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Implementing smart speakers for care home residents across a region: uses, benefits and barriers

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Implementing smart speakers for care home residents across a region: uses, benefits and barriers

Abstract

Background: Smart speakers to improve wellbeing had been trialled in social care by others but we were not aware of any implementation in a majority of care homes across a region. For widespread adoption of new technology, it has to be locally demonstrable and become normalised.

Objective: For 150 (two thirds) care homes in one rural and coastal region to install smart speakers and to explore if and how devices were used, barriers to implementation, and potential benefits.

Methods: Email, workshops, drop-in sessions, phone, and cold calling was used to contact all 230 care homes, offering a free smart speaker and some advisory support. Care homes accepting devices were asked to complete a feedback diary. Non-response rate for diary completion was high, and was thus supplemented with a telephone survey.

Results: It took 7 months to install 156 devices in 92 care homes for older people, 50 for people with physical or mental health needs and eight others. Devices were used mainly for music but also for poetry, recipes, controlling lights, jokes, and video calls. Care home managers reported benefits for residents including enhanced engagement with home activities, enjoyment, calming effects, and acquisition of new skills. Implementation problems included internet connectivity, staff capacity and skills.

Conclusions: Affordable consumer devices, such as smart speakers, should be installed in all care homes to benefit residents. Voice-activated technologies are easy to use and promote interaction. This study indicates that implementation in care homes was possible and that smart speakers had multifaceted benefit for residents and staff. Most care homes in this region now use smart speakers for residents therefore normalising this practice.

Keywords: voice-activated technology, smart speaker, care home, technology enabled care, older people, learning disability

Introduction

The United Kingdom (UK) currently has 425,000 people requiring some form of residential care in over 11,000 care homes [1]. In Cornwall, two thirds of care homes are for older people and one third for people experiencing physical and mental health needs. Care homes are under pressure from an ageing population, an under-resourced workforce [2] and currently from the impact of the COVID-19 virus.

Both the Social Care Institute for Excellence and the Care Quality Commission (CQC) recognise the importance of technology in providing high quality care services [3,4]. For example, technology can help address loneliness through internet-training and video-call interventions [5].

Many projects have focused on cutting-edge technologies still under development [6] rather than commercially available products that may improve quality of life now in residential care. Exceptions include use of affordable companion robots [7]. Implementing technology use, such as Skype, in care homes has not always been straightforward [8]. Studies of smart home technology have identified desired features such as emergency help, health monitoring and environmental control [9,10] but implementation may be prevented due to cost [11].

The literature has numerous examples of 'pilots' and small scale studies and national programmes (such as the UK 'delivering assisted living lifestyles at scale' (dallas) [12,13] were set up to try to address it. Conceptual frameworks on technology implementation such as Greenhalgh's NASSS [14], May and Mair's NPT [15], the longer standing TAM [16] and UTAUT [17] models, and the original work of Roger [18] all include the idea of demonstrability at scale and reaching critical mass [19]. Although the UTAUT2 framework has previously been used to examine the adoption of voice-activated digital assistants with community dwelling older adults [20] we find the NPT framework for assessing and enhancing the implementation of complex interventions into routine practice, the process known as normalisation, more appropriate. The four NPT components for successful integration of interventions, are: coherence, cognitive participation, collective action and reflexive monitoring.

Smart speakers became commercially available in 2014 [21] and have seen a rapid uptake with 20% of households now owning one [22]. In 2018, those aged 55 or older comprised 33% of smart speaker ownership, while 14-18 year olds comprised only 10% [23]. Smart speakers are currently available from providers such as Amazon, Google and Apple, and vary in shape, size and cost, with some models having screens and cameras. For example, the Amazon Echo also contains a 'drop-in' capability where devices, even if in different locations, can be linked and act as an intercom. Most also have the added capability of controlling appliances such as light bulbs, smart doorbells and heating systems to create a 'smart home'. Popular uses for speakers include music, information seeking and entertainment [24,25] but may extend to companionship, healthcare support and better sleep [26]. Speech input and output provides increased accessibility for all users, but particularly for those with limited mobility and vision.

Hampshire and Oxfordshire county councils implemented Alexa devices for 60 people requiring support from social care [27,28]. Both pilot studies found improvements in service users' ability to remain independent and feel less isolated. In Wales, the Innovate Trust investigated how smart speakers could meet the needs of adults with learning differences and reduce staff workload thus saving money [29]. They estimated a potential saving of £20,000 per year across two assisted living sites. There are an increasing number of studies examining the use of smart speakers among community dwelling older adults [30], with qualitative feedback demonstrating commands on first interaction included asking for healthcare-related questions [31]. Despite a survey showing half of care home staff think that artificial intelligence in devices such as smart speakers should be in use to help care for residents [32], we found no evidence of previous implementation of smart speaker use in care homes at scale, that is at the majority of sites across a whole region.

The eHealth Productivity and Innovation in Cornwall and the Isles of Scilly (EPIC) project aims to develop the eHealth sector working with both demand, improving the capability and capacity for using digital technologies, and the supply through supporting small companies producing new products and services. Early workshops identified loneliness as a major health problem, and lack of skills in using technology in care homes as a barrier [33]. Voice technology was identified as an area where local expertise could be expanded but it was clear that its use needed to be normalised [34] and a large user-base would provide the incentive of a local market.

This study aimed therefore to address loneliness and mental wellbeing of care home residents and at the same time to stimulate improved uptake of technology in the care home sector, raising awareness and normalising the use of video calls and voice-activated technologies among care home staff. We aimed to create an expectation of use across the sector.

Aim

We aimed to give at least one smart speaker device to 150 (two thirds) of Cornish residential care homes and to explore if and how devices were used, barriers to implementation, and potential benefits.

Methods

Study design: This mixed methods implementation study used care home staff diaries, and telephone surveys to assess use and impact of smart speakers. We took an eclectic approach to theory, with a lexicon borrowing ideas of 'local demonstrability' [18], 'technology acceptability' [16,17], implementation 'at scale' [13,14], and 'normalisation' [15]. This eclectic conceptual framework drew mostly from NPT. The four NPT components were considered in our aim to understand if the devices were set up and used (cognitive participation), what they were used for (coherence), what barriers were experienced (collective action) and any potential benefits to residents and staff (reflexive monitoring). Ethical approval was granted by the Faculty of Health Ethics Committee (reference 18/19-1054).

Choice of smart speakers: We aimed to implement devices that offered the possibility of videocalls through a screen. In December 2018, the most appropriate device on the market was the Amazon Echo Spot (Figure 1) (Appendix). At Amazon's suggestion the Amazon Kindle Fire (Appendix) was trialled in some homes. Early feedback indicated Echo Spot devices were more physically robust and Kindle Fires looked more like 'regular tablets', which some homes owned and had limited use for. With this feedback, Echo Spots were distributed until October 2019 when they were discontinued. Subsequently, we offered homes the Echo Show 5 (Appendix).



Figure 1. Amazon Echo Spot

Care homes: Using published lists [35] updated through local knowledge, 230 homes were identified. All homes were approached at least once, using a combination of the recruitment methods.

Recruitment and device distribution: Initially, care homes were invited to two workshops, in West and East Cornwall. Participants were presented with project information, received written information, and those who agreed to participate were provided with a device. Eighteen homes attended the two workshops and seventeen agreed to take part. Four further drop-in sessions were held over five months to enable care home staff to speak to researchers about the project. Those agreeing to participate were provided with a smart speaker. Drop-in sessions were advertised via postal and email campaigns and targeted telephone calling. Attendance at local drop-in sessions was low; six people at four sessions from over 200 invited. However, all six agreed to participate. Substantial effort was also made via face-to-face recruitment with research assistants 'cold-calling' approximately 150 homes to explain the project and offer the opportunity to take a device. Cornwall Council also emailed all homes advertising the project resulting in 20 responses.

Support offered to care homes in using the smart speaker: Ongoing support was offered to care homes by two methods. First, the core EPIC team, who had made the initial approach and supplied the device. A monthly email newsletter was circulated with suggestions on different ways to use the device. Second, Digital Health Champions were recruited via undergraduate nursing and occupational therapy programmes and

students aged 16 or more, from two secondary schools. Digital Health Champions were asked to support care home staff in using smart speakers. EPIC team members supported Digital Health Champions with guidance on how to use the device and monthly group skype sessions as a group.

Data collection: Care homes were supplied with a short user guide and a diary to keep track of how and how often they were using the device, any barriers and how they were overcome, and enablers of device use. Only 18 homes returned completed diaries, therefore remaining homes were contacted in early 2020 to take part in a short telephone survey to gain feedback on if they were using the device, if not why, and where it was located. We also asked for short descriptive accounts of their experiences including what the device was being used for, and if they had experienced any problems. Responses were documented verbatim directly during the telephone call. Most (142, 95%) homes provided feedback either via diary or by telephone.

Data analysis: Survey data were analysed using descriptive statistics. Descriptive experiences of the device usage, gathered from diaries and telephone survey, were qualitatively analysed using thematic analysis. We followed the 6-step guide outlined by Braun and Clarke [36].

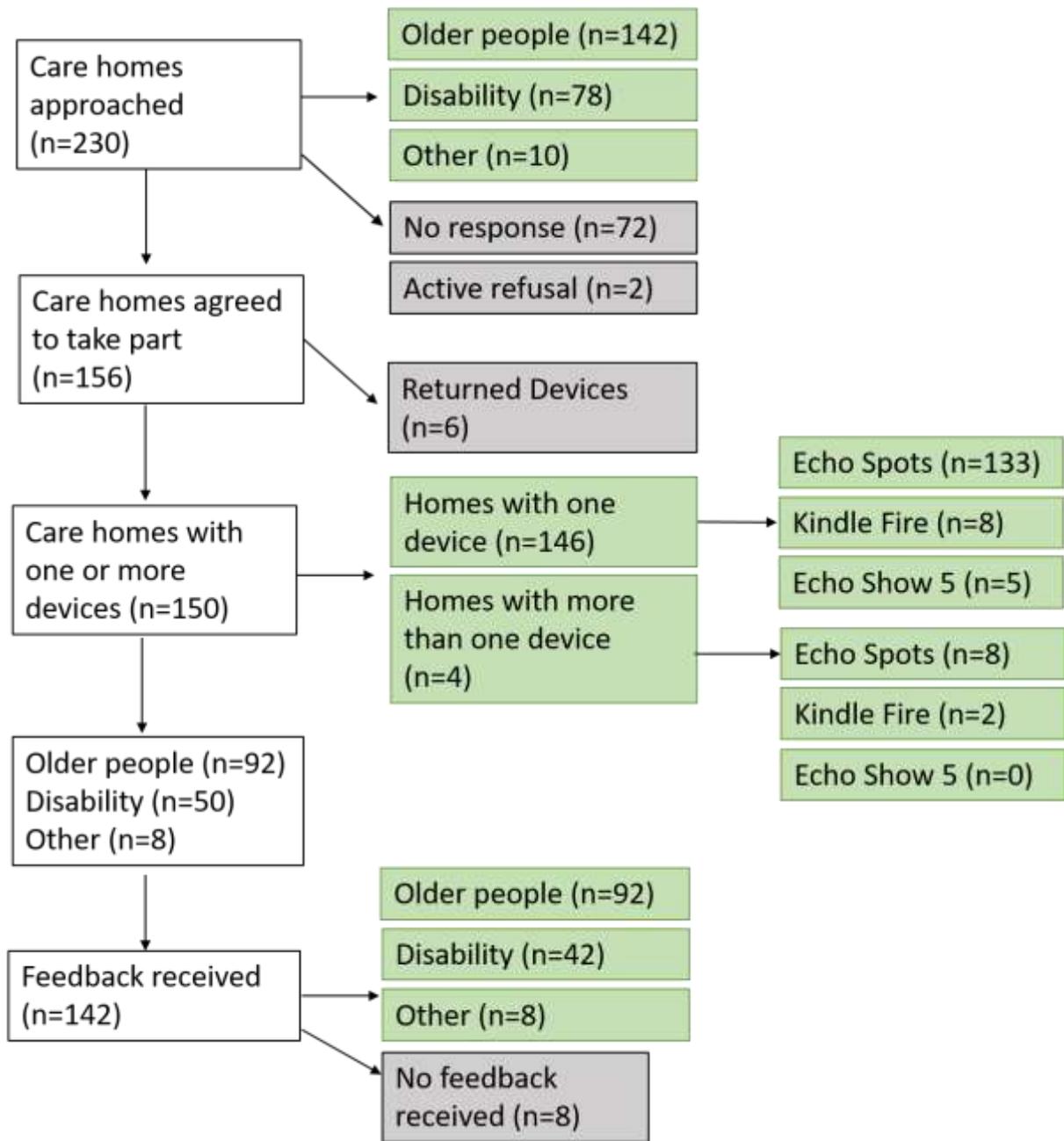


Figure 2. Flowchart of recruitment, interventions, and data collection.

Results

Care homes that took one or more devices: Of 230 homes invited, 156 (68% initial uptake) homes took at least one device (Figure 2). Six homes returned their speaker leaving 150 (65%) with devices (Figure 3). Dividing Cornwall into five areas aggregating primary care networks, uptake was lower in East (44/79, 56%) and West Cornwall (12/23, 52%) compared to the other three areas (67-78%) $\chi^2=10$, 4df, $P=.04$). The 150 homes with devices comprised 92 for older people (estimated resident population 2099 [24]) and 50 for those with physical or mental health needs (resident population 1097). Ten homes received a Kindle Fire, 141 an Echo Spot, and five an Echo Show 5.

Care homes that returned or did not take a device: Reasons for the six returned devices were: (i) management concerns about access to confidential information, (ii) staff thinking it was inappropriate for their clients, (iii) lack of internet access. Of 72 homes (resident population 1740), not taking devices, three had 'positively' declined but most (69) did not respond.

Device usage: Most (142, 95%) care homes provided feedback (Figure 2) of which three-quarters (107/142, 75%) were currently using the device (Table 1). More homes caring for older people were using the device than homes for people with physical and mental health needs (82% Vs 61%; $\chi^2=7.1$; 2df; $P=.028$). Most homes (70/107, 65%) placed the device in communal areas such as living or dining rooms. Homes caring for older people were more likely to move the device around (26/75, 35%) compared to homes for people with physical or mental health needs (2/27, 7%) (Table 1).

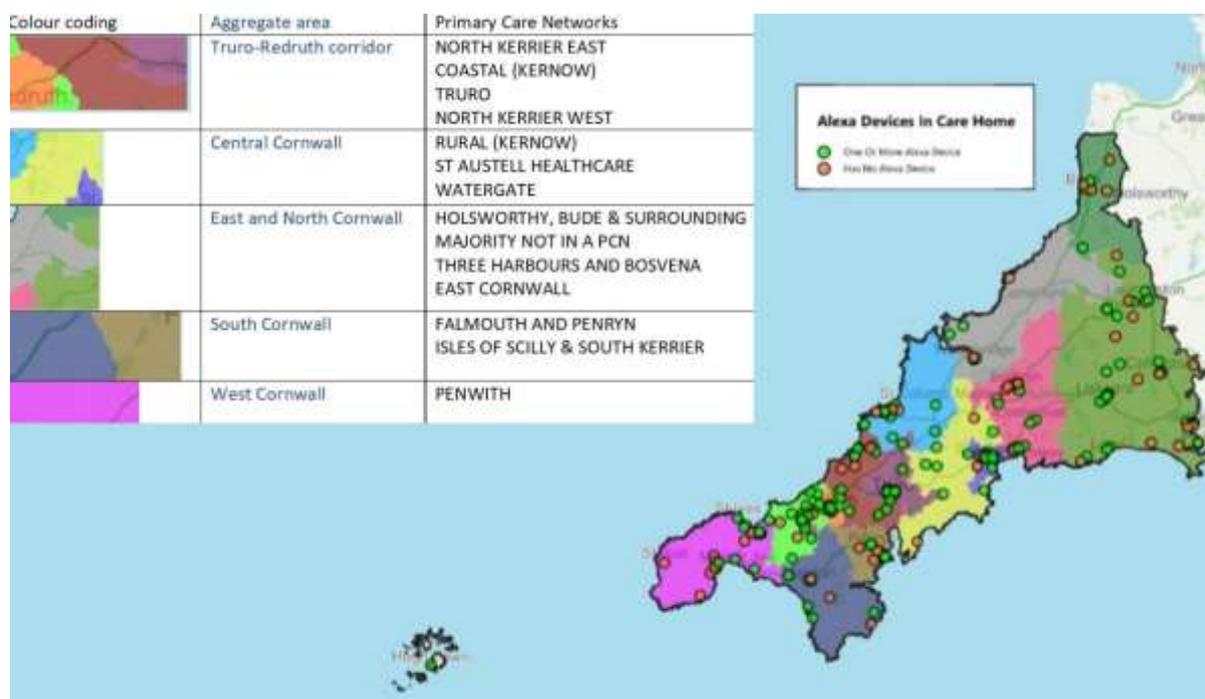


Figure 3. Location of 230 care homes in Cornwall and the Isles of Scilly showing 150 that accepted a smart speaker device and 80 that did not by primary care network areas.

Table 1. Number (%) of care homes using one or more devices at follow-up, by care home type.

Home type	No. of homes using, n (%)	Location of use	No. of homes not using n (%)	Total
Older people	75 (82%)	Moveable 26 (35%)	16 (18%)	91
		Communal 44 (59%)		
		Other 5 (7%)		
Physical / mental health needs	27 (61%)	Moveable 2 (7%)	17 (39%)	44
		Communal 22 (81%)		
		Other 3 (11%)		
Other	5 (71%)	Moveable 0 (0%)	2 (29%)	7
		Communal 4 (80%)		
		Other 1 (20%)		
Total	107 (75%)		35 (25%)	142

Table 2. Themes, sub-themes and example quotes.

Themes and Sub-Themes	Example quotes
Usage	
Music and audio Quizzes and games Jokes and comedy Information seeking Screen use Reminders General engagement/chat Advanced Uses	<p><i>It has been a massive hit with our residents and we have gone on to buy 2 Echo dots. We have downloaded audio books and created playlists for individual residents, and they are really enjoying being able to listen to whatever they fancy.</i></p> <p><i>Skyping families in the USA and Australia has made a real difference to residents and families</i></p> <p><i>Our residents chat to it, say good morning and good night to it</i></p>
Benefits associated with use	
Staff focused benefits Resident enjoyment Resident engagement Technology enabled care Unexpected benefits Companionship	<p><i>Gentlemen on bed rest who is unable to participate in activities. Put on free audible book [sic] for him. He really enjoyed listening and was engaged for several hours, calmly listening to the book. Fantastic option for someone who has poor eyesight and is unable to leave bed.</i></p>
Barriers associated with use	
Video calling Internet connectivity Limitation with device Resident focused problem Staff focused problem Data protection	<p><i>Sometimes residents video call the other building but family members haven't been keen on the video calling, but they are quite elderly themselves.</i></p>
Barriers associated with non-use	
Internet connectivity Limitation with device Resident focused barriers Staff focused barriers Data protection	<p><i>We have become mired around Finance, Capacity, Best Interests and to top it all needing to have parallel wireless networks in each Home, some we have a corporate network for work devices but not guest, we do not want random devices on the secure network as it can access a whole host of other things.</i></p>
Support requested	
Support	<p><i>You asked if we needed any assistance, the only thing I could think of is how to communicate between the two speakers, is that possible? It might be useful for the resident in her room to talk to me in the lounge.</i></p>

Thematic analysis: We identified five themes and 26 sub-themes (Table 2)

Usage: Virtually all (103/107) homes used devices for music and audio including listening to the radio, creating playlists, listening to Christmas carols, background music, and audiobooks (Table 2). More than half (62) used it for information seeking, asking the speaker for the news, weather, and checking tide times when arranging walks. A third (35) used it for quizzes and games, 18 for jokes and comedy and 4 for reminders. Eleven homes reported 'general engagement' with residents talking to and engaging with the smart speaker. One manager reported "*We have a resident who just loves to shout at Alexa, she gets in the neck but because she's compliant, the resident loves it!*" Video calling was reported by only six homes although some homes expressed a desire to use it but had not yet tried. However, two homes were using screens as part of other activities including watching videos, eight in sing-a-long sessions, and three using the 'drop-in' feature. Another found the screen of use when running quizzes or adding enjoyment to listening to music.

Four homes reported 'advanced use' such as connecting multiple devices to create a 'call bell' for one bedbound resident; "*We use it as a makeshift call button, which is linked to all the other devices, when the person presses the button a song plays across the whole house and we know he needs support*". Another used the device to integrate with other smart technology.

Benefits associated with use: In most homes (83/107) all residents had access to the device, 10 reported 75-90% with access, and 14 with more limited access. In diaries and telephone surveys staff relayed benefits of using the speakers despite not being directly asked. These benefits were grouped into five themes (Table 2). The most frequently reported benefit was resident enjoyment (36/107). For example, one reported, "*the person we support has started to really enjoy music and will dance, relax or feel vibrations on the echo spots speaker*" and another "*this has brought great joy and laughter to the home. Lots of dancing and singing currently taking place*".

Relaxation and calming was reported by 11 homes, for example "*when a client is suffering from agitation we asked for thunderstorms and the results were amazing relaxed the client almost within minutes and he slept peacefully*." Seven homes reported that device offered companionship, one saying "*Alexa is the resident's companion that never sleeps, she is always there if a resident can't sleep and wants some company*". Four homes reported the acquisition of a new skill set for residents as a benefit. One said "*our resident has a speech difficulty, so struggles to ask it things, but it helps her to communicate more clearly. She sees staff using it and tries to copy*". Less frequently reported benefits were time saved (2/107), increased staff engagement (3/107) and ease of use (2/107).

Barriers associated with non-use: Among the 35 care homes that reported not using the device, 15 belonged to one care provider whose IT specialist raised concerns about data protection (Table 2). Other reported barriers included lack of time and resource (7/35), internet connectivity (4/35) and lack of skill or confidence around technology (6/35).

Barriers associated with use: Most homes using their device (75/107) reported no barriers setting up and using the speaker. Homes who expressed issues, most frequently reported internet connectivity problems (14/107). Nine homes reported device limitations including the smart speaker's inability to understand certain residents because of speech difficulties or not using the 'desired' language. Barriers to video calling included reluctance from family members, and limitations associated with moving the device.

In two homes, residents had broken the device; however, both homes had re-purchased devices and placed them in more secure locations. Four homes reported that the device caused confusion or residents disliked it, however, in most cases this was part of an adjustment period. One said, *"I think originally they were a little suspicious of the speaker but now they take it in their stride and just accept that they can ask this small "box" questions!"*

Data protection concerns were reported by one home with a device in use. Only one home reported resident inability to operate the device as a problem. A lack of skill/confidence in staff was reported by one home as a concern.

Support offered and requested: Twenty homes contacted the core EPIC team between April 2019 and February 2020. Nine homes wanted support including with set-up, internet connectivity, connecting two devices, or using Skype. Four homes requested an additional device, one wanted a device with a bigger screen, one to exchange their fire tablet with a spot, and five homes requested further support from a student to use the speaker more effectively.

Twenty-four university and eight secondary school students became Digital Health Champions and borrowed a device. Each university student was assigned at least two care homes. Of the recruited care homes, 122 were linked with a Digital Health Champions and offered support via email, phone or occasionally face-to-face. However, only 11 homes provided students with feedback, despite numerous attempts to contact their care homes.

Discussion

Implementation at scale and ‘normalisation’ of use: We aimed to get smart speaker devices used in two thirds of care homes. This proved challenging but was achieved, benefitting residents and creating a ‘user-base’ of voice-activated devices. Although at follow-up 25% (35/142) were not yet using the device, redistribution and prompting was likely to bring these devices into use. Overall, there was emerging ‘normalisation’ [34] of smart speaker use in care homes in Cornwall.

Uses and benefits: Like pilot projects in Oxfordshire and Hampshire [27,28], we received positive feedback on the use of smart speakers. Use was similar to that in the general population [24,25] with music and information seeking the most popular. While music is a basic function, its use supported opportunities for reminiscence, soothing music with end of life care, and calming residents.

Smart speakers may help reduce loneliness and increase independence [27,28]; six of our homes stated devices provided companionship for residents. Further exploration of functions that support independence, particularly for those living with physical or mental health needs is required. For example the ‘reminders’ function has been shown to benefit individuals requiring support while living in their own homes [27,29,37], but only four of 150 homes in our study reported spontaneous use of this function.

Like Pradhan et al. (2018) [11], our results demonstrated unexpected uses including two homes where residents’ interaction with the smart speaker provided opportunities to practice and improve expressive language skills.

Barriers to implementation: Implementing new technology in care homes can prove challenging. Zamir et al (2020)[5] found that implementing video calls within care homes faced barriers such as staff turnover and lack of family commitment. In our study, only six homes reported using devices to make video-calls, suggesting cheaper devices without screens could be used instead. However, screens were used intuitively as part of other activities including reading lyrics for sing-a-long sessions and displaying pictures to support information seeking. It remains to be seen how the COVID-19 pandemic has affected use of videocalls within care homes to overcome ‘shielding’.

Studies have cited lack of digital literacy as a barrier to smart speaker use for individuals requiring social care support at home [27]. Only one home in our study that used a device reported lack of confidence or skill as a barrier, however, for those not yet using it, lack of skill among staff was a concern. One issue experienced by homes was insufficient internet connectivity, however, outages of Wi-Fi or mains power did not pose an unacceptable inconvenience nor did it seem to inhibit continued use. Changing working methods is always difficult [29] and undertaking activities to increase digital literacy of care home staff could facilitate adoption of voice-activated technology.

As Hoy [21] also found, concern over privacy and data protection using smart speakers was of concern for one small chain of homes and one home using the device at follow up. Such concerns therefore appeared to inhibit adoption but did not limit use once installed. Others have found patient privacy and data protection concerns where there is more specific healthcare use [38], yet a pilot project in Stoke-on Trent concluded that

while concerns related to privacy and accessibility cannot be ignored, smart speakers may partially solve some problems facing primary care [39]. Our research suggests that use in communal areas of care homes by groups of users for mainly entertainment purposes creates few privacy concerns. Undertaking activities to increase digital literacy including knowledge of data security of care home staff could facilitate adoption of voice-activated technology for more health and care related uses.

In our study, only one home refused to participate based on 'not liking technology' however, others may find that cultural change hinders wider adoption. Changing working methods is always difficult, as found by a Welsh project on smart-speakers in supported living [29]. Undertaking activities to increase digital literacy of care home staff could facilitate adoption of voice-activated technology.

Negative outcomes: None of the homes reported distress linked to the use of smart speakers and only four homes reported temporary dislike or confusion by residents. However, confusion around the device did not typically affect enjoyment. Other reports suggest people with dementia have shown distress at having a robotic voice speaking to them [40]. How smart speakers are perceived and are of benefit to those experiencing dementia requires more in-depth exploration.

Supporting installation of new technology: Although all care homes had the offer of help from a student Digital Health Champions, we had few (20/150) requests for support. In some cases student Digital Health Champions were particularly active but overall, this aspect of the project had limited uptake as students had difficulty contacting care homes, with most requests for help being received by the core research team. This may be due to the initial personal contact made in distributing devices.

Future uses: As use of smart speakers becomes normalised in care homes one might expect an increased use for other purposes such as providing healthcare information or advice to staff. This extends the use beyond entertainment and further research is needed to evaluate effective workflows [41]. Further research is also needed on designing voice user interfaces for healthcare, as current design training for voice interfaces is relatively limited [42].

Limitations: The feedback collected was primarily from one person, usually the manager, and therefore may only represent a single stakeholder perspective. To gain more in-depth understanding of the practical use, barriers and facilitators of smart speakers, further research is needed from a broader stakeholder base including residents, families and the Digital Health Champions. On collection of feedback, homes were not specifically asked to share benefits of the device usage therefore, the benefits experienced may be understated. We had hoped that care homes would keep diaries and be able to tell us how many of their residents interacted with the smart speakers, but this data collection proved impractical. Systematic exploration of benefits and how they related to specific smart speaker 'skills' and subsets of service users will be important for future research. Further exploration of the sustainability of benefits of the smart speakers is required in the longer term beyond 3-6 months.

Conclusions: This study demonstrated that most care homes are prepared to install and use smart speakers to benefit staff and residents. As an affordable and readily available commercial product, smart speakers represent a highly scalable option to facilitate technology enabled care. Future work needs to explore how to reach the remaining care homes, deal with cyber security concerns, highlight beneficial 'skills' for residents in the longer term and investigate the impact on staff workload. This may lead to opportunities for smart speaker software development supported by local SMEs.

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Contributorship

Katie Edwards recruited most care homes, distributed smart speaker devices, maintained database and data collection, called all care homes for feedback, with DS analysed feedback, with RJ DS wrote draft paper, with RJ liaised with Cornwall Council for grant monitoring. Edited and agreed final paper.

Ray Jones had idea for project in response to Cornwall Council funding opportunity, carried out initial literature and informant review, successfully applied for funding and ethics permission, with TP recruited academic colleagues to support digital health champions, bought smart speaker devices, organised initial workshops, worked with KE DS TP to maintain database, carried out geographical analysis, with KE DS wrote draft paper, with KE liaised with Cornwall Council for grant monitoring. Edited and agreed final paper.

Deborah Shenton worked with KE in recruiting care homes and distributing Alex devices, worked with KE in gathering feedback, with KE analysed feedback, with KE RJ wrote draft paper. Edited and agreed final paper.

Toni Page was co-applicant on application to Cornwall Council and UoP ethics, recruited Digital Health Champions, liaising with nursing and OT academics, worked with KE DS RJ to allocate Digital Health Champions to care homes, supported Digital Health Champions (with written guides and online meetings) in trying to contact care homes. Edited and agreed final paper.

Inocencio Maramba gave technical support in use of smart speaker devices, wrote guide & answered queries from care homes and digital health champions. Edited and agreed final paper.

Tristan Coombe was co-applicant on application to Cornwall Council and UoP ethics, helped with the recruitment of Digital Health Champions. Edited and agreed final paper.

Hazel Cowls was co-applicant on application to Cornwall Council and UoP ethics, helped with the recruitment of Digital Health Champions. Edited and agreed final paper.

Alison Warren was co-applicant on application to Cornwall Council and UoP ethics, helped recruit and manage digital health champions. Edited and agreed final paper.

Fiona Fraser was co-applicant on application to Cornwall Council and UoP, helped with the recruitment of Digital Health Champions. Edited and agreed final paper.

Tanja Križaj was co-applicant on application to Cornwall Council and UoP ethics, helped with the recruitment of Digital Health Champions. Edited and agreed final paper.

Arunangsu Chatterjee advised on the project and further developed links with Amazon and other stakeholders for future work using progress in this project. Edited and agreed the final paper.

Conflicting Interests

No authors have any conflict of interest

Abbreviations

CQC – Care Quality Commission

UK – United Kingdom

EPIC – eHealth Productivity and Innovation in Cornwall and the Isles of Scilly

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Ethical Approval

Ethical approval was granted by the Faculty of Health Ethics Committee (reference 18/19-1054).

Guarantor

Ray Jones

Appendix I

Amazon Echo spot



Amazon Kindle Fire



Amazon Echo Show 5

