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Opinions on the use of technology to improve tablet taking in >65-year-old patients on cardiovascular medications

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Abstract

Objective: This study was performed to evaluate the perceptions of the use of technology to improve cardiovascular medicine taking among patients aged >65 years.

Methods: This qualitative study used focus groups with people aged >65 years taking cardiovascular medications from two East London community centres. Thematic analysis was informed by the Perceptions and Practicalities Approach framework.

Results: Participants welcomed technologies they considered familiar, accessible, and easy to use. They valued the opportunity to receive alerts to help with forgetting and monitoring their treatment. More advanced technologies such as ingestible sensor systems were considered helpful for elderly people with significant cognitive impairments still living in the community because of improved monitoring by caregivers and clinicians and prolonging independence. Although generally adapting to the increase in technology in everyday life, participants raised a number of concerns that included potential reduction in face-to-face communication, data security, becoming dependent on technology, and worrying about the consequences of technological failure.

Conclusions: Participants raised a number of concerns and practical barriers that would need to be addressed for technologies to be accepted and adopted in this patient group.

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Background

Good adherence to cardiovascular medications decreases the incidence of adverse cardiovascular events.[1,2] However, the World Health Organization estimates that 50% of patients do not take their medications as prescribed.[3] Studies have shown that adherence is generally poor across many cardiovascular drug classes.[4] Approximately 9% of cardiovascular events can be associated with poor medication adherence, while good adherence can be associated with a 20% lower risk of cardiovascular disease and a 35% reduced risk of all-cause mortality.[5] Although adherence improves with increasing age[6] and adults aged >65 years show better adherence to cardiovascular medications than younger patients,[7] older patients are more likely to have chronic illnesses and take more prescription medications.[8] Therefore, interventions to improve medication adherence among patients of this age range are warranted.

Numerous technologies using mobile phones and smartwatches[9] exist to aid patients with tablet taking and may additionally be used to monitor adherence.[10] Mobile applications allow patients to receive counselling about medications and reminders to improve and monitor tablet taking. Apps have been effective in increasing adherence to antidepressants,[11] while interactive text message reminders and other automated telecommunication interventions for tablet taking have improved medication adherence[12,13] and clinical outcomes such as systolic blood pressure.[14] Ingestible sensor systems (ISSs) are a combination of wearable and ingestible sensors working in conjunction with mobile phones, personal computers (PCs), or touchscreen tablets to detect ingested medication.[15,16]

These technologies aid not only the patient but also healthcare professionals and family members involved in the patient's care thanks to the option of data sharing.[10]

The use of technology in everyday life among people aged ≥65 years is increasing. In the UK, approximately 89% of adults use the Internet, and users aged 65 to 74 years increased from 52% to 78% in 2011.[17] Approximately 42% of people of all genders aged ≥75 years are now Internet users.[18] Nevertheless, a significant proportion of the >65-year-old population remains unfamiliar with technology, and physical and mental impairments might make it difficult to accept and adopt technology in everyday medication taking. Moreover, the nature of electronic information about personal medication taking raises concerns regarding privacy and data security.[19,20] Acceptability of the available technologies to help with tablet taking in people aged >65 years and privacy and ethical concerns[21] are important factors to consider when designing digital healthcare interventions.

However, we found a paucity of qualitative studies investigating opinions about available technologies to help with medications in patients aged >65 years taking cardiovascular medications. Qualitative studies[21–23] have tended to focus on barriers

to the use of a specific technology and as such have not considered the full range of nuanced opinions on these technologies in the context of daily tablet taking. Therefore, the aim of this study was to evaluate >65-year-old patients' opinions on digital interventions to improve tablet taking delivered through smartphone, smartwatch, and ISS technologies using a theoretical framework that allows identification of practical and perceptual barriers.

Methods

Ethical approval

Ethical approval was granted by Queen Mary University Ethics of Research Committee (QMERC1476a).

Setting

The present study involved two focus groups.[24] The focus groups were organised in the context of gathering patient and public involvement data for a research grant application aimed at improving adherence to antihypertensive medications through digital interventions in primary care, recruiting patients from East London. Because many patients with hypertension are >65 years old, we gathered opinions from this patient group regarding whether technology can play a role in improving the way they take their medications. The focus groups were conducted in two East London community centres: the Southern Grove Community Centre knitting group and the Bromley-by-Bow Community Centre Healthy Lifestyle group. Recruitment was opportunistic, and convenience sampling was applied. Each group comprised six participants. The inclusion criteria were an age of >65 years and taking cardiovascular medications (antihypertensive, antiplatelet, anticoagulant, cholesterol-lowering, or type 2 diabetes medications).

The focus groups took place immediately after the community activity on the centre premises and were facilitated by a general practitioner (GP) and clinical lecturer (A.D.S.) with expertise in qualitative methodologies. A.D.S. worked as a GP in a different UK region and was not part of the participants' care team. The focus group approach was chosen over other qualitative methods (e.g., interviews) as a way of capturing the profiles of a variety of participants and giving each participant a chance to exchange viewpoints and discuss disagreements. All participants provided written informed consent to participate in the study and for their anonymised quotes to be published. Discussions were prompted by printout images of a mobile phone/smartphone, a smartwatch, and an ISS.

The focus group topic guide included three main questions: Do you think technologies could be helpful in improving the way you take your medications? What are the advantages, disadvantages, and practicalities of these technologies? What are the advantages and disadvantages of electronically monitoring your own medicine taking and of sharing these data with family members and healthcare professionals?

Both groups were shown all of the technologies and spent different lengths of time discussing them.

Information was collected about age; cardiovascular medications; ethnicity; access to a smartphone, PC, or touchscreen tablet; and access to the Internet at home.

Analysis

Recordings were transcribed by The Typing Works, a transcription service.[25] The transcription was independently analysed by A.D.S. and A.H. using thematic analysis.[26] The Perceptions and Practicalities Approach (PAPA) framework[27] was used to aid classification of emerging themes into barriers and facilitators to the use of

technology in tablet taking. The PAPA framework provides a theoretical framework to understand adherence to medications based on the overlapping categories of intentional and unintentional non-adherence. The Necessity-Concerns Framework was used in this study to show how concerns about using technologies to help with daily tablet taking can be influenced by judgements of personal need for the technologies and concerns about their potential adverse consequences. A.D.S. and A.H. compared their classification of themes according to the PAPA framework. There were few discrepancies, which were primarily semantic and resolved through discussion.

Results

Participants

Twelve participants took part in two focus groups in 2015. The participants were similar with respect to age range and medications taken, although there were differences in gender, ethnicity, and the use of technology in day-to-day life (see Table 1). The first focus group was a knitting group comprising white British women. The participants had WiFi access at home, and all but one owned a smartphone; this participant had access to an iPad. The second focus group was a health and fitness group from Tower Hamlets comprising two women and four men; three participants were white British individuals and three were South Asian. Only one participant in the second focus group owned a smartphone and had WiFi access at home.

Themes

Various themes regarding barriers to and facilitators of the use of technology to help with daily medication taking emerged in this study (Table 2).

Table 1. Participants' characteristics.

Focus group	M/F	Age, years	Medications	Smartphone, PC, or touchscreen tablet user	Home WiFi access
1	F	65	Blood pressure, cholesterol tablets	Yes	Yes
1	F	72	Cholesterol tablets	Yes	Yes
1	F	76	Blood pressure, cholesterol, antiplatelet/ anticoagulant tablets	Yes	Yes
1	F	69	Blood pressure, cholesterol tablets	Yes	Yes
1	F	75	Blood pressure, cholesterol tablets	Yes	Yes
1	F	73	Cholesterol tablets	Yes	Yes
2	F	71	Blood pressure, cholesterol, type 2 diabetes tablets	No	No
2	F	73	Blood pressure, cholesterol, antiplatelet/ anticoagulant tablets	No	No
2	M	66	Cholesterol tablets	Yes	Yes
2	M	67	Blood pressure, cholesterol, type 2 diabetes tablets	No	No
2	M	75	Cholesterol tablets	No	No
2	M	67	Blood pressure, antiplatelet/anticoagulant, type 2 diabetes tablets	No	No

M, male; F, female; PC, personal computer

Table 2. Opinions on the use of technology to improve tablet taking in people aged >65 years.

	BARRIERS	FACILITATORS
Themes	Practicalities Capability and resources	
Familiarity	• Lacking familiarity with technology	• Welcoming technology when familiar (e.g., through a smartphone or watch)
Accessibility	• Worrying about accessibility (is technology easily available to use when needed?) • Memory problems can affect medicine taking despite the use of technology	
Alerting/Monitoring		• Seeing technology as memory aids through alerts/reminders • Improving medication monitoring by the care team • Real-time monitoring may prevent adverse events
Technology and use of healthcare resources	• Seeing technology as expensive in terms of costs and healthcare professionals' time	• Seeing technology as a way of maximising resources
Technology and cognitive impairments	• Experiencing significant cognitive impairments affects capability to both take medicines and use technology	• Advanced technologies (such as ISS) that require no technical expertise from patients and limited input by caregivers, such as charging batteries
	Perceptions Necessity beliefs and concerns	
Necessity Beliefs		
Presence of technology in everyday life		• Adapting to the increase in technology in everyday life
Importance of adherence to medications	• Thinking that cardiovascular medications are not necessary	• Believing that taking cardiovascular tablets is an essential daily activity
Concerns		
	• Thinking that technology reduces communication; impersonal • Worrying about technological failures • Worrying about data security and privacy • Worrying about dependence on others and on technology itself	• Thinking that technology reduces confusion with polypharmacy • Thinking that technology improves accountability to care team and to self • Being reassured by technology-linked dependence on others rather than self • Thinking that technology prolongs independence

Themes are divided into barriers and facilitators according to the PAPA framework.[27]
ISS, ingestible sensor system

The findings are presented within the following two main groups according to the PAPA framework:

1. Practical factors related to using technology with daily tablet taking (practicalities)
2. Beliefs about using technology with daily tablet taking (i.e., doubts about personal need for technology) and motivational factors (i.e., concerns about the technologies themselves)

Practicalities

Familiarity with technology. The extent to which individuals were familiar with a given technology had an impact on their attitudes toward using it in relation to taking medication.

Participants in the first focus group were accustomed to receiving phone reminders about healthcare appointments, had an understanding of mobile technology, and welcomed the idea of interventions through text messaging or phone alerts/reminders.

> *I mean it's a similar thing with now that hospitals, they text you to remind you about your hospital appointment now [FG1].*

Participants in the second focus group were not familiar with smartphones, but all used wristwatches and preferred interventions using this technology, such as smartwatches.

> *. . .watches, if we all had watches. . .*

> *If it's simpler to use elderly would appreciate more, it's something that they have on their hand, on their arm. . .*

> *It's a continuation of what we're familiar with instead of something that we're not familiar [FG2].*

Participants in both focus groups felt that those least familiar with technology would be the older, more vulnerable part of the population. Interestingly, they were also felt to be those who in theory would benefit most from the technology, thus negating its benefit.

> *A lot of older people who are 70 plus, 80s, 90s who are not going to have this technology, they're not going to have, and it's them people that are probably on the medication and it's more vital that they use the medication [FG1].*

> *95% of it I set up myself 'cos I'm fine with it now, I get my emails on the phone and send emails but you're not going to get elderly people [FG1].*

Nevertheless, the participants recognised that over time this will become less of a problem as the population as a whole becomes more familiar with technology.

> *Are you planning to keep using your smartphone and your internet access for the rest of your life? Yeah, I'm a man of the 21st century. . .[FG2].*

> *I mean we use things [technology] when we're doing our exercises to see how well we're doing, I mean that'd only be the same kind of thing just to do with taking tablets [FG2].*

Accessibility: technology readily available when needed. The ability to use different technologies varied throughout the population. Accessibility of technologies to users was identified as an important issue.

For example, some elderly people do not carry mobile phones with them at all times; they are more likely to wear a wristwatch, which is less likely to be left somewhere and forgotten.

> *The watch is good but the mobile phone, half the time old people don't know where*

they've put the phone, it's the same with glasses, they don't know where they've put them so it wouldn't be of no benefit, but that watch would [FG2].

Owning a phone does not necessarily imply easy accessibility to an intervention being delivered through it.

. . .a smartphone, well, I did have but I put it in the washing machine, I dropped it [FG2].

Moreover, while a technology may be familiar to a person, this does not necessarily mean it is easy to use or accessible to them. The participants in the health and fitness focus group were given pedometers as part of their programme. Some found the pedometers to be too complicated.

You're using a pedometer so you are already doing something.

Yeah, but I found it very difficult using it. . . [FG2].

. . .Well I'm not being funny and I'm not being rude but we're in Tower Hamlets and a lot of people are not really well educated to be doing these smartphones, some are, but a lot of older people. . . [FG2].

Technology as memory aid. One of the major perceived benefits of using technology to improve tablet taking was its use as a memory aid. Participants recognised that forgetting to take medications was a significant problem that would only increase with age.

I think it's good because there's some people who as time goes by lose certain of their faculties as time goes by, and memory beginning to fade and so on, so on, it could have been a short retention in memory can cause you to miss a [medicine]. . . [FG2].

Even participants with a routine or a system to remember tablets, such as calendar packs, acknowledged being susceptible to occasional lapses in memory and saw the benefit of prompting tablet-taking through technology.

. . .you always need to remember these things, they do slip your mind, even if there's days of the week printed on your tablets sometimes you think, "did I take it this morning?" [FG2].

Interestingly, participants highlighted that memory problems could negatively impact the use of technology (e.g., by forgetting to charge or check a device) just like they affected medication taking in the first place.

If they're not going to remember to take their tablets they ain't going to remember to charge their mobiles [FG1].

Technology can improve monitoring by care team. The storage of patient data through technology offers healthcare teams and carers the opportunity of being able to access patients' records of medication taking and therefore better monitor the patients' medicine taking.

I think you know, technology is getting better, I mean my doctor can access anything, ...he can access it from his computer and the hospital Consultant, he's able to have access to that information, I think that is useful [FG2].

I think it's a wonderful idea, because they're being checked and they're being monitored aren't they? [FG1].

A practical advantage of regular monitoring was the immediacy with which

information can reach healthcare professionals and therefore the potential for identifying problems before they become too harmful; e.g., regularly missing important medications or accidentally overdosing.

> *. . .[talking about a common acquaintance who is struggling taking medications] . . .that would have helped, they would have known that she . . .was not taking that[medicine][FG1].*

Technology and the use of resources. Participants showed awareness of the scarcity of resources in healthcare, both in terms of the economic costs of technology itself and its implementation, and the time that healthcare professionals spent monitoring collected data. Elderly people constitute a small proportion of smartphone owners, although they represent the population who would benefit most from this technology in terms of help with tablet taking. Making it accessible to them was felt to involve a significant financial outlay.

> *If it's got to be a smart phone rather than an ordinary phone the cost of providing these for all the elderly is going to be astronomical [FG1].*

Those who regularly struggle with their tablet-taking would be picked up by the technology, but this may create more work for healthcare professionals because all reports generated by the technology will need to be seen by both healthcare professionals and carers. This was perceived as inefficient use of professional time.

> *So every time this person gets their tablets wrong and makes a mistake, the GP is informed practically every day or a family member that they haven't taken their tablets properly. . ..*
>
> *And how on earth would GPs have the time [FG1].*

However, the participants recognised that while the immediate cost might be high, the benefits of regular medication reminders and monitoring could save unnecessary input from being sent to healthcare professionals and even prevent adverse clinical events, thus making it cost-effective overall.

> *So if. . .that's sent out to you and you took all your medication, the GP wouldn't see you so much would he, it'd cut that bit down wouldn't it? [FG2].*

Patients with significant impairments are the main beneficiaries of ISS technology. Participants recognised that in cases of poor medication adherence caused by reduced mental capacity or cognitive function, technology was unlikely to make a difference.

> *For somebody that's completely compos mentis I'd say brilliant, but we're not talking about those sort of people are we? [FG1].*

For patients with cognitive impairments or severe disability, the ISS was identified as the most useful technology because of the potential real-time identification of problems.

> *[Through using the ISS] someone like Paula [name changed to preserve anonymity] would flag up straightaway wouldn't she, that she doesn't know what she's doing [FG1].*
>
> *I think it's a wonderful idea, because they're being checked and they're being monitored aren't they? [FG1].*

The ISS seemed simple enough that, once set up, a minimal understanding of

technology was needed to use it; this could appeal to those not particularly comfortable with technologies.

That technology of actually ingesting a tablet… that's all you'd need to do and it would send a message to those who receive it to the server and they're able to monitor …you wouldn't find it helpful?

It might prolong independence, people's independence… [FG2].

The benefit of ISS technology will be less important where high-level monitoring is available, such as in a care home.

Most probably it won't be useful in homes and all that, care homes… [FG2].

Perceptions

Necessity

Presence of technology in everyday life. Individuals' beliefs regarding necessity determine whether they feel technology is necessary for improving their medication taking.

The participants stated that technology is becoming an ever-larger part of everyday life, is becoming essential for increasingly more people over time, and will become more prominent in healthcare. As the more technology-literate generations age, the elderly population will become more used to technology in the context of a daily activities such as medicine taking.

Now these things are being used more the older people will get used to them [FG1].

Necessity of technology to help with daily medication taking. Interestingly, while many participants considered that the use of technology to improve tablet taking was beneficial and even necessary for some people, most felt that they would not make use of it. They felt that technologies would be necessary for someone 'worse' than them.

I like to stay with some technology, so if there's an appropriate App of course then I'll use it accordingly you know, not for the sake of using it but if it's appropriate then I will use it [FG2].

This was particularly true of ISS technology.

I haven't got a problem with it, it's just that I don't think I take sufficient tablets and I do take them regularly [FG1].

Importance attributed to taking medication. Most participants recognised that considering medication taking to be important would strengthen their beliefs regarding the necessity of the use of technology.

You always need to remember these things, they do slip your mind, even if there's days of the week printed on your tablets sometimes you think, "Did I take it this morning?" [FG2].

The participants also acknowledged that some people intentionally fail to take their tablets because of motivation issues. The participants felt that technology is unlikely to help improve tablet taking in these circumstances and that these patients will likely not consider technology for their medication taking.

…Because like yeah, they [think that medications] are not doing them good

You can't force someone to take tablets if they don't want them

…or I mean a lot of them collect them but then they don't take them [FG2].

Participants in the first focus group discussed the issue of elderly people with significant physical and cognitive impairments who no longer wish to live and believe that medications are no longer needed. Although in theory they may be helped with tablet taking by technology, they might not wish to engage with it. In these cases, technology cannot be forced upon them.

> *A lot of people haven't got anything to carry on for, so you can't force somebody can you? [FG1].*

Concerns

Technology and patient–professional communication. A concern voiced by participants was that distance monitoring of tablet taking through technology can reduce the frequency of healthcare professionals' visits to patients or that their interactions may become somehow impersonal. Patients could be at risk of receiving less face-to-face care, in turn making the elderly more vulnerable.

> *Well I see [technology might cause] lack of communication between professionals and the very elderly…., I'm afraid that this is about cost-cutting [FG1].*

Technology and patients' accountability to the care team and to self. Participants felt that if they knew they were being monitored, they would be more accountable for their tablet taking and that this would encourage them to take their medication. Furthermore, greater involvement of the care team or their family support network would contribute to holding them accountable.

> *…that goes to your GP or a family member; they will know that you have been taking it [FG1].*

The health and fitness focus group compared the proposed technologies to their existing pedometers and saw benefits in being held more accountable not only to their care team but also to themselves because this increased self-awareness would have a positive impact on their daily routines.

> *I think they work; they do make you aware of what you're doing [FG2].*

At the same time, however, the participants acknowledged the risk that the technology would delegate the responsibility of tablet taking to family members and the care team rather than the patients themselves.

> *But that would literally stop you thinking wouldn't it, you'd think, "oh well, they'll know up the surgery whether I took it or not" [FG2].*

Potential technological failures. The second focus group was particularly wary of making technology a large feature of their lives and described how past high-profile failures of the implementation of technology in healthcare have had a significant negative impact on people's confidence in technology. As such, they were reluctant to completely trust in or depend on it.

> *You see this is in an ideal world, I remember there was, the National Health Service right, had invested billions into this high tech computer that was going to be doing all singing all dancing, and guess what, it never did work, so all the investment that they put into this main frame that would then take all the information, it had gone done, it had a bug, it had glitches and it never performed as fit for purpose, so I'm one of these guys who's lost confidence in technology [FG2].*

Moreover, technology itself could fail if, for example, it was not maintained properly.

.It's not fail proof is it, no.

.So it's not so much emphasis on what it can do, what happens when it doesn't do what it should be doing, then what happens next, is there a plan b? [FG2].

. . .I'm really sold on the watch, but. . .but there is some disadvantages, there's going to be a point where you need to put in new lithium battery. . .[FG2].

Technology is useful but you can't depend on it, you never can depend on it . [FG2].

Security concerns. Medication monitoring through technology was seen as more susceptible to misuse than was face-to-face healthcare. Some participants expressed concerns about the safety of their data and the possibility of their whereabouts being tracked through technology.

And I just think when we pick our phone up people know exactly where we are don't they?

. . .if you turn the location off on your phone then they can't put, then they can't find you. . . [FG1].

Dependence on others and on technology versus independence. A concern that emerged in discussion was the reluctance to become dependent on either other people or technology because both are fallible, and over-dependence could cause significant problems when technology or the chain of communication fails.

Just to give you an example, . . . there's some people who'll be told use a walking stick and then you rely on the walking stick so much then you can't take it from them, and some people says, "I'll only use it somewhere down the line, thank you for your advice but I won't, I'll struggle on". . .But some people you offer them a walking stick, they can't even get out the bed without it, so the question is to find a balance [FG2].

However, participants also recognised that receiving assistance with medications through technology would potentially be beneficial by allowing people to look after themselves better, reducing the need for carers or admission to care homes, thus prolonging independence with minimal support.

It might prolong independence, people's independence, . . .on a daily basis as right, this is just what I need to do. . . [FG2].

Others found that the opportunity to depend on someone else would be beneficial and bring peace of mind.

If you think it's going to help you and you're relieved that, you know, someone's going to help you take your medication I think there's far more people going to be like that [FG1].

Participation in studies that test technology to help with medicine taking. When asked about their willingness to enrol in a study testing any of the technologies, the participants generally replied positively, although there were differences between the two focus groups. While the first group welcomed participating in studies using technologies such as smartphones, touchscreen tablets, and smartwatches, the second group clearly indicated they would accept smartwatches only.

Everybody's been used to wearing at some time or another is a watch. . . [FG2].

...So I think ...from our little sampling survey of 6 of us, that most of us would find this much better... [FG2].

In relation to the ISS, participants in the first focus group stated that they would enrol in a study provided that they were reassured about its safety, while participants in the other group felt that the technology was too unfamiliar to consider it. Both groups asked questions about safety issues and any adverse events documented in previous studies.

Have you already done human trials?

And they've had no adverse effects?...

What happens when you have a bath?

I would be willing to do it but if I had it checked out that it wouldn't interfere with whatever else I'm taking [FG1].

...has it been tested in Sweden, has it been tested in Denmark, was there a model that you can follow or are you the front runners, the pathfinders, where are we in the technology? [FG2].

Discussion

We have herein described facilitators of and barriers to the use of technology (specifically through mobile phones, PCs, touchscreen tablets, smartwatches, and the ISS) to improve tablet taking in people aged >65 years on cardiovascular medications using the PAPA framework. Acknowledging and addressing these factors can facilitate the design of digital interventions for this patient group and their recruitment to studies.

Participants welcomed the idea of technologies as memory aids and as a means of monitoring medication taking. Familiarity and accessibility were key factors for accepting technology. Being affected by significant cognitive impairments was seen as an important practical barrier for which technology such as the ISS had potential to help.

Some participants saw technology as an unnecessary expense, while others considered it to be a way of maximising scarce resources and improving patients' independence. Similarly, some were worried about being overly dependent on the technology, while others thought it provided them with reassurance.

Strengths and limitations

The strength of this work lies in the open nature of the discussions on digital interventions through multiple technologies. These opinions may not be captured by studies focusing on specific digital interventions or technologies, but they highlight important factors to be considered when designing digital interventions to improve tablet taking in this patient group. Failing to consider these factors might affect recruitment and retention to studies and ultimately uptake of the technology itself.

Although purposive sampling was not used when recruiting participants from the two community centres (apart from age and treatment with cardiovascular medications), the participants were diverse in terms of their socioeconomic background and their familiarity and access to technology. However, the low number of participants, limited geographical area, and problems extrapolating our findings to the general population represent limitations[28] that necessitate a larger study in a wider geographical area. For example, while most participants in the present study were women, gender bias in access to and use of technology of women over men could not be ascertained and is open to further investigation.

Implications

Development and evaluation of the impact of digital interventions are priorities for healthcare providers on an international scale. Numerous technologies exist to aid patients with tablet taking and may additionally be used to monitor adherence.

Prior studies of the acceptability of technologies to improve tablet taking have focused either on the potential physical adverse effects of the technology[15] or specific practicalities and perceptions, such as usability.[22]

Our study identified a wide range of practical and perceptual barriers to and facilitators of the use of technology. Simple digital interventions to improve tablet taking in individuals aged >65 years hold potential, provided that they offer reminders and monitoring and are based on a technology that patients are already familiar with and have easy access to. Minimising barriers such as privacy concerns, discussing dependency on technology,[29] and having plans in place for technology failure would improve interest and consequently recruitment to research studies.

The results presented here are informative for healthcare practitioners, who are increasingly involved in advising patients about potential strategies to help with daily medicine taking. Non-digital strategies, such as multi-compartment compliance aids, are available to support medication adherence, optimise treatment benefits, and minimise waste. However, there is limited evidence to support their use.[30] Interestingly, participants in our focus groups suggested that those least familiar with technology (i.e., the older, more vulnerable part of the population) could be the ones who benefit the most from digital interventions. They indicated that the ISS is a promising approach because this technology seemed simple enough that, once set up, minimal technological understanding was needed to use it. Compared with non-digital strategies, the ISS was seen as offering the advantage of real-time monitoring and identification of problems before they become harmful.

Further research is needed to investigate whether perceived barriers and facilitators change over time as technology becomes more commonly used in this patient group.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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