Challenges for Healthcare AI to Support Aging in Place Together in the UK

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In this paper we take a sociotechnical and critical perspective to address how a conversational AI system can help to tackle the challenge of an aging population for older people living with others in care at home. As global populations are increasing and older adults continue to 'age in place together' (in multi-generational homes with live-in and live-out residents); there is a demand being placed on AI technology in the home to support care and independent living for older adults. We identify two challenge areas for conversational healthcare AI in the home and discuss how complexities quickly arise which complicate the ability of AI systems to provide optimal health and care in shared settings. The two challenges we discuss include; how multiple residents come to automate their daily lives through conversational AI, and how building trust in conversational AI is key to supporting better health and shared care outcomes. We suggest that supporting human complexity and messiness in the home must be considered for AI before further development of its technical and interoperable complexity.

Additional Keywords and Phrases: Healthcare, AI, conversational AI, Alexa, Echo, smart homes, shared care

ACM Reference Format:

First Author's Name, Initials, and Last Name, Second Author's Name, Initials, and Last Name, and Third Author's Name, Initials, and Last Name. 2018. The Title of the Paper: ACM Conference Proceedings Manuscript Submission Template: This is the subtitle of the paper, this document both explains and embodies the submission format for authors using Word. In Woodstock '18: ACM Symposium on Neural Gaze Detection, June 03–05, 2018, Woodstock, NY. ACM, New York, NY, USA, 10 pages. NOTE: This block will be automatically generated when manuscripts are processed after acceptance.

1 INTRODUCTION

As the global population increases, the number of people moving into old age is increasing, with the number of those over 60 expected to double by 2050 and triple by 2100 [6]. The shift towards an older population represents "one of the most significant social transformations of the twenty-first century" [5] yet presents a range of challenges and opportunities to deliver AI for health and care in the home. We first describe the shift in the UK provision of healthcare for older people and how this is continuing to move towards multi-person inter-generational care provision in people's homes. Following this, we present two key challenges for healthcare AI, situated within this home context and present evidence from an empirical study in HCI that address these challenges directly.

1.1 Aging in Place Together

It is estimated that the proportion of the UK population aged over 65 will increase by 19% between 2015 and 2025 (10.4M to 12.4M), a consequence of which is that there will be a 25% more older people living with disability: an additional 560,000 people who will require care, with dementia cases representing the biggest relative increase [8]. Given the financial challenges and staff shortages in the National Health Service (NHS), in order to provide older people with the care they need, the UK, like many other countries is promoting ‘aging in place’: "The ability to live in one’s own home and community safely, independently, and comfortably, regardless of age, income, or ability level" [25]. Typically, the burden of care falls primarily upon other household residents and family members. The NHS recognises that, "Even people with long term conditions, who tend to be heavy users of the health service, are likely to spend less than 1% of their time in contact with health professionals. The rest of the time they, their carers and their families manage on their own" [10].

Given that the primary locus of health care for aging in place is older people’s homes, it is important to note that the composition of older people’s households is also changing. It is increasingly likely that older people live together with other residents in a household, not only partners but also other family members of different generations. For example, in the United Kingdom in 1997, a ‘cohabiting family’ (made up of one owner, with four or more dependents) accounted for 1.5 million families. By contrast, in 2017, 2.9 million families cohabited with a single owner or couple, representing a 93% increase. Multi-resident, inter-generational families are now the largest growing household group in the UK [27]. Internationally, there has also been an increase in the number of multi-resident households, most commonly in large cities [9].

People who live with older adults in multi-person households may participate in important duties related to an older adult’s Activities of Daily Living (ADL’s), including household tasks e.g. ‘washing and cleaning’ as well as arranging medical appointments and overseeing the purchase and installation of assistive technologies and other devices that leverage AI e.g. smart speakers [3,12,17]. There are clear opportunities for AI technologies to support carers and the people they care for. as well as linking the households to medical professionals e.g sharing health data. However, the ways in which household members in multi-resident homes interact with AI-based technologies to help perform care duties with older adults is not a well-researched area [26]. Studies of existing AI-based technologies in the smart home such as routine assistants [4] and 'smart cameras' that respond "intelligently" to people's motion in the home [16] demonstrate how these technologies respond to the actions of a person in the home. However, whilst some studies do address the use of this technology in shared settings, the outcomes of this research typically focus on the individual as opposed to the household, including carers and other visitors that interact in this space.

In order for people to age in place together successfully with AI therefore, those who are responsible for the different household activities e.g. cleaning, washing up, preparing meals etc. must be successfully negotiated between all the different stakeholders in the home. These shared households must also negotiate how and when rooms are used for different activities e.g. a living room may be used for watching television by some residents and for quieter activities by others. Negotiation is also required when an older person is aging in place in a multi-resident home e.g. negotiating who is responsible for different care duties.

As a result, designers of AI systems that support health and care in shared home spaces must consider how these systems affect not just the primary recipient of care but also the other people living in this shared space. Devices that leverage e.g. conversational AI, such as Amazon's 'Alexa', may afford users different interactions based on their past experiences and expectations for such a system. For example, whereas the device may help one person to follow a set of instructions to iron clothes or take their medication, others users may struggle to interact with the same agent. This complicates the negotiation of care in this shared space when AI-enabled devices are used to support care. Therefore, the negotiation of care in these complex, shared home spaces, presents some distinct socio-technical challenges, which must be addressed when designing AI healthcare technologies that support care for those aging in place together with others.

2 CHALLENGES FOR USING SMART HOME HEALTHCARE AI IN UK HOUSEHOLDS

We focus on two major challenges which may impact the effectiveness of smart home AI healthcare technology that aims to support people aging in place together in shared homes. We conducted a study with 10 UK households (14 participants), with at least one person in care and with one caregiver (live-in or live-out) in each. Participants were required to identify as being socially isolated but also have preexisting social connections to others (whether that be live-in or live-out friends, family, relatives etc.) and were situated in both the Working Age and Older Adult demographics. Participants were given Amazon Echo Show 5 devices. Recruitment proceeded after obtaining institutional (IRB) ethics approval. All participants were asked to complete a demographic questionnaire prior to the study starting to provide information such as name, age, gender, ethnicity, etc. The study ran for a period of 3 months and participants were interviewed before (pre-install), after (post-install) and 3 months after receiving their devices. Interviews were transcribed and data analysis took place between all the authors using NVivo. An iterative thematic analysis was chosen to analyse the data and codes were developed, changed and updated as new interview data was added to the data corpus. Below, we discuss two over-arching themes and subsequent challenges from this data analysis, focussing on *automation* and *trust* through engaging with the 'Alexa' conversational AI.

2.1 Challenge One: Automating Manual Care Activities Through Conversational AI

For households that are aging in place together, being able to automate manual aspects of daily living and caregiving was considered crucial for Alexa to be considered useful. One participant, who regularly wrote in her calendar before receiving the Alexa, commented how: *"it's become so much easier now I can just say 'remind me to [take insulin] at 6 o'clock'. [...] But, I wish it spoke it to me [at the time], rather than just showing on the screen.".* Another participant spoke regarding the convenience of the conversational AI, saying: *"it's all to do with multitasking for me. a person of my age [...] they wouldn't spend their time [jumping between] all these different things - phone, tablet, [lots of] buttons. [...] I just want to shout over at [Alexa] and tell her to remind me to take my tablets and she'll listen and she does it."* The benefits of conversational AI also provided direct

support for automating previously manual medication-related tasks of a safety-critical nature for another participant, to provide shared care support to his spouse, in their home: *" Thyroxin [...] The doctor had upped [my wife's] dose, but I hadn't remembered that it'd changed. [Two weeks later] I've told Alexa my new dose in, y'know milligrams, and it came up, right as rain on [Alexa, on] the day. [...] Interactions with medications, it's quite critical really and so, you know, there's a lot more to it than I think meets the eye."* Others commented on how other people they lived with perceived the device, quoting: *"it's not a she, it's an it. It's not alive [...] I hate that we're calling it 'she'. [...] I'd let a person put [health] information about me out there, not Alexa.",* when referring to their partner humanising Alexa when using it to store or share healthcare information on a cloud service or with a GP.

These accounts show the benefits of turning previously manual tasks (e.g. remembering medication) over to conversational AI and in this case, the system came through for households to support individual and shared care provision. However, these cases of AI automation are not without associated risks. Previous work has revealed how conversational AI in many circumstances is someway off from being able to emulate certain human vocal utterances such as whispering [15], laughter [28], or intimacy [7] without this being perceived as 'creepy' [1]. This is reflected in participants trying to humanise the device by assigning it a gender. By assigning the AI human attributes, in one household, we see this can both frustrate the automation process but also help other people in the home when having social discussions about the technology e.g. by referring to it as a human entity. In our participants' accounts here, there was no need to rely on the technology to convey these human vocal qualities, however, there are some situations e.g. using Alexa to receive and store potentially life-changing health information from a GP, where conveying empathy or emotion through voice, could be beneficial to supporting the sharing of this information from the GP, to the AI, to the patient. As clinical engagements continue to move away from face to face encounters to increasingly automated sharing of healthcare information [19], developing convincingly human AI services that can deliver sensitive information will be crucial, though, as another of our participants noted in this regard; *"I don't think ... [she] can't pull it off convincingly"*.

2.2 Challenge Two: Building Trust to Support Care Through Conversational AI

There are also challenges around trust with the use of a conversational AI like Alexa with a screen. Moving both mundane and complex shared care activities onto a device requires a time commitment but also trust that the device will perform the tasks correctly afterwards. At one level, there are trust issues with the device around individual mundane self-care [14] in the home, as one participant describes: *"I tried putting my [dossette box, reminders for medication] onto her, but I didn't hear anything [...] [next day] when I went down it just said "alarm reminder for so-and-so" but no noise."* In this case, the AI produced an on-screen reminder for a medication task which overrode the voice-based feature of the device. It was unclear whether this was due to a setup error, yet two participants experienced this and described the resulting feelings: *"doesn't make me invested in [Alexa]"* and *"I think [next time, I'd] probably [...] go back to using my phone."* Trust in the conversational AI was lost here and participants did not return to the device to check the settings or to search for why the problem was occurring. As a significant portion of time and trust was invested in the device towards getting e.g. reminders spoken to them accurately on the first attempt, trust was lost and future attempts were not made.

Participants also discussed shared trust issues with the conversational AI in their homes. In one household it was described as important that the device *"make[s] sure she does what [we] tell [it]";* essentially, to be able to trust that Alexa will operate as intended. Describing the sharing of data between GPs and themselves,

participants described: *"I'd be very happy if Alexa said in the morning, 'your blood tests are coming today [...] at what time would you like to be told?' And that would be a really useful thing".* Some participants experienced conversational breakdowns when involving Alexa in engagements with others, such as when trying to get in touch with their GPs via video call: *"I'd say [...] 'Alexa, call Roger.' And she'd misunderstand me. And I'd say 'no, call the bloody GP!' [laughs]"*, informing Alexa about adding household names and contact info: *"I don't think she understood [son's] name, it is an odd one [spelling] though!"* and another articulating "*I don't mind if it's just [arranging] an appointment [but] I don't think she'd get it right if I was in a rush say, or worse. [laughs] I'd rather just call [husband]!"* Some struggled with coordinating shared and self-care tasks by themselves and instead made the people they lived with in the same household use the device for them by proxy e.g. to look up care information: *""I'll always make [husband] go and look up GP drop in times for mum or something, or […] what we can do round here […] with COVID. [...] [Mum] uses it for her Latin music though."* and when experts aren't on-hand: "*if it was on a weekend or nobody was available then, yes, I'd make [granddaughter] probably ask her [Alexa] and go on the internet to find out [the healthcare-related information] or make a phone call or something like that."*

In these shared situations with others, Alexa is used as a last-resort information source when human experts e.g. GPs are unavailable to be involved in either important shared care tasks or mundane self-care activities [14]. Performing shared care in the home is further complicated by using Alexa due to the complex UK living arrangements of 'cohabiting families' [24], which sees people with different intents and priorities for this type of conversational AI wanting to e.g. listen to music rather than look up clinical information. We also see power imbalances here e.g. where parents makes their grandchild or spouse look up information for them, due to their status e.g. device owner, person in care, in the home. We see a lack of trust placed in the reliability of this conversational AI too. Whilst participants may somewhat trust the information output that Alexa provides, the drawbacks to the AI e.g. misunderstanding, time to complete a task and inaccuracies resulting from initial setup errors, reduce individuals' trust in the technology and in some instances, this increases reliance on other human actors to mediate information for them, from the conversational AI.

3 DISCUSSION AND CONCLUSIONS

As conversational AI systems [2,22] become more complex and integrate with other technology e.g. IoT systems, the ability to interface with humans to deliver effective healthcare in a home setting must not be neglected. The accounts in this paper show that at an individual level, whilst people are able to follow steps to automate their mundane self-care practises, the AI does not fully emulate a human response; in some cases resulting in unease from household members who do not identify with the AI's artificial human traits e.g. perceiving female voice, whereas others do. In turn, a household with varying levels of trust and willingness to automate using the AI, results in less effective shared care support. We also see how trust in Alexa is fragile and how initial errors result in far lower trust later on. Complexity also increases when introducing other household members and when searching for information, power imbalances arise and resulting misunderstandings from the device show how trust is quickly lost, meaning greater time investment is needed from other human actors in order to source the correct, health-critical information [11,18], both from the internet and from other people e.g. GPs and healthcare professionals for older people [13,20,21]. Therefore, these human complexities and household setups such as the UK shared care context, must be addressed before developing and interfacing AI further with other systems and devices making use of VAs e.g. [23], which will

only add further complication to AI systems that are yet unrefined for supporting shared health and care activities for humans.

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