explore their understanding of the technologies, their perceptions of the key barriers to adoption and their ideas about how technology uptake can be facilitated.

The work reported here adds to the scholarly body of knowledge related to the uptake of Smart Home Technology for telemonitoring by examining the perspectives of key stakeholder groups. The qualitative nature of the research means that care should be taken when generalizing the findings beyond the study locations, however it is valuable because it highlights the need to address many organizational issues which have been largely neglected in related health informatics scholarship to date. In particular, the study found that many potential users acknowledged that adoption was inhibited by their lack of knowledge about the capabilities, availability and potential benefits of the technologies.

The next section of this paper summarizes the extant literature used to identify key issues to guide the interviews. Next, we explain the methodological approach and the characteristics of the respondents. In-depth, semi-structured interviews were selected because they can provide a comprehensive understanding of participants' perspectives of a chosen phenomenon. We interviewed representatives of three key stakeholder groups to gain a range of perspectives.

Then we present and discuss the findings from the thematic analysis of the interviews and identify perceived barriers and facilitators for adoption of the technologies. The paper concludes by identifying areas requiring further research and offering recommendations for facilitating uptake of the technologies.

## **BACKGROUND**

This research focuses on the use of Smart Home Technology, which is defined as “a residence equipped with computing and information technology, which anticipates and responds to the needs of the occupants, working to promote their comfort, convenience, security and entertainment through management of technology within the home and connections to the world beyond” (Aldrich, 2003, p. 17). The Smart Home literature is divided into four domains: service, technology, organization and finance (Solaimani et al., 2015). There has been significant growth in the technology domain but little attention has been given to the organizational domain, which examines a range of topics, including ethical and legal issues, privacy and security, technological and organizational alignment, responsibility and dependency created by services, role division, key players and academia–industry relationships (Solaimani et al., 2015). Our research focuses on the organizational domain since many of these issues must be resolved before these technologies can be successfully deployed.

Key article databases, including Google Scholar, Business Source Complete, Web of Science, Scopus and Emerald Insight, were searched using a series of keywords that are commonly used to describe technology for older adults (Chan et al., 2008; Magnusson et al., 2004). These keywords included: New Technology, Gerontechnology, Assistive Technology, Information and Communication Technology, Telecare, Telehealth, Telemedicine, Telematics, Smart Home Technology, barriers and adoption. The terms were further refined to include key themes and issues from the literature. Additional searches included: ethics, legal, privacy and security. From this search, 13 articles (Alaiad & Zhou, 2017; Coughlin et al., 2007; Courtney, 2008; Courtney et al., 2008; Demiris et al., 2004;

Demiris et al., 2008; Ehrenhard et al., 2004; Elers et al., 2018; Melenhorst et al., 2004; Offermann-van Heek & Ziefle, 2019; Pal et al., 2018; Peek et al., 2016; Sanders et al., 2012) were found that had collected primary data on barriers to the adoption of Smart Home Technology within the organizational domain. Most of the studies were exploratory and used qualitative semi-structured interviews or case studies. The number of participants in the qualitative studies ranged from 11 to 44.

The existing literature recognizes a number of inter-related issues within the organizational domain that hinder or facilitate the development and deployment of Smart Home Technology to support older adults; these issues are summarized below.

## Human and Social Factors

Ethics is a complex issue with privacy, responsibility, dependence, individual freedoms, civil rights, personal autonomy, informed consent, confidentiality, property rights and ownership concerns at the core of the development and use of Smart Home Technology (Stip & Rialle, 2005). While technologies offer major benefits to older people, and potentially to their families, they are also leading older people to a new life of being monitored at all times, potentially with less direct personal contact (Elers et al., 2018). Many studies identify privacy as a major issue arising from the utilization of Smart Home Technologies (Alaiad & Zhou, 2017; Beckwith, 2003; Courtney, 2008; Courtney et al., 2008; Demiris et al., 2008; Elers et al., 2018; Gövercin et al., 2010; Morris et al., 2013; Offermann-van Heek & Ziefle, 2019; Pal et al., 2019; Rosenberg et al., 2012). The development of an ethical and social framework for either implementation or design could facilitate the widespread adoption of Smart Home Technology (Chan et al., 2009).

Confidentiality of information is a big concern for patients when using technology-based systems (Courtney, 2008; Elers et al., 2018). Communication between parties must be safe and secure when accessing and using patient's medical information. Processes and procedures must be in place to ensure that patient data can only be accessed by those who are authorized to view it (Chan et al., 2008). The implementation of security systems protecting patient data is essential. Policy makers play an important role in this process, as they can enact laws to ensure that patients have a high quality of care, and they can anticipate the legal conflicts that could arise between recipients and providers of such telemonitoring services.

## Costs

Many studies suggest that telemedicine, assistive technology and smart home resources can reduce costs, improve healthcare services and can be more convenient for clinicians and patients than face to face consultations (Allen et al., 1999; Bynum et al., 2003; Chan et al., 2008; Dansky et al., 2001; Kun, 2001), but there is little empirical evidence to support these arguments (Reeder et al., 2013). End users need to be convinced of the value of Smart Home Technology for it to be adopted in homes around the country or the world (Ehrenhard et al., 2014; Elers et al., 2018). Convincing users with empirical evidence is difficult, as there is little substantial evidence that Smart Home Technology has a positive impact on clinical outcomes or that it can, at this time, help aid older adults in independent living (Peek et al., 2017; Reeder et al., 2013).

Specifically, questions remain as to who should invest in Smart Home Technology? It is suggested that public and private sector organizations have the ability to come together to share information and overcome barriers to technology adoption. The goal here is to ensure that network infrastructure can be affordable and put in place so that cost efficiency can be achieved in the most appropriate and timely manner (Kun, 2001).

One barrier to adoption is the perception that older adults might not be able to afford the installation costs of Smart Home Technology (Demiris et al., 2004; Pal et al., 2019). However, some literature examining older adults' perceptions of these products may not be accurate, as they are based only on assumptions (Demiris et al., 2004; Ehrenhard et al., 2014) made by respondents who did not

use Smart Home Technology regularly, but were asked to comment on it. More research is needed into the actual cost of operating these systems and older people's ability to pay for such services.

## **Platform Management and Infrastructure**

Lack of standardization of technology, compatibility of tools and interoperability of devices are other barriers to the implementation of Smart Home Technology (Ehrenhard et al., 2014; Pal et al., 2019). Furthermore, the cost of installing Smart Home Technology in an existing building is often very high; constructing a new building is often more cost effective than installing smart products in existing structures. Additionally, there are many significant ongoing costs, such as networking costs, systems upgrades and training (Ehrenhard et al., 2014). It is important to understand how key stakeholders perceive these costs so that their concerns can be addressed.

## **Facilitating Adoption**

The literature suggests that there may be a number of ways to facilitate the adoption of Smart Home Technologies. The development of ethical and social frameworks for implementation and design have been suggested as a way to overcome privacy and ethical issues (Chan et al., 2009).

Governments can speed market adoption by using regulations to enforce standards and certifications and by providing subsidies to companies operating in this space. Subsidizing product development can be very beneficial when set-up costs are high, but benefits can also be found in the long term. Collaboration between the public and private sectors, as well as through interdisciplinary teams, could help reduce infrastructure costs (Kun, 2001; Peek et al., 2016) and increase innovation (He & Lee, 2006). Finally, increasing older adults' awareness of Smart Home Technology and training them in its use has also been suggested as a facilitator to adoption (Ehrenhard et al., 2014; Peek et al., 2016).

## **The New Zealand Context**

There is lack of literature that examines organizational issues relating to the uptake of Smart Home Technology in New Zealand, and it is unclear as to what extent home/retirement villages and older adults are adopting these products. However, anecdotal evidence from discussions with people working in the aged-care sector suggests that there is increasing interest in, and use of, these technologies. We hope that this research will identify some of the key issues which need to be resolved in order for the use of these technologies to become much more widespread.

## **METHODOLOGY**

This exploratory research examined stakeholder perceptions of barriers to the adoption of Smart Home Technology for older adults in New Zealand using a business management perspective and a pragmatic approach (Creswell & Creswell, 2017). All participants were interviewed using a semi-structured framework based on the themes identified in the literature: external issues (political, economic, legal, environmental issues), human and privacy issues, costs, platform management. Thematic analysis was implemented to analyze the data (Creswell & Creswell, 2017).

## **Participants**

The perspectives of three relevant populations were sought for this research: managers at rest homes and retirement villages, technology developers and older adults. A total of 17 participants were recruited through snowball sampling. The research process was reviewed and conducted following Massey University's ethical guidelines and procedures.

Seven managers (four females, three males) were recruited from rest homes and retirement villages in New Zealand. There was a range of entities, from not-for-profit trusts to private commercial

businesses. The sizes of the organizations ranged from a 34-bed facility at a hospital to organizations that supported 3,500 people in several residential homes and villages. The technology adopted by the participants varied from one organization which used no technology and had limited infrastructure (i.e., no Wi-Fi or network cabling) to organizations that adopted some or all of the following technologies: GPS monitoring, call-bell systems, pressure mats, sensors, video surveillance, motion detection, laser lights, computer-based patient management systems, automatic doors and alarm systems.

Seven older adults (four males, three females) in New Zealand were recruited for this research. Their ages ranged from 70 to 89 years. All lived independently in their own home. The older adults varied greatly in their use of technology, ranging from not having Internet access but using a computer and a basic cell phone, to having broadband access, computers, laptops, TV streaming adaptors, smart phones and tablets.

Three Smart Home developers (all male) were recruited from a range of universities in New Zealand. Each was involved directly in research and development.

## Analysis

Interviews, lasting between 28 and 95 minutes, were conducted at the rest home managers' offices, the developers' offices and in the older adults' homes. The conversations were audio recorded and then transcribed. NVivo was used to code the data and identify themes. Initially, each interview was coded separately. The transcripts from each of the three population groups—rest home managers, technology developers and older adults—were then analyzed separately to identify the salient themes for each group. Finally, the three population groups were examined as a whole to identify similarities and differences in their perspectives. Peer debriefing (Creswell & Creswell, 2017) was used to enhance the quality of the analysis.

## FINDINGS AND DISCUSSION

The key barriers to technology adoption that were identified across the three stakeholder groups are summarized in Figure 1, and the facilitating conditions are summarized in Figure 2. The respondents identified many themes that have been found in the previous research, although sometimes with a slightly different perspective. In addition, some important new issues emerged. These key issues are discussed in more detail below.

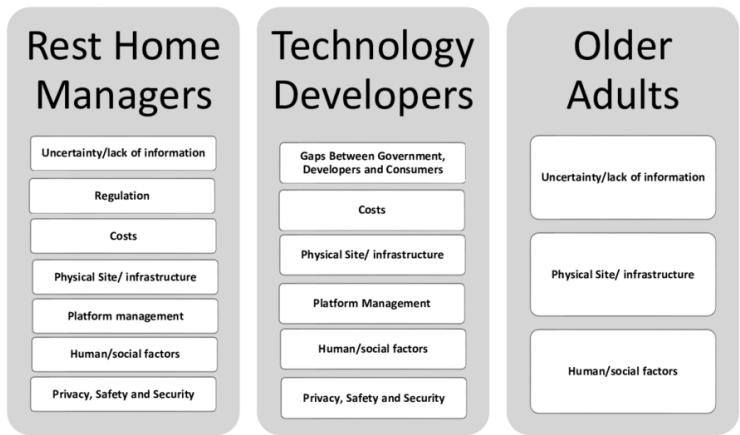
### Lack of Information

The developers had very specific definitions of Smart Home Technology as well as expert knowledge of what it is. In contrast, less than half of the rest home/retirement village managers and only one older adult were familiar with the term. Many of the managers applied a broad definition of Smart Home Technology. The managers who understood and who were interested in adopting new technology said that one of the major problems was knowing what technology is available. For example:

*We are just not really knowledgeable with what is out there and what can be used. Most of our interest is around best practice around patient care and we don't really think too much in terms of how technology can impact that. There needs to be more information floating through to us at this level. (Rest Home Manager 5)*

Limited knowledge of technology, including its benefits, was the largest barrier to the adoption of Smart Home Technology. Without awareness of what Smart Home Technology is and the benefits it can provide, it will be difficult for widespread adoption to take place. This finding is not directly reflected in the literature on organizational barriers to the adoption of Smart Home Technology.

Figure 1. Summary of the barriers of adoption across the research population



Lack of knowledge was observed at different levels in the organizations, from the managers themselves to the staff in the rest homes and retirement villages. Four out of the seven managers suggested that staff lacked basic computer skills, and this was a hindrance to the adoption of the technology. Again, there is no known research in the Smart Home literature that suggests that staff skills are a barrier to the adoption of Smart Home Technology. However, the wider literature on the adoption of innovative health information systems suggests that adopting new technology can be disruptive to organizational functioning. Therefore, training and support of staff is particularly important (Creswell & Sheikh, 2013).

### Developer–Consumer Gap

Several of the themes (i.e., gaps between government, developers and consumers; design of technology; uncertainty; and lack of knowledge) across all three participant groups suggested that there are gaps between technology developers and consumers. The developers suggested that they did not have the correct networks to take the technology beyond the development stage, and rest home managers and older adults struggled to find information about Smart Home Technology and developments in the field. This finding is not supported by any known literature as a barrier to the adoption of Smart Home Technology.

Our research also found that developers used a research process starting with examining the literature (i.e., the psychological, engineering and medical literature), and did not involve the end user until a late stage of development—once a product is considered developed and ready for testing.

*Most of the time what happens is that you come across different research on what is going on in the world from the literature. You cannot do something that the people want, because people always lag in timeframe. What I mean is, if you think of the iPhone, the people who are developing it, they are actually not talking to the people [who buy it]. They are developing it based on their intelligence. There can be different ways of development. Some development comes from the need; some development goes the other way—it is developed around what can be used. (Developer 1)*

This finding is also reflected in literature (Wilson et al., 2015) in which researchers argue that developers need to design for user needs (not vice versa) and use participatory co-design.

## Costs

Costs were a barrier to adoption for two of the participant groups studied—the developers and the rest home/retirement village managers. Research suggests that private and public sectors can work together to reduce costs and encourage the adoption of technology (Kun, 2001). However, our results suggest that there is a gap between the private and public sectors, and that perhaps the rest homes and government do not communicate effectively. Unfortunately, this research only examined the views of rest home managers, not regulators or government officials, due to time constraints. Therefore, there could be other opinions about, and reasons for, this perceived gap.

The rest home/retirement village managers called for standardization and national decisions to be made to aid rest home decision-making processes regarding technology. Staff at aged care facilities say that they have limited income and their costs keep rising without receiving comparable increases in government funding.

Developers also see cost as a barrier and they perceive that older adults who are reliant on state pensions cannot afford to adopt Smart Home Technology. However, when discussing costs with older adults who lived independently, the majority (six out of seven participants) did not think that cost was a barrier to the adoption of new technology, in general. However, they were unable to comment on Smart Home Technologies, in particular.

Some managers of rest homes/retirement villages suggested that they would balance the cost of the technology with the care benefits that it would provide:

*If you buy the technology and there is no benefit in terms of reducing costs, then I don't think that anybody is going to do that. . . . I think that cost is just one part of the whole equilibrium. It is also the ease of using it and the societal view to it, and also if it improves care or not in real terms. (Rest Home Manager 4)*

However, it is difficult to justify the cost of technology adoption when the care benefits discussed in the literature are generally vague (Skubic et al., 2009), do not provide a reduction in workforce demands or overall healthcare expenditures, nor do they improve health outcomes (Agree et al., 2005; Fuhrer, 2007; Peek et al., 2017). Additionally, in New Zealand rest home/retirement villages there are regulations mandating staffing levels; therefore, the possibility of Smart Home Technology reducing staffing costs is limited.

The cost of information technology (IT) outsourcing was also considered a barrier to adoption.

*We are not an IT rich organization so we have to outsource a lot of support, which is a significant cost to us. (Rest Home Manager 5)*

This lack of in-house IT expertise has not previously been found as a barrier to the adoption of Smart Home Technology in the literature.

The cost and time of training staff was also seen as a barrier to adoption by the majority of the rest home/retirement village managers. There is no known research that demonstrates this finding.

## Platform Management, Infrastructure and Physical Site

Infrastructure and the physical sites were barriers for adoption of Smart Home Technology for each participant group. Some of the rest homes did not have Wi-Fi, which made it difficult to adopt new technology. Others had very large organizational sites, and there were “black spots” where the Wi-Fi did not work. Moreover, adding cabling to old buildings would be difficult and unsightly.

*We are trying to retrofit, we are struggling with that . . . we are dealing with old buildings that are built in a different time and the cost of putting anything in is really high . . . the actual age of the building is a barrier. (Rest Home Manager 3)*

Additionally, there are significant costs to installing and upgrading infrastructure. Other issues were that rural businesses had very slow Internet and, in one rest home, there were frequent power outages because public infrastructure cannot keep up with the population growth in that area.

The developers echoed these concerns and said that older adults do not always have Internet, which is a problem for technology adoption. Generally, for technology to move forward in New Zealand, reliable Wi-Fi must be accessible across the country; however, the cost to implement this could be significant. Concerns from developers about a lack of access to the Internet among older adults were substantiated by some of the older adult participants in our study.

Platform management became an issue for rest home/retirement village managers when the organization had adopted a range of technologies which need to be integrated. Developers, probably because of their knowledge, saw platform management as a large barrier. Similar issues and barriers were found in the literature, particularly in relation to cost and infrastructure (Chan et al., 2009).

Managers of rest home/retirement villages stated that regulation was a barrier to the adoption of Smart Home Technology. There was a lack of standardization of technology, and regulators were slow to adapt to changes in the market when new technologies were introduced.

*Basically the standards and the Ministry of Health are a bit slow to keep up with the progressing technology and so when we talk about a Dementia unit that doesn't have locked doors people in the Ministry kind of panic and go 'well how are you meeting health and disability sector standards.' So, we are using the technology, video surveillance, motion detection, pressure area mats and GPS, . . . Yeah, the standards just haven't caught up to the technology. (Rest Home Manager 1)*

This finding suggests that there is not enough support or investment for the adoption of technology, despite the governmental initiative of aging in place (New Zealand Government, 2013; Statistics New Zealand, 2013).

## **Human and Social Factors**

Rest home/retirement village managers identified the potential reduction of human interaction as a barrier to the adoption of Smart Home Technology. Increased use of technology in place of staff could have an impact on older adults' psychological well-being.

*Families pay more for the human aspect. . . . Loneliness is a big issue. It is a big issue within the homes and with some of our community clients outside. They might only see someone once or twice a week. So, if we are going to suggest that we are going to take somebody away [by using technology], they could get depressed. Loneliness is a predictor of death. (Rest Home Manager 3)*

Both the managers and the developers talked about loneliness as a factor that impacts the adoption of technology. Again, there is no research in the mainstream Smart Home Technology literature that supports this factor as a barrier to adoption. The wider literature on ICT and older adults finds many positive outcomes of adopting ICT technology, including reduced depression, increased perceived social support and connectedness, and reduced loneliness. Despite these findings, there are still mixed results, and the evidence is far from clear (Blaschke et al., 2009).

Acceptance of Smart Home Technology, and technology in general, was considered a barrier by both the rest home/retirement village managers and the developers. Acceptability was defined from various perspectives, including social, governmental and individual acceptability. Acceptance



of technology was also an issue for older adults but was described as fear arising from technical incompetence and a lack of interest. The managers and developers did not discuss many variables that would increase or decrease acceptance, apart from addressing privacy concerns, which is a common theme in the literature. The fear of using new technologies found among older adults is supported in the literature as a barrier to the adoption of Smart Home Technology (Melenhorst et al., 2004; Pal et al., 2018). Lack of interest is not discussed as a barrier in the literature, but researchers have described the different interest levels among consumers of Smart Home Technology (Venkatesh et al., 2001).

Privacy, safety and security themes that emerged generally did not match those in the literature. The managers of rest home/retirement villages had mixed opinions when it came to privacy, with only four of seven participants saying it was important when adopting new technology. This varied depending on the technology being used in the organization. Safety and security were seen by all managers of the rest homes/retirement villages as important to the adoption of new technology. All developers considered privacy an issue and discussed the importance of creating trust among the users of new technology.

*There is a concern of breaches if you are tracking everything that people do. There is a chance of theft of property if information is given to the wrong person. (Developer 1)*

Surprisingly, none of the older adults considered privacy an issue when adopting new technology, a finding that is contradictory to the majority of the Smart Home Technology literature (Balta-Ozkan et al., 2013; Beckwith, 2003; Chan et al., 2008; Chan et al., 2009; Courtney, 2008; Sanders et al., 2012; Wilson et al., 2015). Perhaps this was the case because our study only examined technology that they were using regularly and none of the participants utilized monitoring technology.

## **Facilitating Adoption**

There were a number of key themes that participants suggested could help facilitate the adoption of Smart Home Technology. These are summarized in Figure 2 and they generally align with themes that have been identified in previous research.

Having partnerships, relationships and collaboration with key business partners, other developers, interdisciplinary teams, older adults and their families were ways to facilitate technology adoption.

*Have interdisciplinary teams from engineering, computer science, psychology and medicine that could help. Having international connections around the world doing similar things is helpful. (Developer 2)*

The literature suggests that there is a need for multi-disciplinary teams and collective action (He & Lee, 2006; Solaimani et al., 2015). However, there is little research in this space.

Having government support and funding could help speed the adoption of Smart Home Technology. This finding has been supported by researchers who found that government support and funding facilitated the adoption of innovative health technologies and Smart Home Technologies (Creswell & Sheikh, 2013; Ehrenhard et al., 2014). Subsidization can be beneficial when initial set-up costs need to be overcome, and benefits can be reaped later (Ehrenhard et al., 2014).

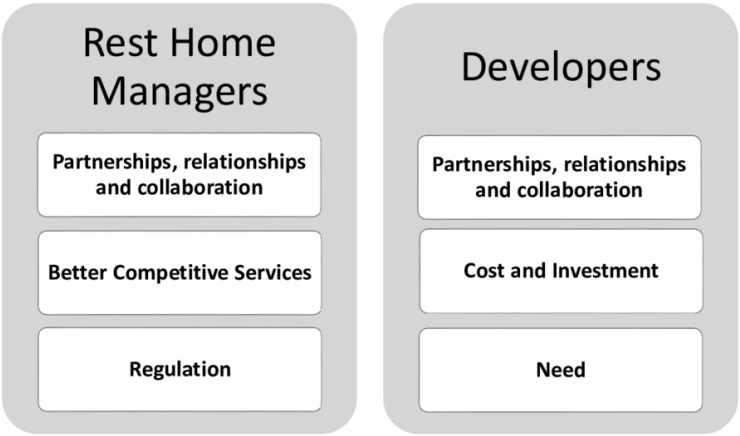
Reducing the cost of technology and increasing investment in New Zealand could help facilitate the adoption of technology. Cost is considered in many studies as a barrier to overcome (Balta-Ozkan et al., 2013; Solaimani et al., 2015). However, the development of appropriate measures still needs further research, especially when examining the benefits which accrue from maintaining the independence of older adults (Peek et al., 2017).

Lastly, rest homes/retirement village managers felt that wider recognition of the benefits of Smart Home Technology by the public would encourage its adoption in rest homes as there would be increased demand for the better services it enables.

*Providing additional or better services because, at the end of the day, when we are in this environment, ultimately there is a choice, especially in the aged care market. And if we are not providing a service that our clients want or need, then our occupancy drops. We can use the technology to provide better services and sell those services to keep our occupancy high because people want to stay with us because they believe in what we are doing. (Rest Home Manager 1)*

To our knowledge, using Smart Home Technology to provide a competitive advantage has yet to be studied in depth.

Figure 2. Summary of the facilitators of adoption across the research population



## CONCLUSION

This study examined the barriers to adoption of Smart Home Technology for older adults in New Zealand. The relatively small sample size limits our ability to draw wide-ranging conclusions from our findings, but the research does suggest some areas that warrant further investigation. The major themes from the literature were identified by our respondents; however, new themes also emerged. We argued that lack of knowledge was the biggest barrier to adoption among older adults. Most of the older adult respondents were not aware of Smart Home Technology and did not know what benefits the technology offered. Therefore, there would be very little chance that they would adopt it in an independent living situation.

For older adults who were in rest homes, managers had a large influence over the adoption of Smart Home Technology. There were a number of issues in an organizational context that influenced the adoption of Smart Home Technology. However, lack of information was again the biggest barrier to adoption. Less than half of the managers of rest homes/retirement villages understood what Smart Home Technologies are, and those who adopted technology widely still had difficulty identifying what options were available and the benefits it would bring to their organization.

We also argued that there was a developer–consumer gap and, to increase adoption of technology, this gap needed to be closed. We suggested a number of ideas to facilitate closing the gap, such as including the end user earlier in the research and development process; publishing more research that examines the benefits of Smart Home Technology for larger populations where it is more likely

to be cost effective for organizations to adopt; and having multi-discipline teams identify end user requirements.

Although, many studies argued that cost is a barrier to the adoption of Smart Home Technology, this study suggested that addressing cost issues is more complex than just reducing price. Cost is not such a large barrier if the technology is going to significantly improve individual quality of life or, in the case of rest homes, help alleviate industry issues such as staff shortages. There also needs to be more research on benefits of Smart Home Technology so that the aged care industry can see the advantages of these technologies.

Privacy was not a large concern for over half of the rest home managers or any of the older adults, but it was very important to the developers. This outcome was surprising, as privacy is frequently cited within the academic literature as being important to users. However, this difference could be due to limitations in this study, and further research into this issue would be useful.

Overall, the findings suggest the use of Smart Home Technologies is still in the early stages of adoption within New Zealand, and progress is hampered by a lack of information and standardization. There needs to be more opportunities for creating networks with end users and important stakeholders to facilitate awareness of Smart Home Technology products. There are a few such networking initiatives within the EU, but there do not seem to be any within New Zealand (Wilson et al., 2015).

## Limitations

The sample size was limited by the time and resource constraints of the project. However, it was similar in size to other primary research studies identified in the literature that used qualitative methodologies. However, it must be acknowledged that saturation (the point where additional participants do not produce new information) may not have been achieved in the present study. Furthermore, those interviewed do not provide a complete picture of the current situation within New Zealand. Care should be taken when generalizing the findings drawn from the study beyond the study locations and future research examining this topic could take a wider scope. Using a range of populations strengthened the richness of the data and provided some triangulation, however, it did not investigate the perspective of government stakeholders and policymakers; future research could examine how they can influence or facilitate the adoption process.

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