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Smith, Suzanne

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Technical Support Needs of Older Users of Digital Health Technologies to Support Self-Management of Multimorbidity

Suzanne Smith¹[0000-0002-8486-7087], Patricia McAleer¹[0000-0002-4604-9067], Julie Doyle¹[0000-0003-4017-6329], Shane Gavin¹[0000-0002-4604-9067], and John Dinsmore²[0000-0001-8387-3496]

¹ NetwellCASALA, Dundalk Institute of Technology, Dundalk, Ireland
² Trinity College Dublin, Ireland

Abstract. Marketplace digital health and wellness devices have become more accessible, but there has been little examination of the specific issues that arise when such devices are deployed to large groups of novice digital technology users, such as older adults, for use over time. ProACT, a digital application and technology platform, is designed to support older people to self-manage multiple chronic health conditions. Analysis of technical support records, relating to participants of the 12-month ProACT proof-of-concept trial in Ireland, identified hardware, software and user issues with the technology. Meeting these needs required flexibility, good communication, respect, and speed from the research team. Enabling maximum engagement with new DHTs requires understanding the challenges end-users may experience, particularly those with minimal previous experience with such technologies.

Keywords: Older adults, Digital health, Multimorbidity, Technology use.

1 Introduction

Multimorbidity (the presence of two or more chronic health conditions), is both more prevalent among older adults and is considered the norm [1]. A cultural transformation in doctor-patient relationships, from a paternalistic to a shared-partnership approach to healthcare, encourages patients to take responsibility for the work of self-managing their own health and wellbeing [2]. Consumer oriented health and wellbeing devices proliferate the marketplace, often offering easy and inexpensive options for measuring wellbeing parameters. However, many ‘off-the-shelf’ digital health technologies (DHTs) are not specifically designed with the older user in mind, resulting in usability challenges [3].

For persons with multimorbidity (PwM), condition self-management is often burdensome, disrupting normal daily practices of living [4-5]. Successful DHT trials include a purposely-designed engagement ecosystem that considers technology usability, participant functional abilities, and the role of research team support [6-8]. This paper presents findings from technical support engagement with participants (n=60) in Ireland, during the 12-month ProACT proof-of-concept trial. ProACT is a digital

application and technology platform designed to support older people to self-manage multiple chronic health conditions with or without support from members of their care network. Findings will inform practical strategies for wide scale DHT deployment among end-users unfamiliar with digital technologies, who may also be living with burdensome health or wellbeing challenges influencing adoption of digital supports for health and wellbeing self-management.

2 Method

The ProACT CareApp is a Progressive Web Application (PWA) provided on an iPad. The ProACT technology kit consisted of an iPad and a selection of ‘off-the-shelf’ devices from Withings (including the Activité watch, Body Analyser weight scale and Blood Pressure Monitor [BPM]) and iHealth (SPO2 pulse oximeter, iGluco blood glucometer (BGM), wrist BPM, arm BPM). The CareApp is used to self-report on health and wellbeing (e.g. breathlessness, mood), set goals in relation to physical activity, add people to a care network with whom data can be shared, view educational information, and view data over time. The full ProACT platform, including all of its backend components, has been described elsewhere [9]. Data synced from the digital device to the related third party application (3PA), was collected through the open Application Programme Interface (API), and transferred to ProACT, where the data was aggregated and displayed via the ProACT CareApp dashboard.

2.1 Study Procedures

To minimise workload for participants and avoid using personal online accounts, the relevant apps (Apple, ProACT CareApp, Health Mate for Withings devices and iHealth and iGluco for the iHealth devices) were preloaded on the iPad and anonymous accounts for each participant was set up and managed by the research team. During deployment, the research team paired and connected devices to Bluetooth or WiFi as required. Trial iPads were set up without a PIN code, to facilitate ease of access for participants. Reviewing readings, answering daily reflection questions and reviewing collated health and ‘how-to [use the technology]’ information required opening the ProACT CareApp on the iPad provided. An easy to remember 4-digit pin was required to open the CareApp. The full trial protocol is described elsewhere [10].

The research team undertook extensive pre-trial testing of a range of potential (Withings and iHealth) devices to determine the most appropriate based on comfort, usability and reliability (e.g. of data transfer from devices to the ProACT CareApp). At least two researchers at each trial site continued device testing throughout the trial, to maintain familiarity with the devices and CareApp. Training was provided in person during deployment, which took place over two visits, to minimise overload on participants. Training videos were available through the ProACT CareApp and a paper-based training manual provided to each participant.

A technical support help desk (staffed by a member of the research team) was available during weekdays. A ‘please contact me’ button was included in the ProACT

CareApp to request a support call. Where resolution was not possible by phone, a technical support visit was arranged to the participant's home. A nurse-led triage service provided clinical oversight during the trial, by monitoring readings and phoning the PwM if readings breached acceptable parameters. Over time during the trial, the role of the triage team expanded to include making monthly care support calls to participants, which at times included participants identifying technical or participation challenges.

2.2 Data Collection and Analysis

During the trial, a help desk log of calls was maintained in a shared Google Sheets document. To facilitate expedient communication between researchers in the field trying to address technical issues, and colleagues in the office, a WhatsApp group was established. Findings, presented in this paper, are based on data collected from the help desk call log summaries, researcher WhatsApp text messages, and participant interviews. An inductive thematic analysis [11] was conducted and supported using NVivo software for Windows [12].

3 Findings

Trial participants (n=60) were older adults (65 years+; median age = 73 years), mainly men (n=35, 58%), with a range of multimorbid chronic health conditions. The majority of participants (n=35, 58%) were living with others. Eight participants withdrew and three died over the course of the trial. Quotes use the format: participant trial identifier, age, sex, and health conditions e.g. (P043, 77, F, COPD+CHF). References to help desk and WhatsApp communications note the relevant participant about whom the message was being sent e.g. (WhatsApp/Help desk, P043).

From 473 help desk issues logged, 399 (84%) related to technical support required by the participant. Administrative issues such as scheduling appointments, or notification that the participant was in hospital or would be away, and requests for test strips or batteries etc. made up the remaining 74 (14%) issues. Triage nurses also provided notification to the help desk (n=54, 10%), of technical issues identified during their calls with participants. Technical support needs were due to either hardware (n=183), software (n=126) or user issues (n=90).

Technical issues logged per participant ranged from 0-27 issues (mean = 7). Half of participants (n=30, 51%) required low levels of technical support, reporting fewer than six issues over the course of the trial, with nine (15%) participants reporting over 13 issues. Variation in the types of support needed also differed by trial month (Figure 1).

3.1 Hardware Issues

The BPM was most often cited in the help desk log (n=154), '*BP [blood pressure] cuff not working properly [participant] tried 11 times to get a reading*' (Help desk, P053). Repeated issues were also found with BPMs, '*When using the BP cuff blue lines appear on the screen, this happened 10 days ago was resolved with a visit but it is now*

appearing again' (Help desk, P001). Difficulties with the BGM were more likely to relate to questions about readings but occasionally participants identified malfunctions with the monitor, *'BG only working intermittently - sometimes reading will just not take even though lancing pen turned up to 5, and a lot of blood there'* (Help desk, P014). Most participants with diabetes already had a BGM and where the trial BGM was deemed unsatisfactory; participants manually entered readings from their own device.

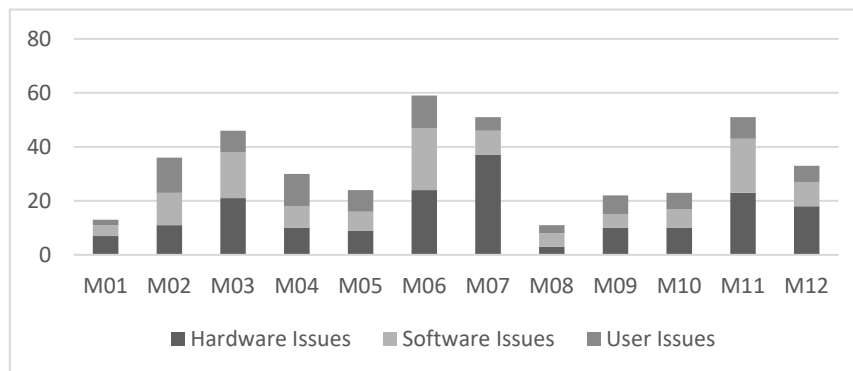


Fig. 1. Help desk technical issues by trial month

Issues with watches (n=39) included not displaying correct readings, *'[watch] is not working correctly, one min[ute] it's 2.40 and the next it could be 5.45pm'* (Help desk, P055). Attempts by both participants and researchers to correct malfunctions were not always successful, *'[Participant] has recalibrated the watch himself lots of times. Time is right, data displaying in HM [Health Mate app] right but the dial on the watch measuring steps is always at 5k'* (Help desk, P039). Furthermore, the silicone strap provided with the watch caused skin irritation for some participants, requiring replacement with leather watch straps.

The language used by participants was usually non-technical and terms such as having been 'logged out', devices having 'died', or iPads 'not working' were typical when participants made contact with the help desk team. However, iPad malfunction was rarely the cause, *'iPad working fine, however, BPM and watch weren't so these were exchanged'* (Help desk, P051). Battery life for each device type was established during pre-trial testing and a battery replacement schedule was established as part of the trial protocol. However, unscheduled battery changes were required for devices, particularly the BPM (n=23) throughout the trial. Watch batteries were expected to last nine months or more, yet despite a six-month battery replacement schedule five (8%) participants required early watch battery replacements. Reports of rechargeable devices failing to charge, was often due to use of the incorrect charging cable – all charging cables were white and with connectors of a similar size, making them difficult to tell apart. Some pulse oximeters also failed to hold a charge, requiring replacement. Internet connection quality was a challenge, requiring home visits to re-set devices, *'The participant's own iPad is working ok, yet the ProACT one keeps dropping off the WiFi.'* (WhatsApp, P038). Changes in broadband provider or interrupted internet connectivity (n=14) also

affected trial devices, *'P051 had power outage and now nothing [is] working!'* (Help desk, P051).

3.2 Software Issues

Software issues (n=126) represented 32% of technical support queries, while 30% (n=37) of software issues related to updates. Of these, most (n=21, 57%) were iOS update related, such as notifications that updates were required, leaving many participants unsure about what to do. Others, who responded to on-screen instructions to initiate the update were unable to follow the steps to complete the process, such as how to respond to a prompt for iCloud backup. In some instances, iOS updates stalled in the middle of the update. Following iOS updates, some iPads required a reset and for devices to be re-paired, usually necessitating a home visit to resolve.

The nature of the ProACT trial was iterative, with learnings applied to the design of the app and platform as data was collected during the trial. As the ProACT CareApp and data aggregation platform were updated, modifications were pushed to the app, in the background. Usually this process was seamless and participants were unaware of subtle changes in the functioning or appearance of the CareApp. However, at times, display issues arose when bug fixes and updates were applied, especially early in the trial, *'COPD symptom data graphs a mess today. Getting error messages for chest tightness, phlegm amount, cough'* (WhatsApp, P043). Server errors affecting access to the ProACT CareApp were also experienced, *'there is an issue with the server - developers say it is out of their control and they have contacted IT to try and resolve it'* (WhatsApp message).

Pairing issues (n=60) arose where devices proved difficult to pair with Bluetooth or WiFi, requiring additional visits to re-attempt connecting or to replace devices, *'[the] scales will not connect. Any recommendations? We've tried taking out the batteries, disconnecting from WiFi and turning iPad off. Still not connecting'* (WhatsApp, P010). At times, the device was not recognised by the relevant 3PA to pair. On other occasions, the device was displayed as paired with the app but there was no connection when attempting to use the device, *'...had to take her BP cuff [back] it would not pair no matter what I did with it and her watch wouldn't pair either...the WiFi connection seemed quite slow but that shouldn't have an impact on the Bluetooth?'* (WhatsApp, P013). At times, however, devices could not be unpaired, to enable re-pairing and to re-establish connection, *'...both [other researcher] and I found that we can't disassociate the watch from the HM app. When trying to do so we get kicked out of the app. Only way to do it is to associate the new watch and select Yes that we want the new one to replace the existing watch on the account.'* (WhatsApp message).

Data syncing issues (n=33) occasionally arose between the devices and their related 3PA, which in turn resulted in no data transfer to the ProACT CareApp. The devices with most data syncing issues were the BPM (n=9) and the BGM (n=12). Pairing difficulties with the BPM prevented data collection because the device would only work when paired with the app. By contrast, the BGM could be used without the 3PA and would hold a number of readings for later upload. This allowed participants to continue monitoring while awaiting a technical support visit. Manually uploading blood glucose

readings taken offline required opening the iGluco app to sync the data. BGM data syncing issues were, therefore, sometimes due to participants not opening the iGluco app. Nonetheless, it was not always possible to determine the cause of BGM syncing errors, *'BG readings appearing on glucometer screen and also on iPad but don't seem to be saving in iHealth [iGluco app]'* (Help desk, P027), requiring BGM devices to be replaced.

3.3 User Issues

Login difficulties (n=13) were reported by researchers addressing device 'lock out' issues, during home visits. In some cases either participants, or others, had set/re-set the iPad password, which the participant had then forgotten, *'Daughter phoned to say that there was now a passcode on iPad but there wasn't one before'* (Help desk, P025). Login issues also arose following 3PA updates, especially where participants may have responded to a prompt to update the app, which then required login details to proceed. Login details were also required to use the app following an update, *'PwM was logged out of Health Mate app, so logged her back in. When updating the apps, there were problems with validating the iHealth app'* (Help desk, P001).

Calls (n=10) were received requesting replacement of a range of hardware components from the trial-kit. Three participants reported losing watches while on holidays. Other requests were mainly for device charging cables, either because participants had lost them, or because participants believed the cables had not been provided. On occasion, it transpired upon a technical visit, that device cables were not lost but that the participant was using the incorrect charger, *'BPM wasn't charged (using wrong wire...)'* (WhatsApp, P010).

Reports of incorrect use increased during the early deployment phase but declined overall from trial month four. Incidences of incorrect use were greatest for the BPM (n=20), *'She tends to be talking and moving when using it which seems to cause the measurement to fail'* (WhatsApp, P028). Usability of the BPM was also a concern, *'[PwM] can't get BP cuff to work at all - she says when she puts it on she can't get it on tight enough and then when she goes to press the button on the iPad to take reading the cuff falls back off. Said she keeps getting a message saying measurement failed but also mentioned a red light on BP cuff'* (Help desk, P037). The BPM was identified as the most problematic device to use, *'P043 said cuff very hard to use. May try the other [iHealth] bpm with them and see if easier to use? Have had 3 people say this BP cuff is very hard to use'* (WhatsApp, P043). Furthermore, using the BPM was identified as a source of stress for some participants, *'P052 finding it very hard (to use BP cuff) and results in very high reading due to anxiety'* (WhatsApp, P051).

Concerns about the accuracy of readings (n=42) were noted in the help desk log (n=42) and WhatsApp messages, *'P055 has very irregular sleep patterns and the watch doesn't always pick it up properly.'* (Help desk, P055). For participants who had previously used self-monitoring devices, queries were raised about differences in reading values. This was particularly evident for blood glucose readings, where higher readings were noted on the BGM than on participants' own devices, *'...she's not happy with the iHealth glucometer it's showing readings that are much higher than what her own are showing and she's wondering should she be worried...'* (WhatsApp, P007).

3.4 Help Desk Support

Ongoing training was provided by telephone and during technical support visits (n=165). Help desk support was provided by project researchers, none of whom were product technical experts. As such, researchers were often trouble-shooting technical challenges in real-time, through trial and error, *'I think I connected to the 5g[GHz] with the iPad so the 2.4g[GHz] didn't show in the scales set up. So next week I will reconnect iPad to 2.4g[GHz] (if it is there!) and hopefully get it working'* (Help desk, P004). Where a home visit was unsuccessful, devices were returned to the office to be factory re-set and re-configured with the trial apps before being redeployed and paired with devices on-site, *'If I don't get it working I'll have to bring it away/replace or can I do hard reset?'* (WhatsApp, P010). Use of WhatsApp enabled real-time team collaboration for identifying cause and solution to technical challenges, *'I'm getting this message, never had this problem before. Has anyone any idea what's up?'* (WhatsApp message), or requesting passwords for 3PA accounts and facilitating two-factor authentication when re-setting up device accounts when in the field.

Participants recognised the technical support role of the researchers, *'Just the amount of effort that seems to be behind it, you know... It's sincere commitment, that's what I would call it, you know, rather than sort of just doing a job. Any of the [researchers] I spoke to so far, they all seem to be committed to the thing'* (P057, M, 83, CHF+CHD, T2). Patience was noted as an important characteristic in how technical support was provided. Likewise, speed of response ensured that self-monitoring by participants was not unduly interrupted by technical challenges, *'I was helped along every time and I offered to go in, take it in to get it sorted and I was told "no, no, no, you don't bother. We'll be out to you". And so [they] arrived straight away or as soon as possible to sort it out for me'* (P047, 69, M, COPD+CHD, T4).

4 Discussion

Participation in DHT trials requires mastery of both multiple domains (such as health interpretation and digital technology) as well as (often) multiple devices [11]. Understanding the nature and implications of providing technical support for the use of DHTs is not only pertinent to trials but also necessary for widespread adoption of new DHTs to be effective in real-world contexts [12-13]. The potential for low complexity technical challenges such as getting equipment to work, false alarms, faulty readings, battery life, power supply interruptions, and slow response time in resolving issues, to provoke sufficient irritation with unfamiliar technologies and trigger participants' withdrawal from DHT studies should not be underestimated [12-14]. Users who experience malfunctions in DHT are less likely to continue its use [15] even if users themselves cause malfunctions, such as forgetting to charge their device. Overall usability and reliability of self-monitoring devices, as well as the provision and nature of support to mediate digital self-monitoring, were found to be influential in maintaining ongoing engagement in the ProACT proof-of-concept trial [16]. While none of the ProACT research team were hardware or software technicians, they were sufficiently comfortable and familiar with the devices contained in the trial kit to provide fast, calm, and

effective responses. Nonetheless, issues arose that had not previously been encountered by the research team, or for which they may not have had the technical knowledge to evaluate, requiring real-time troubleshooting rather than either simple protocol-based responses or deeper technical evaluation. Familiarity with the trial technology, including the ongoing and sometimes changing functionality of the devices, as well as awareness of contextual factors for participants (such as health status), were critical to enable researchers to react comprehensively and reassuringly to participant concerns as they arose.

Ensuring both DHT trial participation, and effective implementation planning for real-world transferability of innovations, requires comprehensive understanding of the technical support needs of users such as older adults. This paper contributes to this knowledge and encourages further research with other cohorts of novice DHT users.

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