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BARRIERS AND FACILITATORS TO USE OF DIGITAL HEALTH TOOLS BY HEALTH CARE PRACTITIONERS AND THEIR PATIENTS, BEFORE AND DURING THE COVID-19 PANDEMIC: A MULTI-METHODS STUDY

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Complete List of Authors:	Turnbull, Sophie; University of Bristol Dack, Charlotte; University of Bath, Department of Psychology Lei, Jiedi; King's College London Aksu, Irem; City University of London, Department of Psychology Grant, Sabrina; Bristol Medical School Lasseter, Gemma; University of Bristol Ainsworth, Ben ; University of Southampton
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BARRIERS AND FACILITATORS TO USE OF DIGITAL HEALTH TOOLS BY HEALTH CARE PRACTITIONERS AND THEIR PATIENTS, BEFORE AND DURING THE COVID-19 PANDEMIC: A MULTI-METHODS STUDY

S Turnbull*, Bristol Medical School, University of Bristol, UK, Sophie.turnbull@bristol.ac.uk
C Dack, Department of Psychology, University of Bath, UK, cnd31@bath.ac.uk
J Lei, Institute of Psychiatry, Psychology and Neuroscience, King's College London, UK. jiedi.lei@kcl.ac.uk
I Aksu, Department of Psychology, City, University of London, UK. iremaksu96@gmail.com
S Grant, Translational Health Sciences, Musculoskeletal Research Unit, Bristol Medical School, UK, drsabrinagrant@gmail.com
G Lasseter, NIHR Health Protection Research Unit in Behavioural Science and Evaluation, Bristol Medical School, University of Bristol, UK, gemma.lasseter@bristol.ac.uk
B Silarova, Personal Social Services Research Unit, University of Kent, UK. b.silarova@kent.ac.uk
B Ainsworth, School of Psychology, Faculty of Environmental and Life Sciences, University of Southampton, Southampton, UK, ben.ainsworth@soton.ac.uk

*Corresponding author
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Abstract

Objectives

To explore how HCPs used and made decisions about DHTs in their clinical practice before and during the COVID-19 pandemic.

Design:

Multi-methods study. Semi-structured telephone interviews were conducted prior to the COVID-19 pandemic with a purposive sample of HCPs. An online survey was conducted with HCPs during the pandemic, to ensure that the qualitative findings remained relevant within the rapidly-changing healthcare context. Participants were recruited through HCP networks, snowballing and social media. Data were analysed thematically.

Setting:

Phone interviews and online survey.

Participants:

HCPs represented a range of professions from primary and secondary care across England, with varied socioeconomic deprivation.

Results:

24 HCPs were interviewed, and 16 HCPs responded to the survey. In the interviews, HCPs described three levels where decisions were made, which determined who would have access to what DHTs: health organisation, HCP, and patient levels. These decisions resulted in the unequal implementation of DHTs across health-services, created barriers for HCPs using DHTs in their practice, and influenced HCPs decisions on which patients to supply or discuss DHTs with. In the survey, HCPs described being provided support to overcome some of the barriers at the organisation and HCP level during the pandemic. However, they cited similar concerns to pre-pandemic about barriers patients faced using DHTs (e.g., digital literacy). In the absence of centralised guidance on how to manage these barriers, health-services made their own decisions about how to adapt their services for those who struggled with DHTs.

Conclusions:

Decision-making at the health organisation, HCP and patient level influence inequalities in access to DHTs for HCPs and patients. The mobilisation of centralised information and resources during the pandemic can be viewed as good practice for reducing barriers to use of DHTs for HCPs. However, attention must also be paid to reducing barriers to accessing DHTs for patients.

Keywords

Internet-based intervention; health care disparities; socioeconomic factors; primary care; digital health; health services accessibility; qualitative research

ARTICLE SUMMARY

Strengths and limitations of this study

- This is the first study to explore the impact of decision making around the use of Digital Health Technologies (DHTs) by health care practitioners on access to DHTs for patients, before and during the COVID-19 pandemic.
- We initially conducted a qualitative study just prior to the COVID-19 pandemic to explore how health care practitioners use DHTs and the potential impact on inequalities. To ensure our findings were relevant and informative in a 'post-COVID' landscape we developed and disseminated a questionnaire that explored whether COVID-19 had changed the way that healthcare professionals used DHTs.
- Double coding of a subset of interviews by five members of the team and ongoing discussion about coding structure ensured the coding scheme was robust.
- Challenges recruiting participants for both the interviews and the survey, may limit the generalisability of the findings.
- As patients were not included in this study, reflections about the barriers patients experience accessing DHTs are from the health care practitioner's perspective.

BACKGROUND

In recent years, primary care practice has rapidly increased the use of Digital Health Technologies (DHTs) (1).DHT's include smartphone apps, digital tools for diagnosing or treating conditions, wearable devices (e.g. pedometers) and platforms that provide remote healthcare (2). This has been accelerated by the COVID-19 pandemic, in which the majority of face-to-face appointments were suspended and Health Care Practitioners (HCPs) were required to encourage the uptake of digital self-management tools for patients, including using remote consultations and mobile health apps (3-5). DHTs have the potential to increase access to health interventions, whilst reducing demand on an overstretched healthcare system (6-8). The National Health Service (NHS) Long Term Plan has outlined the role of DHTs in transforming 'healthcare in the digital age', to achieve the goal of delivering world-class personalised medicine in primary care practices and social care (1). However, the successful implementation of DHTs relies on both the patients and HCPs being willing and able to engage with these interventions (9, 10), and there are ongoing concerns about the impact of DHTs on health inequalities (11).

DHTs have been found to be effective in supporting patients to self-care for a range of health conditions (7, 12-15). Health interventions designed specifically to support disadvantaged groups can be more effective for those groups, thus reducing inequalities (7, 14, 16, 17). However, recent evidence has found that such benefits may be limited for people from lower socio-economic groups, who do not have the resources (such as time, finances, technical proficiency) to access and use DHTs (18-20). Less is known about how HCPs use DHTs for helping patients to manage their own health and wellness, the barriers

they face doing so, and the implications this may have for the access to DHTs for their patients (9, 19, 21). There are indications that HCPs face challenges incorporating DHTs into their existing systems and practices, and establishing risk and rapport with patients in remote consultations (9, 21). Patients have also reflected that they feel HCPs have limited knowledge of what self-care DHTs are available and effective (19).

Our multi-methods study was designed to explore how HCPs (e.g., General Practitioners (GPs), nurses, pharmacists) used and made decision about DHTs in their clinical practice before and during the COVID-19 pandemic. We aimed to 1) understand barriers and facilitators to the use of DHTs by HCPs, and the implications for the access patients have to DHTs, and 2) whether these changed during the pandemic.

METHODS

Design

This study adhered to the COREQ (Consolidated Criteria for Reporting Qualitative Research) guidelines on the reporting of qualitative research (22). It was a multi-methods study, comprising semi-structured interviews and an online survey with HCPs working in English primary and secondary care services. The interviews were conducted prior to the pandemic (November 2019-March 2020) and the survey was conducted during the pandemic (July 2020-August 2020). Both studies explored how HCPs accessed and used DHT. The methodological orientation of the study was a mixed inductive and deductive approach (23, 24). Ethical approval was granted by the University of Bath's Psychology Research Ethics

Committee for the interviews and survey (PREC reference number: 19-211 and 20-142 respectively).

Interviews

Participants

Participants for the interviews were recruited through a range of networks, including National Institute of Health and Care Research School of Primary Care Research, community networks, social media (snowballing), and Academic Health Service Networks across England. HCPs were purposively sampled to represent primary and secondary care health professionals from a range of backgrounds from across England, working in locations that varied in their level of socioeconomic deprivation (Table 1). Socio-economic deprivation was determined by collecting the postcode of the health service where the HCP worked, and mapping it to the England Indices of Multiple Deprivation (IMD)(25).

Procedure/Data collection

The topic guide (see Supplementary material) was developed through author collaboration, consultation with qualitative experts, and input from Patient and Public Involvement representatives. The topic guide was piloted and revised for clarity following feedback from two GPs.

All interviews were semi-structured and conducted over the telephone by the same researcher (JL). All participants were provided with written information via email about the study before agreeing to be interviewed. Participants were informed that the purpose of the study was to explore which DHTs are used by healthcare professionals in their clinical work, how these tools were used to support their daily tasks (both client and non-client facing),

and their experiences with different DHTs. At the beginning of each interview participants were given the opportunity to ask questions, were assured of their voluntary participation, and could withdraw their data until anonymisation and analysis. Participants provided informed consent using an online form before the interview. Interviews were conducted via phone at a mutually convenient time, lasted 17 to 51 minutes (mean = 32 minutes; median = 30 minutes), and took place in private, quiet settings, often participants' offices or homes. HCPs received a £70 payment as compensation.

Each participant took part in one interview, with no repeat interviews. Short field notes were taken during the interviews. All interviews were audio-recorded, transcribed, anonymised and imported into NVivo Software (NVivo qualitative data analysis Software; QSR International Pty Ltd. Version 1.6.2). Transcripts and findings were not returned to participants for comment or correction. Interviews were undertaken with all willing participants, with the sample size guided by principles of information power rather than data saturation (26).

Data Analysis

Analysis of qualitative data began shortly after data collection started and was ongoing and iterative. Corrected, anonymised transcripts were coded using NVivo software. An inductive thematic analysis approach was used for the analysis of the qualitative interviews (23), subsequently a deductive approach was taken to investigate similarities and differences between themes emerging from the surveys (24). Initial codes were developed by JL. Five members of the multidisciplinary research team also coded a sample of transcripts and then met to discuss and develop significant broader patterns of meaning (potential themes). ST

organized the codes into final themes, which were agreed upon by the core team (ST, BA, and CD).

Research team and reflexivity

Personal characteristics

JL, a female PhD student in clinical and developmental psychology during data collection, conducted all interviews. JL received postgraduate training in qualitative methodology and had experience with semi-structured interviews and thematic analysis. She was supervised by senior academics experienced in qualitative research (CD and BA).

Relationship with participants

There was no prior relationship between the research team and study participants. The participants knew that the study was about the use of DHTs in primary healthcare, and that JL was a student researcher. The position taken by JL was that DHTs have the potential to empower people in self-monitoring and care and facilitate HCPs to share wider range of resources with patients from diverse backgrounds. However, JL felt that there may be barriers in assessing the quality of different DHTs by HCPs, and accessibility regarding both hardware and software issues for patients from more disadvantaged backgrounds.

COVID-19 Survey

As interviews occurred before the first UK COVID-19 lockdown in Mar 2020, we developed an online survey to capture evolving healthcare delivery, ensuring continued relevance to the changing context. The survey sought to understand general views on DHTs and specifically how the COVID-19 pandemic affected their usage. The survey (see

Supplementary materials) included free text responses, multiple choice questions and Likert scales. Feedback from three GP stakeholders informed the optimisation of the survey.

Participants were invited to complete the survey through advertisements on social media (Twitter) and email, disseminated through academic primary care research networks and departments. English-speaking HCPs that use DHTs were included in the study, with no further exclusion criteria used for participant recruitment. Data collection took place between July 2020 and August 2020. Informed consent was obtained before survey participation. Participants were given the option to enter a prize draw for a £50 Amazon gift voucher as an incentive.

ST analysed the free text responses thematically by ST using the coding structure developed during the analysis of the qualitative interview data (included in the coding tree in the Supplementary material). Themes emerging from the survey were discussed and refined by ST, CD and BA.

RESULTS

In total 24 HCPs were interviewed: 10 GPs, 4 nurses, 8 pharmacists, 1 psychologist and 1 systems manager; their characteristics are outlined in Table 1. Participants approached the study if they were interested, there were no participants who dropped out of the interview study. Most of the HCPs were women (63%), in the 31-40 age range (58%), worked in a GP practice (46%), had been in their role for 1-5 years (58%) and had 1-5 years' experience using digital health tools in their practice (67%). The median practice IMD decile was 4

(interquartile range 3-8) (25), indicating the participants worked in more deprived areas than average for England.

22 HCPs consented to take part in the survey, however 3 participants were excluded as they did not report their job title and an additional 3 participants were excluded as they did not finish the survey. We do not have information on the completion rate of the surveys, as we only received surveys that were completed. This left a total of 16 HCPs: 7 GPs, 4 pharmacist, 2 nurses, 1 dietitian, 1 clinical psychologist and 1 cardiac surgeon (Table 1). There were 9 women and 7 men, with an age range of 28 to 66 (*M*= 41, *SD*= 11.6) and the years of experience ranging from 1 year to 43 years qualified.

Table 1: Participant demographics

Demographic characteristics	**Qualitative interview sample N=24**	**Survey sample N=16**
Gender (n)		
Male	9	6
Female	15	10
Age range (n)		
21-30	5	4
31-40	14	7
41-50	3	2
51-60	2	2
61-70	0	1
Place of work (n)		
Medical School & GP Practice	1	0
GP Practice	11	9
University	1	0
Hospital	5	3
Turning Point	1	0
Community Pharmacy	2	4

NHS Trust	2	0
Integrated Urgent Care Service	1	0
Length of time in role (n)		
<1 year	7	0
1-5 years	14	11
6-10 years	0	2
>10 years	3	3
Time using digital health tools (n)		
"The whole time"	1	Not collected
"Not long"	1	
<1 year	3	
1-5 years	16	
6-10 years	2	
>10 years	1	
Socio-economic deprivation of practice area (Median, Interquartile range)		
Practice IMD Decile (1 most deprived and 10 least deprived)	4 (3-8)	Not collected

Digital Healthcare Tools used

HCPs discussed a range of technologies that they considered to be a DHT, including: treatment algorithms, digital self-care behavioural interventions, email text and video call consultations, correspondence with patients (e.g., practice text message systems), and data storage systems.

Results from thematic analysis

There were two main themes that emerged from the interviews conducted prior to the pandemic: the role of DHTs in HCPs clinical practice, and decision-making at three levels that determined who got access to what DHTs. There was an additional theme from survey, where HCPs described changes in access to and the use of DHTs during the pandemic. An outline of the themes and subthemes are available in Table 2.

Table 2: Themes and subthemes

Theme	Subtheme
Role of digital healthcare tools	None
Levels of access to digital health tools: Health organisation level	• Influence of strategic decisions and incentive structures
Levels of access to digital health tools: Health Care practitioner level	• Health Care Practitioner's digital skills • Health Care Practitioner's knowledge of what DHTs were available and effective • Health Care Practitioner's perceptions about digital health tools • Health Care Practitioner's access to training and informal support within the organisation or practice
Levels of access to digital health tools: Patient level	• Health Care Practitioner's perceptions of which patients can use and benefit from digital health technologies • Health Care Practitioner's making judgements about who to use DHTs with
Changes in access to and use of DHTs during the pandemic	• How HCPs adapted to a remote-led model of care during the pandemic • Barriers and facilitators to providing care through DHTs during the COVID pandemic • Barriers and facilitators for patients accessing care through DHTs during the COVID pandemic

Pre-pandemic interviews

Role of digital healthcare tools

In the interviews that were conducted prior to the COVID-19 pandemic, HCPs generally viewed DHTs as having the potential to make information and services easier for patients to access. However, some HCPs felt that DHTs were not suitable for everyone under every circumstance, and that remote consultations could not replace the '*human side and that caring side'* (ID P5) and they '*shouldn't be done at the expense of face-to-face consultations.' (ID P8)*

Decision-making at three levels that determined who got access to what digital health tools

Prior to the pandemic, three levels were identified where decisions were made about who should have access to what DHTs and what support they would receive to access them. These were the 1) health organisation, 2) HCP, and 3) patient levels.

Health Organisation level

Influence of strategic decisions and incentive structures

HCPs described how strategic decisions made by individual health services and incentive structures created challenges for the adoption and implementation of DHTs. There was generally a perception that there was no cohesive digital strategy across healthcare services with *'…all practices are doing slightly different things' (ID P2).* An HCP felt that it was challenging for practices to prioritise the adoption of DHTs because they were not supported by traditional incentives structures, which would compensate for the time involved in managing the new digital treatments and services:

> *'… [digital health is] not one of the key performance indicators (…) it's not yet at the point where commissioners are saying, look, you know, you said to us, you're going to offer digital interventions. Show us by March that you've offered 2500. (…). it's often commissioners that drives practice because obviously commissioners are the ones that actually pay for the services.' (ID P15)*

HCP level

The uptake of DHTs by HCPs and their decision to recommend them to patients, was influenced by: the HCP's digital skills, their knowledge of what DHTs were available and

effective, their perceptions of the quality of DHTs, and the availability of training and informal support for HCPs to use DHTs.

HCP digital skills

HCP use of DHTs in their practice and their ability to recommend them to their patients, was reliant on their digital skills. Some HCPs described finding technology '*intuitive and quite basic'* (ID P17). Others felt a lack of digital skills were a barrier to them supporting patients: '*I've actually found that simple things [using DHTs] I don't know how to do, it means that I can't do my job, just because I've not had the training'* (ID P22).

There was a perception by some of the participants that older HCPs would struggle to learn about and use new DHTs, because they '*were not responsive to learning the new ways of doing things…'* (ID P30).

HCP's knowledge of what DHTs were available and effective

HCPs were aware there were lots of DHTs available that may be able to support their practice and patients, but many felt they did not have specific knowledge of what they should use or how they worked. One participant spoke about how multiple different digital systems were being introduced in their practice, that '*have got amazing functionality but we don't know about it and we don't know how to use it*' (ID P10). Another described how there were *'websites and apps that I've got experience of using and are very happy to recommend'*, while other DHTs they had heard of but '*don't know how good they are'* which impacts how they '*sell*' DHTs to their patients (ID P8). A participant described how the high

workload for HCPs presented challenges for them to remember what DHTs are available and how to use them in a short consultation:

> *'…people will do the training and then they've got loads of other things do it. They'll forget about it. So at the point (…) I'm thinking this client could maybe do digital, but I can't remember how to log on.' (ID P15)*

HCP perceptions about the quality of DHTs

HCPs made judgements about what DHTs to use or recommend to patients based on their perceptions of the quality or reliability of DHTs. They talked about the challenges in determining which DHTs were trustworthy, and which were *'flawed and quite risky'* (ID P10). Some HCPs talked about being happy to recommend government-led online sources of information, like the National Institute of Clinical Excellence (NICE) website, because it was a *'reputable source'* (ID P13).

There was a sense from some of the HCPs that DHTs could not always be trusted to manage or deliver patient care. One participant felt that if there was something important that needed to be communicated with a patient '*someone needs to phone as well, we can't totally trust the technology'* (ID P20). Another recalled incidences where '*systems have just gone down and then you're completely stuck'*, making it impossible to access essential patient information (ID P7).

Access to training and informal support within the organisation or practice

HCPs described how the provision and quality of formal training to use DHTs was variable across health services, and consequently it was '*learn by using'* (ID P4). Some felt formal

training for DHTs was not accessible for HCPs because they had to '*take time out of your practice'* (ID P1), which they did not have. For those who had attended training, some HCPs felt it was useful, while others felt they did not *'meet a broad range of people's learning needs*' (ID P13).

Many of the HCPs described how they learned about DHTs and their features through other HCPs in the health service where they worked. The availability and quality of this support was not consistent across practices or organisations, and was determined by the level of digital skills of the people working in the individual health service:

> *'…someone in the practice has either figured it out or seen it elsewhere and then they show someone else and so some people know how to do it. Some people don't. It's all a bit patchy…' (ID 10)*

Patient level

HCPs made judgements about which patients would benefit from DHTs. Their perceptions often influenced whether they recommend DHTs or used them with patients.

HCP's perceptions of which patients can use and benefit from DHTs

HCPs generally believed that DHTs were most suitable for digitally literate, '*young, fit'* (ID P2) individuals, and those who were '*able bodied and mentally able'* (ID P32).

HCPs identified patient groups who they thought faced barriers accessing and using DHTs. This included patients with '*very low literacy'* (ID P10), '*whose language is not English'* (ID P5), and those who '*never embraced the internet or any digital tech'* (ID P32). Some patients

were viewed as more isolated, lacking support from a '*team or family or carers*' to help them access DHTs (ID P12).

Some DHTs placed criteria that excluded vulnerable and underserved groups. For example, a HCPs also spoke about the Babylon app that has: '*excluded a ridiculous number of people from being able to use its service (…) like no woman can become pregnant, no one with social service needs, no one with mental health problems, so there's many exclusions for people with the highest needs.' (ID P9)*

There were conflicting opinions about digital health accessibility for people who lived in lower income areas. Some felt most people with lower incomes '*have phone access now anyway, so they will rely on their phones and online'* to access health information and support (ID P4). However, concerns were raised that the '*disadvantage of the digital stuff is potentially exacerbating health inequalities'* (ID P8). A participant described the intersection between age and deprivation being particularly problematic:

> '*…we work in a relatively deprived area and most to our particularly younger patients do have Internet access and you know have mobiles, but a lot of our older patients don't' (ID P8).*

Although many HCPs spoke about how the elderly could be excluded from using DHTs, some had their presumptions about age-related technology uptake challenged by experiences with older patients being adept at using DHTs:

> *'… a chap who was 80 years old, he came into my clinic room (…), he opened his tablet and he logged on to his own umm… personal page on his*

own practice to give me information. (…) I was like oh gosh that's really impressive can I have a look' (ID P20).

Conversely, an HCP had found that *'…a lot of young people don't want treatment digitally' (ID 15)*, because they were concerned around inadvertent disclosure of stigmatised health conditions:

'…they're saying, actually, I don't want something on my phone that my mates going to see. And it's got something about anxiety on it or it's got something like I'm a family member of somebody with an alcohol problem' (ID P15)

HCP's making judgements about who to use DHTs with

The perception of HCPs about the appropriateness of DHTs for a specific patient group influenced their decisions regarding DHT use. HCPs described how they were less likely to communicate with older adults or those with '*mental disabilities'* (ID P9) using DHTs. Several HCPs said they were less likely to engage in discussions about or supply DHTs to discuss or older patients:

'…the older generation are a little bit 'oh no, I don't want to do that', or 'it confuses me'. So yeah, I judge who I would discuss apps with and technology with age wise…' (ID P32)

A participant stated that their team were targeting '*the younger ones'* in their roll out of an app to support people with bowel cancer (ID P25). However, she acknowledged that the majority of their '*patients are 70-89'* and were *'not going to be able to use the app'* (ID P25).

Some HCPs described how the perception that someone was lacking digital skills, resulted in them being prioritised for face-to-face consultations, when '*clinically, they didn't need that priority*' (ID P5). A participant reflected that '*the less digitally enabled person might get more of my attention than the more digitally enabled'* (ID P11).

COVID 19 Survey

Changes in access to and use of DHTs during the pandemic

HCPs who completed the survey about their use of DHTs during the pandemic, described a dramatic shift in '*practice to almost completely remote working'* in response to government implemented COVID restrictions (Survey ID 10). They described how: they adapted to this shift, the barriers and facilitators to providing care almost exclusively through DHTs, and their perceptions of the barriers and facilitators for patients accessing care through DHTs during the pandemic.

How HCPs adapted to a remote-led model of care during the pandemic

Some of the HCPs reflected positively on the shift to the delivery of care through technology. Participants described how being '*forced to engage better with digital technology'* (Survey ID 25), made them realise '*the potential of just what you can do by phone (and sometimes video)'* (Survey ID 9). An HCP concluded that '*It has changed the way we work for the long term, I think in a good way.*' (Survey ID 25). However, several of the HCPs cited similar concerns to pre-pandemic about practising through remote appointments. They found it: '*more difficult to understand a patient's problem and support them when you are unable to see them in person and perform certain tests'* (Survey ID 15).

In addition to hindering the development of an '*appropriate patient physician relationship*' (Survey ID 17).

Barriers and facilitators to providing care through DHTs during the COVID pandemic

The barriers to providing care through DHTs during the pandemic described by the HCPs were similar to pre-pandemic. These included '*Internet problems'* (Survey ID 13), issues with DHTs being properly approved and integrated through healthcare services, '*Issues around consent and data sharing'* (Survey ID 25), and staff being willing or able to engage with DHTs. For example, a participant described how '*some older staff didn't want to work digitally and struggled to accept change'* (Survey ID 10).

However, HCPs described having more resources available to overcome these issues during the pandemic compared to prior to the pandemic. An HCP described how their organisation '*facilitated*' the use of DHTs '*more and removed any existing barriers'* (Survey ID 28):

> *'...initially [there was] lots of confusion over how we were going to be able to offer patient appointments and what apps etc were NHS approved etc. The local Primary care network were fantastic in supporting local surgeries in implementing change. Barriers also were financial, but when funding was granted for extra equipment etc, there was a boom in embracing new ways of working(...) there was so much change happening at once, that it was sometimes difficult to keep up with the latest information and what was available to use. An online network called Teamnet became the 'go to'*

site for updated information and technology and government updates.'

(Survey ID 10)

Barriers and facilitators for patients accessing care through DHTs during the COVID pandemic

The HCPs felt that some patients faced challenges when they were '*forced to adapt and resort to digital tools*' in the pandemic (Survey ID 25). However, they felt most patients were able to engage with the new way of accessing health support and were more '*accepting of the technologies as there isn't an alternative'* during lockdown periods (Survey ID 6).

For those patients who did face barriers in accessing and using DHTs, the issues described by the HCPs were similar to pre-pandemic. HCPs felt that '*there is still a group of patients and conditions for which face to face consulting is preferable'* (Survey ID 9). A participant spoke about '*poorer patients not having internet or not [being] aware of how to use [the internet]'* (Survey ID 30). An HCP described how: '*…elderly patients with no mobile phones or laptops have felt isolated and victimized, age discrimination really. Some cannot or will not embrace technology and want to be seen face to face or can't get phone to connect to video call...' (Survey ID 6)*

HCPs highlighted ways in which their services adapted to improve access to health services for those who faced challenges using remote consultations during the pandemic. Most of the HCPs described offering phone consultations, or face-to-face consultations with '*PPE equipment'* (Survey ID 30) '*where safety can be maintained'* (Survey ID 28). Some HCPs spoke about how their services made further adjustments to the delivery of their digital

support, by establishing alternative people to contact if the patient did not have good digital skills, or by providing equipment to access services: '*Patients who do not have access to any digital tool (mostly elderly) we usually contacted their children etc who would be able to assist them'* (Survey ID 15). A participant spoke about how they had '*obtained consent for patients who don't have smartphones, to allow them to use a neighbours phone (…) to make a video call'* (Survey ID 10). A participant described how their service provided '*mobile phones for homeless clients'* (Survey ID 14).

DISCUSSION

Principal findings

In our pre-COVID-19 pandemic interviews, HCPs across different healthcare settings in England generally acknowledged the potential benefit of DHTs in enhancing patient access to healthcare services. However, they expressed concerns regarding the appropriateness of DHTs for specific patient populations, viewing face-to-face appointments as superior in certain situations. The HCPs described three levels where decisions were made which determined who would have access to what DHTs. These were: the health organisation, HCP, and patient levels. At the organisation level, HCPs described a lack of cohesive strategy across healthcare services and traditional incentive structures targeting digital health, which resulted in disparities in DHT adoption. At the HCP level, a wide variation in digital skills and knowledge of DHTs created barriers to HCPs using these tools in their practice and recommending them to patients. HCPs described a lack of high-quality centralised information and formal training, and inconsistencies in provision of support across practices or organisations. At the patient level, HCPs held beliefs about groups of patients they felt would benefit from DHTs (e.g., young and fit). These preconceptions influenced HCP's

decisions on whether to introduce DHTs to patients and whether to use these tools for patient communication.

In the survey conducted during the pandemic, the HCPs described an almost complete shift to remote delivery of care. While many barriers to DHT use persisted, HCPs reported receiving significant support to overcome these challenges during the pandemic. This included support from the local Primary Care Networks to implement the shift to digital services, funding for extra equipment, and an online network (e.g., Teamnet) that provided the most up to date information about what DHTs were available.

HCPs felt that the majority of their patients were able to adapt to the change in the delivery of services, mostly due to the lack of alternatives during the pandemic. However, similar concerns regarding digital exclusion persisted. To address these issues, HCPs implemented strategies to enhance access to healthcare services for patients facing difficulties with DHTs. This often included offering face-to-face appointments with the HCP wearing full personal protective equipment (PPE) or providing additional support for accessing digital services.

Strengths and limitations

To the authors knowledge, this is the first study to explore the impact of decision making around the use of DHTs by HCPs on access to DHTs for patients, before and during the COVID-19 pandemic. In addition to our planned qualitative study, we developed and disseminated a questionnaire that explored whether COVID-19 had changed the way that healthcare professionals used DHTs. By doing this, we were able to ensure that our earlier 'pre-COVID' work was still relevant to inform future research and policymaking.

Complete audio data was recorded for all interviews, and there were no issues with lost data. Double coding of a subset of interviews by five members of the team and ongoing discussion about coding structure ensured the coding scheme was robust. Multiple views of the data promoted confidence in the credibility of the findings (27). A diverse range of experiences and opposing sides of arguments were identified and presented.

There were challenges recruiting participants, which resulted in relatively small samples for both the interviews and survey. This may have resulted in important experiences related to DHT access and use not being captured. As patients were not included in this study, reflections about the barriers patients experience accessing DHTs are from the HCP's perspective. Consequently, this may not accurately reflect the barriers and facilitators patients experienced accessing DHTs prior to and during the pandemic.

Interpretations in the Context of Existing Literature

Our study agrees with previous qualitative research conducted in the United States, that emphasised the influence of organisational context on DHT access (28). Puckett et al. (2020) found that inequality in access to diabetes pumps was related to whether the clinic distributed resources equally as standard policy, or whether they provided patients with access dependent on their pre-determined policy/eligibility (e.g. interaction with the health service) (28).

Our study found that during and prior to the pandemic, HCPs had concerns about accessibility of online consultations, and made adaptations to support patients who were

less digitally literate or did not have internet access. These findings are similar to those of recent qualitative studies conducted before (20), and during the pandemic (29), where HCPs reported that remote consultations could improve access for some groups (e.g. those with caring responsibilities, not able to leave their homes) (20, 29). However, they also had concerns about digital exclusion and accessibility for some patients (20, 29), and described providing face-to-face appointments for those who they perceived to be less able to use the digital services (e.g. older adults))(20).

Two YouGov surveys of NHS staff and patients found that while the majority of patients and NHS staff responded positively to the increased use of technology in healthcare during the pandemic, certain groups, including those over 55, individuals with caregivers, or those unemployed, reported negative experiences with DHTs more frequently than the general population(5). This corresponds with the perceptions of the HCPs in our study, that the majority of patients adapted well to delivery of care through technology. But those who were older and had lower incomes faced greater barriers accessing DHTs before and during the pandemic.

In our study, some HCPs described having limited knowledge of what DHTs were available and what to recommend to their patients. This corresponds with the findings from a qualitative study exploring digital access for patients with T2D, where participants felt HCPs were not knowledgeable about self-care DHTs (19).

Implications for Research, practice and policy

Improving digital infrastructure and training of HCPs

The centralised response to the pandemic and the way in which barriers to accessing DHTs were universally addressed in healthcare services across the United Kingdom described by HCPs in our survey, can be seen as an illustration of good practice in tackling inequalities in access to DHTs at the organisational and HCP level. A recent white paper the Department of Health and Social Care laid out the aim to make the innovations that the COVID pandemic accelerated permanent (30). However, it is unclear what support will remain to reduce barriers to accessing and using DHTs, and whether this will be universally provided. Future support could consist of government funding and incentives, ensuring HCPs have access to and are aware of central repositories that provide up-to-date information about evidence-based DHTs that they could recommend to their patients (e.g. ORCHA), and support for health services to adopt innovations (e.g. Adopting Innovation programme (5)).

Reducing inequalities in access to DHTs for patients

The HCPs in this study did not describe any centralised provision of support to ensure less digitally engaged patients had access to DHTs during the pandemic. Instead, individual HCPs and health organisations made decisions about who could benefit from DHTs, and what support would be offered to reduce barriers to accessing DHTs. By making judgements about who can benefit from DHTs, HCPs are potentially preventing some patients from being able to benefit from these services, which has implications for inequalities in access to healthcare. This is particularly poignant as we move towards the 'digital first' service as laid out in the NHS Long Term plan (1). To avoid digital exclusion, through the lack of provision of information about DHTs, it could become standard policy that all patients should be signposted to evidence based DHTs. This could be sent to patients utilising existing systems

(e.g., accuRx) so as not to add additional burden on to HCP, and to circumvent HCPs acting as gatekeepers to DHTs. HCPs could also be provided with information about where to signpost patients for support to access or use DHTs. Digital participation schemes piloted by NHS digital have been successful in reducing inequalities in access to DHTs, by providing people with low digital literacy with support from digital champions (31, 32). Although there are plans to roll these out more widely following the success of the pilots (31), current unequal provision of these services across the UK risks widening digital inequities in areas not served by these schemes. Speeding up the availability of this support could involve the development and roll out of engaging accessible training for digital health champions and access to up-to-date resources these digital champions could refer to.

Conclusions

This research has highlighted how decision-making at the health organisation, HCP, and patient levels influence inequalities in access to DHTs for HCPs and patients. The pandemic prompted the centralised mobilisation of resources for health organisation and HCPs to access and implement of DHTs. However, the patients still faced uneven access to DHTs, determined by decisions made by individual health services and HCPs. Attention must be paid to ensuring all patients have access to information about what DHTs could support them. There is also a need to increase access to support for less digitally engaged patients so they can benefit from the 'digital first' health service.

List of abbreviations

DHT	Digital Health Technologies
NHS	National Health Service
UK	United Kingdom
IMD	Indices of Multiple Deprivation
GP	General Practitioner
HCP	Health Care Practitioner

Declarations

Ethics approval and consent to participate

All activities were approved by and conducted in accordance with the University of Bath Psychology Research Ethics Committee (PREC reference number: 19-211 and 20-142 respectively) and the Declaration of Helsinki for both the interviews and online survey. The participants received both written and verbal information about the research. Informed consent was collected from all participants. Interview participants provided written consent before the interview was arranged and which was confirmed with verbal consent immediately prior the interview. Those who completed the survey provided informed consent ahead of data collection.

Consent for publication

Not Applicable.

Availability of data and materials

Anonymised datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

None

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Author contributions

ST drafted the manuscript. BA and CD contributed towards drafting and revising the manuscript. ST, CD, BA, SG, GL and BS contributed towards the conception and study design. JL conducted the interviews and developed the initial coding structure. IA was involved in disseminating and collecting the survey data. ST, CD, BA, SG, GL and JL were involved in the analysis and interpretation of findings. All authors read and approved the final version of the paper.

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Patient and public involvement group

The topic guide for the interviews was revised following input from the Patient and Public Involvement group.

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Supplementary material

Qualitative interviews- topic guide

University of Bath
Department of Psychology
Tel: 01225 38 3251
Ben Ainsworth b.ainsworth@bath.ac.uk
Charlotte Dack c.n.dack@bath.ac.uk

Topic Guide

Introduction and confirmation of consent

First of all, I would like to thank you for taking the time to talk to me today. As you know, I am interested in hearing about your experiences of using digital healthcare tools within your practice.

With your permission I will record the interview so that I am able to transcribe all that was said. If you want to stop the interview or recording at any time, you are free to do so. Once the interview is transcribed, all names and identifying information will be removed to ensure anonymity.

Also, if it is okay with you, I would like to take some brief notes during the interview.

Are you happy to consent to take part in the study and for the interview to be recorded?

Before we begin do you have any final questions about the study?

Before we start, I want to stress that there are no right or wrong answers – I want to hear about *your* experiences.

1. Could you tell me how long you have worked at the practice?

2. What do you think is the purpose of digital healthcare tools?
   Prompt: What are they there to provide?
   Prompt: Benefits vs. disadvantages

3. Could you tell me a bit about any digital healthcare tools that you use/recommend?
   Prompt: What are the different kind of tools (if any) that you use? How do you use them? Who do you use them with? Could you tell me about any tools you like or dislike? What about them do you like or dislike?

4. Can you tell me about the ways that digital healthcare tools affect patient experiences?
   Prompt: some patients more than others

5. 5. Can you tell me about how digital healthcare tools affect your day-to-day work?
   Prompt: time saving / demands on time?

6. What are some of the issues you have experienced when using digital healthcare tools?
   Prompt: Usability; Internet assess; Digital Divide; Digital literacy; Reach everybody?

7. What are your thoughts on the current plans for the NHS 'digital transformation'?
   Prompt: Short/long term benefits/drawbacks

8. What are your thoughts on existing training for using digital tools?
   Prompt: Any unmet training needs? Any additional areas to target?

Online Survey

1. What is your job title?
2. In general, how frequently do you use the following types of digital tools as a healthcare professional in your practice? Please complete each item. (Multiple choice from: Never, Daily, Once a week, Once a month)
    a. Online Appointment system
    b. Skype/ Teams consultations
    c. Remote monitoring technology
    d. Digital note taking
    e. Apps
    f. Text SMS system
    g. Online self-management tools
    h. Other (with free text)
3. What would prevent you from using digital healthcare tools? - Selected Choice
4. What would prevent you from using digital healthcare tools? - Other (Free text)
5. In you practice, how would you describe the patient demographics that you care for? (Age, types of conditions) (Free text)
6. To what extent do you agree with the following statement? - Digital self-management tools benefit me as a healthcare professional in my practice. (Multiple choice, select from: Strongly Disagree, Disagree, Somewhat disagree, Neither agree nor disagree, Somewhat Agree, Agree, Strongly Agree)
    a. Please explain your rating for the question on to what extent do you agree with the statement: 'Digital self-management tools benefit me as a healthcare professional in my practice' (Free text)
7. To what extent do you agree with the following statement? - Digital self-management tools benefit the patient in my practice. (Multiple choice, select from: Strongly Disagree, Disagree, Somewhat disagree, Neither agree nor disagree, Somewhat Agree, Agree, Strongly Agree)
    a. Please explain your rating for the question on to what extent do you agree with the statement: 'Digital self-management tools benefit the patient in my practice?' (Free text)
8. Do you think patients using self-management digital tools affect their ability to take ownership of their own healthcare needs? (Yes/No)
    a. Please explain why. (Free text)

9. To what extent do you agree with the following statement? - Digital self-management tools benefit my relationship with patients in my practice. (Multiple choice, select from: Strongly Disagree, Disagree, Somewhat disagree, Neither agree nor disagree, Somewhat Agree, Agree, Strongly Agree)
10. How do you feel about giving patients more responsibility for their own healthcare by using digital self-management tools? (Free text)
11. Do you think using digital self-management tools in your practice affect the interaction between you and your patients? (Yes/No)
    a. If yes, how? (Free text)
12. Can you describe any experiences where digital tools have created conflicts between you and your patients? (Free text)
13. Has the COVID19 pandemic changed your use of digital tools in your clinical practice? (Yes/No)
    a. Can you describe what these changes are? (Free text)
14. Has there been any barriers to using digital tools in clinical practice during COVID19 Pandemic? (Yes/No)
    a. Please explain why. (Free text)
15. To what extent do you agree with the following statements with regards to using digital tools before COVID19 pandemic? - Digital tools benefited me in my practice. (Multiple choice, select from: Strongly Disagree, Disagree, Somewhat disagree, Neither agree nor disagree, Somewhat Agree, Agree, Strongly Agree)
16. To what extent do you agree with the following statements with regards to using digital tools before COVID19 pandemic? - Digital tools benefited my patients in my practice. (Multiple choice, select from: Strongly Disagree, Disagree, Somewhat disagree, Neither agree nor disagree, Somewhat Agree, Agree, Strongly Agree)
17. To what extent do you agree with the following statements with regards to using digital tools before COVID19 pandemic? - Digital tools allow my patients to take responsibility for their own healthcare. (Multiple choice, select from: Strongly Disagree, Disagree, Somewhat disagree, Neither agree nor disagree, Somewhat Agree, Agree, Strongly Agree)
18. To what extent do you agree with the following statements with regards to using digital tools before COVID19 pandemic? - As a clinician I feel more comfortable giving my patients more responsibility for their own healthcare. (Multiple choice, select from: Strongly Disagree, Disagree, Somewhat disagree, Neither agree nor disagree, Somewhat Agree, Agree, Strongly Agree)

19. To what extent do you agree with the following statements with regards to using digital tools during COVID19 pandemic? - Digital tools benefited me in my practice. (Multiple choice, select from: Strongly Disagree, Disagree, Somewhat disagree, Neither agree nor disagree, Somewhat Agree, Agree, Strongly Agree)
20. To what extent do you agree with the following statements with regards to using digital tools during COVID19 pandemic? - Digital tools benefited my patients in my practice. (Multiple choice, select from: Strongly Disagree, Disagree, Somewhat disagree, Neither agree nor disagree, Somewhat Agree, Agree, Strongly Agree)
21. To what extent do you agree with the following statements with regards to using digital tools during COVID19 pandemic? - Digital tools allow my patients to take responsibility for their own healthcare. (Multiple choice, select from: Strongly Disagree, Disagree, Somewhat disagree, Neither agree nor disagree, Somewhat Agree, Agree, Strongly Agree)
22. To what extent do you agree with the following statements with regards to using digital tools during COVID19 pandemic? - As a clinician I feel more comfortable giving my patients more responsibility for their own healthcare. (Multiple choice, select from: Strongly Disagree, Disagree, Somewhat disagree, Neither agree nor disagree, Somewhat Agree, Agree, Strongly Agree)
23. During COVID19 pandemic, in what ways have you accommodated the patients who do not have access to the digital tools that you used in your clinical practice? (Free text)
24. Age:
25. Gender:
26. Ethnicity - Selected Choice
    a. Ethnicity - Other ethnic group, please specify - Text
27. What are your professional qualifications? (Masters degree, nursing degree, doctor of medicine, QCF level, etc)
28. How long have you been working in your current role? (Year, Month)
29. What is your practice postcode? (Please enter the first half of the postcode: eg. if M33 7AE - then enter M33)

Coding tree

Name	Description	Files	References
Changes in access to and use of DHTs during the pandemic		0	0
Barriers to uptake during COVID		0	0

Name	Description	Files	References
Barriers to access for patients		0	0
COVID led tech uptake leaving some groups behind	e.g. elderly/ digitally isolated	1	1
Not having the necessary equipment		1	4
Not knowing how to use or wanting to use tech		1	3
Patients digital not suitable for	During covid	1	1
Barriers to use for HCPs		0	0
Financial barriers		1	1
Issues with confidentiality		1	2
Knowing what tech to use and recommend		1	1
Managing the huge change		1	2
New systems not supported correctly		1	1
Technical issues with new tech reliance		1	1
Tech not working properly		1	3
Challenges with tech only care	e.g. issues with diagnostics etc.	1	2
Managing relationship in consultation		1	2
Showing patients things		1	1
COVID led to change in perception of tech		1	1
COVID led to change in practice for HCP		1	12
COVID limiting access to support		1	3
COVID prompted increase in tech use		2	9

Name	Description	Files	References
Patients more accepting of tech		1	1
Support to overcome issues		1	7
Providing access to equipment		1	1
Providing Alternative contact for health information or services		1	2
Providing face to face appointments		1	6
Levels of access to DHTs	Different levels where decisions about access to DHTs are made	0	0
Clinician's decisions-making about who DHTs are appropriate for		0	0
Deciding who is suitable for DHTs		5	8
Lack of digital literacy means prioritised for face-to face appointment		3	4
Only recommend DHTs that are credible and approved		0	0
Can only provide access to recommended DHTs		1	1
Determining which sources are credible to share		5	9
Perceptions of who is excluded from tech		0	0
Age based assumptions about digital literacy		13	18
Assess patients' access to digital tech		3	3
DHTs exclude certain patients		1	1
Digital literacy affects self-care		6	8

Name	Description	Files	References
Disability		3	4
DT causes inequality depending complexity of healthcare needs		1	1
Lacking digital access		9	12
Language and culture barriers		2	3
Literacy affects accessing online tools		3	3
Most people have DT access		3	4
Not all patients can use tech	HCPs feel that not all patients can use and benefit from tech	3	3
Preference for DT challenges stereotypes		4	7
Tech access inequality - clinician bias and stereotypes		2	7
Tech access inequality - Literacy and digital literacy		12	17
Who DHTs work for	HCPs perceptions about who DHTs work for	5	6
Tech access inequality - SES		10	15
Technology complicated to explain		1	1
Clinician's Level of understanding and skill using DHTs		1	1
DHT uptake reliant on HCP digital skills		13	17
Tech too complicated to use by HCPs		1	1
HCPs don't know how to use tech		7	9
Age related assumptions about adoption of DHTs		3	4
HCP had perceptions challenged use of tech in their job		1	1

Name	Description	Files	References
Use of DHTs affected by trust and knowledge of features		0	0
HCPs don't trust tech		1	1
HCPs refuse to adopt tech		3	3
Takes time to adapt to new tech in their working practice	Takes clinicians time to learn about new features of tech and how to use it in their work.	3	3
Practice or organisational Level		0	0
All practices adopting tech differently		1	1
DHTs are or are not a priority to health service		2	3
Lack of promotion = poor patient adoption rate		2	2
Strategic decisions about DHT adoption		1	2
Training		0	0
DHT adoption related to peer support and training		12	21
Understanding of tech dependant on skills of people in practice		4	4
No time for DHT training		3	3
Tech training - individualised support and training		10	16
Role of DHTs	HCPs perspectives on the roles of digital health technologies	0	0
For practices in the management of patients		0	0
Adds to workload		10	17
DHT to improve communication between health services		0	0

Name	Description	Files	References
Better MDT communication amongst professionals		12	21
Challenges with referrals		1	1
Different systems are not compatible		12	23
NHS should be one unified system		7	8
Practices need to work together		1	1
DHTs lead to inappropriate appointments	Over sensitive algorithms and digital triage leads to inappropriate appointments	2	3
For planning and streamlining healthcare services	There was a perception from the HCPs that DHTs were useful for resource planning and for streamlining and standardizing practice.	0	0
Accuracy in record keeping		12	17
DT cannot resolve labour shortages		2	3
DT helps resource planning		2	3
DT perceived to be cost-saving measure		1	1
DT streamlines care system		3	3
Lacking control over referral and appointments		3	6
Online triaging mis-assesses clinical needs		5	7
DHTs lead to inappropriate appointments	Over sensitive algorithms and digital triage leads to inappropriate appointments	2	3
Referral tool cumbersome		1	1
Tech helps to make best use of clinicians' time		2	2
Tech provides safer and better governance		4	8

Name	Description	Files	References
Technology aids standardisation, data analysis, evaluation		10	14
Unreliable technology is a nightmare		16	26
Technology is not user friendly		10	13
In patient care		0	0
Digital information easier for patients to access		6	8
Ease of information sharing with patients		9	13
Faster and easier access to healthcare		4	7
Patients want results fast		1	1
Some patients hard to contact		2	3
Technology broadens clinical outreach		1	2
Finding the right information online	They talked about the importance of finding credible sources of info	0	0
Control of info vs finding the right resources	There was a conflict between HCPs feeling that patients having access to health information online was good, but that there was a lack of control over finding the right sources for the right people. Some HCPs described how access digital health tools could increase an individual's autonomy and engagement in their care. Others cited concerns about patients accessing information from unreliable sources.	11	17
Right information for the right people		5	6
Patient misunderstanding		5	9
Patients have greater responsibility towards own healthcare		9	17
Tech and info induce anxiety in patients		6	8

Name	Description	Files	References
Technology saves time in healthcare		12	23
in the interaction between patients and HCPs		0	0
Confidentiality and information security		11	21
Disparity and tension in patient and clinician need		1	2
Digital technology cannot replace the value of in person consultations		11	23
Detracts from human interaction		8	13
Not doing face-to-face means increased clinical risk		1	1
Online patient-clinician relationships are just as good as offline		1	1
Digital tool interferes with human consultation		3	5
How to use the data in consultations		5	6
Transparency conflicts with candidness		3	5
One way messaging-no patient response		6	9
One way communication cuts out patient response		6	7
Online screening and assessment useful		10	22
Information overload for clinicians		2	2
Use for shared decision making		4	11
Role for HCPs		0	0
Deskill the HCPs		3	4

Name	Description	Files	References
HCPs can tailor systems to their needs		2	2
Technology improves staff training and knowledge		8	11

COREQ (COnsolidated criteria for REporting Qualitative research) Checklist

A checklist of items that should be included in reports of qualitative research. You must report the page number in your manuscript where you consider each of the items listed in this checklist. If you have not included this information, either revise your manuscript accordingly before submitting or note N/A.

Topic	Item No.	Guide Questions/Description	Reported on Page No.
Domain 1: Research team and reflexivity			
Personal characteristics			
Interviewer/facilitator	1	Which author/s conducted the interview or focus group?	
Credentials	2	What were the researcher's credentials? E.g. PhD, MD	
Occupation	3	What was their occupation at the time of the study?	
Gender	4	Was the researcher male or female?	
Experience and training	5	What experience or training did the researcher have?	
Relationship with participants			
Relationship established	6	Was a relationship established prior to study commencement?	
Participant knowledge of the interviewer	7	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	
Interviewer characteristics	8	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	
Domain 2: Study design			
Theoretical framework			
Methodological orientation and Theory	9	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	
Participant selection			
Sampling	10	How were participants selected? e.g. purposive, convenience, consecutive, snowball	
Method of approach	11	How were participants approached? e.g. face-to-face, telephone, mail, email	
Sample size	12	How many participants were in the study?	
Non-participation	13	How many people refused to participate or dropped out? Reasons?	
Setting			
Setting of data collection	14	Where was the data collected? e.g. home, clinic, workplace	
Presence of non-participants	15	Was anyone else present besides the participants and researchers?	
Description of sample	16	What are the important characteristics of the sample? e.g. demographic data, date	
Data collection			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	
Repeat interviews	18	Were repeat inter views carried out? If yes, how many?	
Audio/visual recording	19	Did the research use audio or visual recording to collect the data?	
Field notes	20	Were field notes made during and/or after the inter view or focus group?	
Duration	21	What was the duration of the inter views or focus group?	
Data saturation	22	Was data saturation discussed?	
Transcripts returned	23	Were transcripts returned to participants for comment and/or	

Topic	Item No.	Guide Questions/Description	Reported on Page No.
		correction?	
Domain 3: analysis and findings			
Data analysis			
Number of data coders	24	How many data coders coded the data?	
Description of the coding tree	25	Did authors provide a description of the coding tree?	
Derivation of themes	26	Were themes identified in advance or derived from the data?	
Software	27	What software, if applicable, was used to manage the data?	
Participant checking	28	Did participants provide feedback on the findings?	
Reporting			
Quotations presented	29	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	
Data and findings consistent	30	Was there consistency between the data presented and the findings?	
Clarity of major themes	31	Were major themes clearly presented in the findings?	
Clarity of minor themes	32	Is there a description of diverse cases or discussion of minor themes?	

Developed from: Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

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BARRIERS AND FACILITATORS TO USE OF DIGITAL HEALTH TOOLS BY HEALTH CARE PRACTITIONERS AND THEIR PATIENTS, BEFORE AND DURING THE COVID-19 PANDEMIC: A MULTI-METHODS STUDY

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BARRIERS AND FACILITATORS TO USE OF DIGITAL HEALTH TOOLS BY HEALTH CARE PRACTITIONERS AND THEIR PATIENTS, BEFORE AND DURING THE COVID-19 PANDEMIC: A MULTI-METHODS STUDY

S Turnbull, Bristol Medical School, University of Bristol, UK, Sophie.turnbull@bristol.ac.uk
C Dack*, Department of Psychology, University of Bath, UK, cnd31@bath.ac.uk
J Lei, Institute of Psychiatry, Psychology and Neuroscience, King's College London, UK. jiedi.lei@kcl.ac.uk
I Aksu, Department of Psychology, City, University of London, UK. iremaksu96@gmail.com
S Grant, Translational Health Sciences, Musculoskeletal Research Unit, Bristol Medical School, UK, drsabrinagrant@gmail.com
G Lasseter, University of Bristol, UK, gemmalasseter@gmail.com
B Silarova, Personal Social Services Research Unit, University of Kent, UK. b.silarova@kent.ac.uk
B Ainsworth, School of Psychology, Faculty of Environmental and Life Sciences, University of Southampton, Southampton, UK, ben.ainsworth@soton.ac.uk

*Corresponding author
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Abstract

Objectives

To explore how Health Care Practitioners (HCPs) made decisions about the implementation of Digital Health Technologies (DHTs) in their clinical practice before and during the COVID-19 pandemic.

Design

A multi-methods study, comprising semi-structured interviews conducted prior to the COVID-19 pandemic. Supplemented with an online survey, that was conducted during the pandemic with a different sample, to ensure the qualitative findings remained relevant within the rapidly-changing healthcare context. Participants were recruited through HCP networks, snowballing and social media. Data were analysed thematically.

Setting

Phone interviews and online survey.

Participants

HCPs represented a range of professions from primary and secondary care across England, with varied socioeconomic deprivation.

Results

24 HCPs were interviewed, and 16 HCPs responded to the survey. In the interviews, HCPs described three levels where decisions were made, which determined who would have access to what DHTs: health organisation, HCP, and patient levels. These decisions resulted in the unequal implementation of DHTs across health-services, created barriers for HCPs using DHTs in their practice, and influenced HCPs decisions on which patients to supply DHTs with. In the survey, HCPs described being provided support to overcome some of the barriers at the organisation and HCP level during the pandemic. However, they cited similar concerns to pre-pandemic about barriers patients faced using DHTs (e.g., digital literacy). In the absence of centralised guidance on how to manage these barriers, health-services made their own decisions about how to adapt their services for those who struggled with DHTs.

Conclusions

Decision-making at the health organisation, HCP and patient level influence inequalities in access to DHTs for HCPs and patients. The mobilisation of centralised information and resources during the pandemic can be viewed as good practice for reducing barriers to use of DHTs for HCPs. However, attention must also be paid to reducing barriers to accessing DHTs for patients.

Keywords

Internet-based intervention; health care disparities; socioeconomic factors; primary care; digital health; health services accessibility; qualitative research

ARTICLE SUMMARY

Strengths and limitations of this study

- To ensure our qualitative study conducted just prior to the COVID-19 pandemic were relevant and informative in a 'post-COVID' landscape, we developed and disseminated a questionnaire that explored whether COVID-19 had changed the way that healthcare professionals used DHTs.
- Double coding of a subset of interviews by five members of the team and ongoing discussion about coding structure ensured the coding scheme was robust.
- Challenges recruiting participants for both the interviews and the survey, may limit the generalisability of the findings.
- As patients were not included in this study, reflections about the barriers patients experience accessing DHTs are from the health care practitioner's perspective.

BACKGROUND

In recent years, primary care practice has rapidly increased the use of Digital Health Technologies (DHTs) (1). DHT's include smartphone apps, digital tools for diagnosing or treating conditions (including those that use Artificial Intelligence (2)), wearable devices (e.g. pedometers) and platforms that provide remote healthcare (3). This has been accelerated by the COVID-19 pandemic, in which the majority of face-to-face appointments were suspended and Health Care Practitioners (HCPs) were required to encourage the uptake of digital self-management tools for patients, including using remote consultations and mobile health apps (4-6). DHTs have the potential to increase access to health interventions, whilst reducing demand on an overstretched healthcare system (7-9). The National Health Service (NHS) Long Term Plan has outlined the role of DHTs in transforming 'healthcare in the digital age', to achieve the goal of delivering world-class personalised medicine in primary care practices and social care (1). However, the successful implementation of DHTs relies on both the patients and HCPs being willing and able to engage with these interventions (10, 11), and there are ongoing concerns about the impact of DHTs on health inequalities (12).

DHTs have been found to be effective in supporting patients to self-care for a range of health conditions (8, 13-16). Health interventions designed specifically to support disadvantaged groups can be more effective for those groups, thus reducing inequalities (8, 15, 17, 18). However, recent evidence has found that such benefits may be limited for people from lower socio-economic groups, who do not have the resources (such as time, finances, technical proficiency) to access and use DHTs (19-21). Less is known about how

HCPs use DHTs for helping patients to manage their own health and wellness, the barriers they face doing so, and the implications this may have for the access to DHTs for their patients (2, 10, 20, 22). There are indications that HCPs face challenges incorporating DHTs into their existing systems and practices [18], and establishing risk and rapport with patients in remote consultations (10, 22). Patients have also reflected that they feel HCPs have limited knowledge of what self-care DHTs are available and effective (20).

Our multi-methods study was designed to explore how HCPs (e.g., General Practitioners (GPs), nurses, pharmacists) used and made decision about DHTs in their clinical practice before and during the COVID-19 pandemic. We aimed to 1) understand barriers and facilitators to the use of DHTs by HCPs, and the implications for the access patients have to DHTs, and 2) whether these changed during the pandemic.

METHODS

Design

This study adhered to the COREQ (Consolidated Criteria for Reporting Qualitative Research) guidelines on the reporting of qualitative research (23). It was a multi-methods study, comprising semi-structured interviews and an online survey with HCPs working in English primary and secondary care services. The primary study was the semi-structured interviews that were conducted prior to the pandemic (November 2019-March 2020). This was supplemented with the survey, a secondary study that was conducted during the pandemic (July 2020-August 2020) with a different sample. Both studies explored how HCPs accessed and used DHTs. However, the survey also explored how the COVID-19 pandemic affected

HCP attitudes to and usage of DHTs. The qualitative findings from the survey were compared with the findings from the interviews, in order to explore similarities and differences in DHT use that occurred due to the COVID-19 pandemic, and to ensure that the qualitative findings remained relevant within a rapidly shifting healthcare context. The methodological orientation of the study was a mixed inductive and deductive approach (24, 25). Ethical approval was granted by the University of Bath's Psychology Research Ethics Committee for the interviews and survey (PREC reference number: 19-211 and 20-142 respectively).

Interviews

Participants

Participants for the interviews were recruited through a range of networks, including National Institute of Health and Care Research School of Primary Care Research, community networks, social media (snowballing), and Academic Health Service Networks across England. We recruited HCPs who represented primary and secondary care health professionals from a range of backgrounds from across England, working in locations that varied in their level of socioeconomic deprivation (Table 1). Socio-economic deprivation was determined by collecting the postcode of the health service where the HCP worked, and mapping it to the England Indices of Multiple Deprivation (IMD)(26).

Procedure/Data collection

The topic guide (see Supplementary material) was developed through author collaboration, consultation with qualitative experts, and input from Patient and Public Involvement representatives. The topic guide was piloted and revised for clarity following feedback from two GPs.

All interviews were semi-structured and conducted over the telephone by the same researcher (JL). All participants were provided with written information via email about the study before agreeing to be interviewed. Participants were informed that the purpose of the study was to explore which DHTs are used by healthcare professionals in their clinical work, how these tools were used to support their daily tasks (both client and non-client facing), and their experiences with different DHTs. At the beginning of each interview participants were given the opportunity to ask questions, were assured of their voluntary participation, and could withdraw their data until anonymisation and analysis. Participants provided informed consent using an online form before the interview. Interviews were conducted via phone at a mutually convenient time, lasted 17 to 51 minutes (mean = 32 minutes; median = 30 minutes), and took place in private, quiet settings, often participants' offices or homes. HCPs received a £70 payment as compensation.

Each participant took part in one interview, with no repeat interviews. Short field notes were taken during the interviews. All interviews were audio-recorded, transcribed, anonymised and imported into NVivo Software (NVivo qualitative data analysis Software; QSR International Pty Ltd. Version 1.6.2). Transcripts and findings were not returned to participants for comment or correction. Interviews were undertaken with all willing participants, with the sample size guided by principles of information power rather than data saturation (27).

Data Analysis

Analysis of qualitative data began shortly after data collection started and was ongoing and iterative. Corrected, anonymised transcripts were coded using NVivo software. An inductive thematic analysis approach was used for the analysis of the qualitative interviews (24), subsequently a deductive approach was taken to investigate similarities and differences between themes emerging from the surveys (25). Initial codes were developed by JL. Five members of the multidisciplinary research team also coded a sample of transcripts and then met to discuss and develop significant broader patterns of meaning (potential themes). ST organized the codes into final themes, which were agreed upon by the core team (ST, BA, and CD).

Research team and reflexivity

Personal characteristics

JL, a female PhD student in clinical and developmental psychology during data collection, conducted all interviews. JL received postgraduate training in qualitative methodology and had experience with semi-structured interviews and thematic analysis. She was supervised by senior academics experienced in qualitative research (CD and BA).

Relationship with participants

There was no prior relationship between the research team and study participants. The participants knew that the study was about the use of DHTs in primary healthcare, and that JL was a student researcher. The position taken by JL was that DHTs have the potential to empower people in self-monitoring and care and facilitate HCPs to share wider range of

resources with patients from diverse backgrounds. However, JL felt that there may be barriers in assessing the quality of different DHTs by HCPs, and accessibility regarding both hardware and software issues for patients from more disadvantaged backgrounds.

COVID-19 Survey

As interviews occurred before the first UK COVID-19 lockdown in Mar 2020, we developed an online survey to capture evolving healthcare delivery, ensuring continued relevance to the changing context. The survey sought to understand general views on DHTs and specifically how the COVID-19 pandemic affected their usage. The survey (see Supplementary materials) included free text responses, multiple choice questions and Likert scales. Feedback from three GP stakeholders informed the optimisation of the survey.

Participants were invited to complete the survey through advertisements on social media (Twitter) and email, disseminated through academic primary care research networks and departments. English-speaking HCPs that use DHTs were included in the study, with no further exclusion criteria used for participant recruitment. Data collection took place between July 2020 and August 2020. Informed consent was obtained before survey participation. Participants were given the option to enter a prize draw for a £50 Amazon gift voucher as an incentive.

ST analysed the free text responses thematically by ST using the coding structure developed during the analysis of the qualitative interview data (included in the coding tree in the Supplementary material). Themes emerging from the survey were discussed and refined by ST, CD and BA.

Patient and public involvement

The topic guide for the interviews was revised following input from the Patient and Public Involvement group.

RESULTS

In total 24 HCPs were interviewed: 10 GPs, 4 nurses, 8 pharmacists, 1 psychologist and 1 systems manager; their characteristics are outlined in Table 1. Participants approached the study if they were interested, there were no participants who dropped out of the interview study. Most of the HCPs were women (63%), in the 31-40 age range (58%), worked in a GP practice (46%), had been in their role for 1-5 years (58%) and had 1-5 years' experience using digital health tools in their practice (67%). The median practice IMD decile was 4 (interquartile range 3-8) (26), indicating the participants worked in more deprived areas than average for England.

22 HCPs consented to take part in the survey, however 3 participants were excluded as they did not report their job title and an additional 3 participants were excluded as they did not finish the survey. We do not have information on the completion rate of the surveys, as we only received surveys that were completed. This left a total of 16 HCPs: 7 GPs, 4 pharmacist, 2 nurses, 1 dietitian, 1 clinical psychologist and 1 cardiac surgeon (Table 1). There were 9 women and 7 men, with an age range of 28 to 66 (*M*= 41, *SD*= 11.6) and the years of experience ranging from 1 year to 43 years qualified.

Table 1: Participant demographics

Demographic characteristics	Qualitative interview sample N=24	Survey sample N=16
Gender (n)		
Male	9	6
Female	15	10
Age range (n)		
21-30	5	4
31-40	14	7
41-50	3	2
51-60	2	2
61-70	0	1
Place of work (n)		
Medical School & GP Practice	1	0
GP Practice	11	9
University	1	0
Hospital	5	3
Turning Point	1	0
Community Pharmacy	2	4
NHS Trust	2	0
Integrated Urgent Care Service	1	0
Length of time in role (n)		
<1 year	7	0
1-5 years	14	11
6-10 years	0	2
>10 years	3	3
Time using digital health tools (n)		
"The whole time"	1	Not collected
"Not long"	1	
<1 year	3	
1-5 years	16	
6-10 years	2	
>10 years	1	
Socio-economic deprivation of practice area (Median, Interquartile range)		
Practice IMD Decile (1 most deprived and 10 least deprived)	4 (3-8)	Not collected

Digital Healthcare Tools used

HCPs discussed a range of technologies that they considered to be a DHT, including: treatment algorithms, digital self-care behavioural interventions, email text and video call consultations, correspondence with patients (e.g., practice text message systems), and data storage systems.

Results from thematic analysis

There were two main themes that emerged from the interviews conducted prior to the pandemic: the role of DHTs in HCPs clinical practice, and decision-making at three levels that determined who got access to what DHTs. There was an additional theme from survey, where HCPs described changes in access to and the use of DHTs during the pandemic. An outline of the themes and subthemes are available in Table 2.

Table 2: Themes and subthemes

Theme	Subtheme
Role of digital healthcare tools	None
Levels of access to digital health tools: Health organisation level	• Influence of strategic decisions and incentive structures
Levels of access to digital health tools: Health Care practitioner level	• Health Care Practitioner's digital skills • Health Care Practitioner's knowledge of what DHTs were available and effective • Health Care Practitioner's perceptions about digital health tools • Health Care Practitioner's access to training and informal support within the organisation or practice
Levels of access to digital health tools: Patient level	• Health Care Practitioner's perceptions of which patients can use and benefit from digital health technologies • Health Care Practitioner's making judgements about who to use DHTs with
Changes in access to and use of DHTs during the pandemic	• How HCPs adapted to a remote-led model of care during the pandemic

	• Barriers and facilitators to providing care through DHTs during the COVID pandemic • Barriers and facilitators for patients accessing care through DHTs during the COVID pandemic

Pre-pandemic interviews

Role of digital healthcare tools

In the interviews that were conducted prior to the COVID-19 pandemic, HCPs generally viewed DHTs as having the potential to make information and services easier for patients to access. However, some HCPs felt that DHTs were not suitable for everyone under every circumstance, and that remote consultations could not replace the '*human side and that caring side'* (ID P5) and they '*shouldn't be done at the expense of face-to-face consultations.' (ID P8)*

Decision-making at three levels that determined who got access to what digital health tools

Prior to the pandemic, three levels were identified where decisions were made about who should have access to what DHTs and what support they would receive to access them. These were the 1) health organisation, 2) HCP, and 3) patient levels.

Health Organisation level

Influence of strategic decisions and incentive structures

HCPs described how strategic decisions made by individual health services and incentive structures created challenges for the adoption and implementation of DHTs. There was generally a perception that there was no cohesive digital strategy across healthcare services with *'…all practices are doing slightly different things' (ID P2).* An HCP felt that it was

challenging for practices to prioritise the adoption of DHTs because they were not supported by traditional incentives structures, which would compensate for the time involved in managing the new digital treatments and services:

> *'… [digital health is] not one of the key performance indicators (…) it's not yet at the point where commissioners are saying, look, you know, you said to us, you're going to offer digital interventions. Show us by March that you've offered 2500. (…). it's often commissioners that drives practice because obviously commissioners are the ones that actually pay for the services.' (ID P15)*

HCP level

The uptake of DHTs by HCPs and their decision to recommend them to patients, was influenced by: the HCP's digital skills, their knowledge of what DHTs were available and effective, their perceptions of the quality of DHTs, and the availability of training and informal support for HCPs to use DHTs.

HCP digital skills

HCP use of DHTs in their practice and their ability to recommend them to their patients, was reliant on their digital skills. Some HCPs described finding technology '*intuitive and quite basic'* (ID P17). Others felt a lack of digital skills were a barrier to them supporting patients: '*I've actually found that simple things [using DHTs] I don't know how to do, it means that I can't do my job, just because I've not had the training'* (ID P22).

There was a perception by some of the participants that older HCPs would struggle to learn about and use new DHTs, because they '*were not responsive to learning the new ways of doing things…'* (ID P30).

HCP's knowledge of what DHTs were available and effective

HCPs were aware there were lots of DHTs available that may be able to support their practice and patients, but many felt they did not have specific knowledge of what they should use or how they worked. One participant spoke about how multiple different digital systems were being introduced in their practice, that '*have got amazing functionality but we don't know about it and we don't know how to use it*' (ID P10). Another described how there were *'websites and apps that I've got experience of using and are very happy to recommend'*, while other DHTs they had heard of but '*don't know how good they are'* which impacts how they '*sell*' DHTs to their patients (ID P8). A participant described how the high workload for HCPs presented challenges for them to remember what DHTs are available and how to use them in a short consultation:

> '*…people will do the training and then they've got loads of other things do it. They'll forget about it. So at the point (…) I'm thinking this client could maybe do digital, but I can't remember how to log on.' (ID P15)*

HCP perceptions about the quality of DHTs

HCPs made judgements about what DHTs to use or recommend to patients based on their perceptions of the quality or reliability of DHTs. They talked about the challenges in determining which DHTs were trustworthy, and which were '*flawed and quite risky'* (ID

P10). Some HCPs talked about being happy to recommend government-led online sources of information, like the National Institute of Clinical Excellence (NICE) website, because it was a *'reputable source'* (ID P13).

There was a sense from some of the HCPs that DHTs could not always be trusted to manage or deliver patient care. One participant felt that if there was something important that needed to be communicated with a patient '*someone needs to phone as well, we can't totally trust the technology'* (ID P20). Another recalled incidences where '*systems have just gone down and then you're completely stuck'*, making it impossible to access essential patient information (ID P7).

Access to training and informal support within the organisation or practice

HCPs described how the provision and quality of formal training to use DHTs was variable across health services, and consequently it was '*learn by using'* (ID P4). Some felt formal training for DHTs was not accessible for HCPs because they had to '*take time out of your practice'* (ID P1), which they did not have. For those who had attended training, some HCPs felt it was useful, while others felt they did not *'meet a broad range of people's learning needs*' (ID P13).

Many of the HCPs described how they learned about DHTs and their features through other HCPs in the health service where they worked. The availability and quality of this support was not consistent across practices or organisations, and was determined by the level of digital skills of the people working in the individual health service:

'…someone in the practice has either figured it out or seen it elsewhere and then they show someone else and so some people know how to do it. Some people don't. It's all a bit patchy...' (ID 10)

Patient level

HCPs made judgements about which patients would benefit from DHTs. Their perceptions often influenced whether they recommend DHTs or used them with patients.

HCP's perceptions of which patients can use and benefit from DHTs

HCPs generally believed that DHTs were most suitable for digitally literate, '*young, fit*' (ID P2) individuals, and those who were '*able bodied and mentally able*' (ID P32).

HCPs identified patient groups who they thought faced barriers accessing and using DHTs. This included patients with '*very low literacy*' (ID P10), '*whose language is not English*' (ID P5), and those who '*never embraced the internet or any digital tech*' (ID P32). Some patients were viewed as more isolated, lacking support from a '*team or family or carers*' to help them access DHTs (ID P12).

Some DHTs placed criteria that excluded vulnerable and underserved groups. For example, a HCPs also spoke about the Babylon app that has: '*excluded a ridiculous number of people from being able to use its service (…) like no woman can become pregnant, no one with social service needs, no one with mental health problems, so there's many exclusions for people with the highest needs.' (ID P9)*

There were conflicting opinions about digital health accessibility for people who lived in lower income areas. Some felt most people with lower incomes '*have phone access now anyway, so they will rely on their phones and online'* to access health information and support (ID P4). However, concerns were raised that the '*disadvantage of the digital stuff is potentially exacerbating health inequalities'* (ID P8). A participant described the intersection between age and deprivation being particularly problematic:

> '*…we work in a relatively deprived area and most to our particularly younger patients do have Internet access and you know have mobiles, but a lot of our older patients don't' (ID P8).*

Although many HCPs spoke about how the elderly could be excluded from using DHTs, some had their presumptions about age-related technology uptake challenged by experiences with older patients being adept at using DHTs:

> *'… a chap who was 80 years old, he came into my clinic room (…), he opened his tablet and he logged on to his own umm… personal page on his own practice to give me information. (…) I was like oh gosh that's really impressive can I have a look' (ID P20).*

Conversely, an HCP had found that *'…a lot of young people don't want treatment digitally' (ID 15)*, because they were concerned around inadvertent disclosure of stigmatised health conditions:

> *'…they're saying, actually, I don't want something on my phone that my mates going to see. And it's got something about anxiety on it or it's got*

something like I'm a family member of somebody with an alcohol problem'

(ID P15)

HCP's making judgements about who to use DHTs with

The perception of HCPs about the appropriateness of DHTs for a specific patient group influenced their decisions regarding DHT use. HCPs described how they were less likely to communicate with older adults or those with '*mental disabilities'* (ID P9) using DHTs. Several HCPs said they were less likely to engage in discussions about or supply DHTs to discuss or older patients:

'…the older generation are a little bit 'oh no, I don't want to do that', or 'it confuses me'. So yeah, I judge who I would discuss apps with and technology with age wise…' (ID P32)

A participant stated that their team were targeting '*the younger ones'* in their roll out of an app to support people with bowel cancer (ID P25). However, she acknowledged that the majority of their '*patients are 70-89'* and were *'not going to be able to use the app'* (ID P25).

Some HCPs described how the perception that someone was lacking digital skills, resulted in them being prioritised for face-to-face consultations, when '*clinically, they didn't need that priority*' (ID P5). A participant reflected that '*the less digitally enabled person might get more of my attention than the more digitally enabled'* (ID P11).

COVID 19 Survey

Changes in access to and use of DHTs during the pandemic

HCPs who completed the survey about their use of DHTs during the pandemic, described a dramatic shift in '*practice to almost completely remote working'* in response to government implemented COVID restrictions (Survey ID 10). They described how: they adapted to this shift, the barriers and facilitators to providing care almost exclusively through DHTs, and their perceptions of the barriers and facilitators for patients accessing care through DHTs during the pandemic.

How HCPs adapted to a remote-led model of care during the pandemic

Some of the HCPs reflected positively on the shift to the delivery of care through technology. Participants described how being '*forced to engage better with digital technology'* (Survey ID 25), made them realise '*the potential of just what you can do by phone (and sometimes video)'* (Survey ID 9). An HCP concluded that '*It has changed the way we work for the long term, I think in a good way.*' (Survey ID 25). However, several of the HCPs cited similar concerns to pre-pandemic about practising through remote appointments. They found it: '*more difficult to understand a patient's problem and support them when you are unable to see them in person and perform certain tests'* (Survey ID 15). In addition to hindering the development of an '*appropriate patient physician relationship*' (Survey ID 17).

Barriers and facilitators to providing care through DHTs during the COVID pandemic

The barriers to providing care through DHTs during the pandemic described by the HCPs were similar to pre-pandemic. These included '*Internet problems'* (Survey ID 13), issues with

DHTs being properly approved and integrated through healthcare services, '*Issues around consent and data sharing'* (Survey ID 25), and staff being willing or able to engage with DHTs. For example, a participant described how '*some older staff didn't want to work digitally and struggled to accept change'* (Survey ID 10).

However, HCPs described having more resources available to overcome these issues during the pandemic compared to prior to the pandemic. An HCP described how their organisation '*facilitated*' the use of DHTs '*more and removed any existing barriers'* (Survey ID 28):

> *'...initially [there was] lots of confusion over how we were going to be able to offer patient appointments and what apps etc were NHS approved etc. The local Primary care network were fantastic in supporting local surgeries in implementing change. Barriers also were financial, but when funding was granted for extra equipment etc, there was a boom in embracing new ways of working(...) there was so much change happening at once, that it was sometimes difficult to keep up with the latest information and what was available to use. An online network called Teamnet became the 'go to' site for updated information and technology and government updates.'*
>
> *(Survey ID 10)*

<u>Barriers and facilitators for patients accessing care through DHTs during the COVID pandemic</u>

The HCPs felt that some patients faced challenges when they were '*forced to adapt and resort to digital tools*' in the pandemic (Survey ID 25). However, they felt most patients were

able to engage with the new way of accessing health support and were more '*accepting of the technologies as there isn't an alternative'* during lockdown periods (Survey ID 6).

For those patients who did face barriers in accessing and using DHTs, the issues described by the HCPs were similar to pre-pandemic. HCPs felt that '*there is still a group of patients and conditions for which face to face consulting is preferable'* (Survey ID 9). A participant spoke about '*poorer patients not having internet or not [being] aware of how to use [the internet]'* (Survey ID 30). An HCP described how: '*…elderly patients with no mobile phones or laptops have felt isolated and victimized, age discrimination really. Some cannot or will not embrace technology and want to be seen face to face or can't get phone to connect to video call...' (Survey ID 6)*

HCPs highlighted ways in which their services adapted to improve access to health services for those who faced challenges using remote consultations during the pandemic. Most of the HCPs described offering phone consultations, or face-to-face consultations with '*PPE equipment'* (Survey ID 30) '*where safety can be maintained'* (Survey ID 28). Some HCPs spoke about how their services made further adjustments to the delivery of their digital support, by establishing alternative people to contact if the patient did not have good digital skills, or by providing equipment to access services: '*Patients who do not have access to any digital tool (mostly elderly) we usually contacted their children etc who would be able to assist them'* (Survey ID 15). A participant spoke about how they had '*obtained consent for patients who don't have smartphones, to allow them to use a neighbours phone (…) to make a video call'* (Survey ID 10). A participant described how their service provided '*mobile phones for homeless clients'* (Survey ID 14).

DISCUSSION

Principal findings

In our pre-COVID-19 pandemic interviews, HCPs across different healthcare settings in England generally acknowledged the potential benefit of DHTs in enhancing patient access to healthcare services. However, they expressed concerns regarding the appropriateness of DHTs for specific patient populations, viewing face-to-face appointments as superior in certain situations. The HCPs described three levels where decisions were made which determined who would have access to what DHTs. These were: the health organisation, HCP, and patient levels. At the organisation level, HCPs described a lack of cohesive strategy across healthcare services and traditional incentive structures targeting digital health, which resulted in disparities in DHT adoption. At the HCP level, a wide variation in digital skills and knowledge of DHTs created barriers to HCPs using these tools in their practice and recommending them to patients. HCPs described a lack of high-quality centralised information and formal training, and inconsistencies in provision of support across practices or organisations. At the patient level, HCPs held beliefs about groups of patients they felt would benefit from DHTs (e.g., young and fit). These preconceptions influenced HCP's decisions on whether to introduce DHTs to patients and whether to use these tools for patient communication.

In the survey conducted during the pandemic, the HCPs described an almost complete shift to remote delivery of care. While many barriers to DHT use persisted, HCPs reported receiving significant support to overcome these challenges during the pandemic. This included support from the local Primary Care Networks to implement the shift to digital

services, funding for extra equipment, and an online network (e.g., Teamnet) that provided the most up to date information about what DHTs were available.

HCPs felt that the majority of their patients were able to adapt to the change in the delivery of services, mostly due to the lack of alternatives during the pandemic. However, similar concerns regarding digital exclusion persisted. To address these issues, HCPs implemented strategies to enhance access to healthcare services for patients facing difficulties with DHTs. This often included offering face-to-face appointments with the HCP wearing full personal protective equipment (PPE) or providing additional support for accessing digital services.

Strengths and limitations

To the authors knowledge, this is the first study to explore the impact of decision making around the use of DHTs by HCPs on access to DHTs for patients, before and during the COVID-19 pandemic in England. In addition to our planned qualitative study, we developed and disseminated a questionnaire that explored whether COVID-19 had changed the way that healthcare professionals used DHTs. By doing this, we were able to ensure that our earlier 'pre-COVID' work was still relevant to inform future research and policymaking.

Complete audio data was recorded for all interviews, and there were no issues with lost data. Double coding of a subset of interviews by five members of the team and ongoing discussion about coding structure ensured the coding scheme was robust. Multiple views of the data promoted confidence in the credibility of the findings (28). A diverse range of experiences and opposing sides of arguments were identified and presented.

There were challenges recruiting the sample of healthcare professionals, meaning both survey and interviews had (relatively) small samples. However considering both datasets using principles of information power (27), suggests that the findings are still relevant and valuable, although some experiences related to DHT access and use may not have captured. As patients were not included in this study, reflections about the barriers patients experience accessing DHTs are from the HCP's perspective. Consequently, this may not accurately reflect the barriers and facilitators patients experienced accessing DHTs prior to and during the pandemic.

Interpretations in the Context of Existing Literature

Our study agrees with previous qualitative research conducted in the United States, that emphasised the influence of organisational context on DHT access (2, 29). Puckett et al. (2020) found that inequality in access to diabetes pumps was related to whether the clinic distributed resources equally as standard policy, or whether they provided patients with access dependent on their pre-determined policy/eligibility (e.g. interaction with the health service) (29).

Concerns about the quality and reliability of DHTs cited by the HCPs in the interviews in this study, reflect previous review findings that the majority of commercially available health apps are not evidence based or do not reflect public health guidelines (30). The same review reported that in surveys from Germany and (31) the United States (32, 33) agreed with the HCP views in this study that those who used health apps were more likely to be younger, in good health, higher income, education and health literacy (30). Although some HCPs in our interviews described how their presumptions about age-related technology uptake was

challenged when older patients were highly engaged with DHTs, and younger patients were disinterested in technology.

Our study found that during and prior to the pandemic, HCPs had concerns about accessibility of online consultations, and made adaptations to support patients who were less digitally literate or did not have internet access. These findings are similar to those of recent qualitative studies conducted before (21), and during the pandemic (34), where HCPs reported that remote consultations could improve access for some groups (e.g. those with caring responsibilities, not able to leave their homes) (21, 34). However, they also had concerns about digital exclusion and accessibility for some patients (21, 34), and described providing face-to-face appointments for those who they perceived to be less able to use the digital services (e.g. older adults)(21). A multinational survey found that ophthalmologists felt clinical Artificial Intelligence would improve accessibility of eye care services, but were less convinced about whether it would result in improvements in quality or affordability (2). They were unsure about whether the COVID-19 pandemic would increase adoption of digital technology in the health system, or result in the increased in implementation of the technology through investment, training healthcare workers or educating the public (2).

Two YouGov surveys of NHS staff and patients found that while the majority of patients and NHS staff responded positively to the increased use of technology in healthcare during the pandemic, certain groups, including those over 55, individuals with caregivers, or those unemployed, reported negative experiences with DHTs more frequently than the general population (6). This corresponds with the perceptions of the HCPs in our study, that the majority of patients adapted well to delivery of care through technology. But those who

were older and had lower incomes faced greater barriers accessing DHTs before and during the pandemic.

In our study, some HCPs described having limited knowledge of what DHTs were available and what to recommend to their patients. This corresponds with the findings from a qualitative study exploring digital access for patients with T2D, where participants felt HCPs were not knowledgeable about self-care DHTs (20).

Implications for Research, practice and policy

Improving digital infrastructure and training of HCPs

The centralised response to the pandemic and the way in which barriers to accessing DHTs were universally addressed in healthcare services across the United Kingdom described by HCPs in our survey, can be seen as an illustration of good practice in tackling inequalities in access to DHTs at the organisational and HCP level. A recent white paper the Department of Health and Social Care laid out the aim to make the innovations that the COVID pandemic accelerated permanent (35). However, it is unclear what support will remain to reduce barriers to accessing and using DHTs, and whether this will be universally provided. Future support could consist of government funding and incentives, ensuring HCPs have access to and are aware of central repositories that provide up-to-date information about evidence-based DHTs that they could recommend to their patients (e.g. ORCHA), and support for health services to adopt innovations (e.g. Adopting Innovation programme (6)).

Reducing inequalities in access to DHTs for patients

The HCPs in this study did not describe any centralised provision of support to ensure less digitally engaged patients had access to DHTs during the pandemic. Instead, individual HCPs

and health organisations made decisions about who could benefit from DHTs, and what support would be offered to reduce barriers to accessing DHTs. By making judgements about who can benefit from DHTs, HCPs are potentially preventing some patients from being able to benefit from these services, which has implications for inequalities in access to healthcare. This is particularly poignant as we move towards the 'digital first' service as laid out in the NHS Long Term plan (1). To avoid digital exclusion, through the lack of provision of information about DHTs, it could become standard policy that all patients should be signposted to evidence based DHTs. This could be sent to patients utilising existing systems (e.g., accuRx) so as not to add additional burden on to HCP, and to circumvent HCPs acting as gatekeepers to DHTs. HCPs could also be provided with information about where to signpost patients for support to access or use DHTs. Digital participation schemes piloted by NHS digital have been successful in reducing inequalities in access to DHTs, by providing people with low digital literacy with support from digital champions (36, 37). Although there are plans to roll these out more widely following the success of the pilots (36), current unequal provision of these services across the UK risks widening digital inequities in areas not served by these schemes. Speeding up the availability of this support could involve the development and roll out of engaging accessible training for digital health champions and access to up-to-date resources these digital champions could refer to. Such an approach is in line with recent recommendations to recognise variation in user needs to improve technology adoption and acceptance (38).

Conclusions

This research has highlighted how decision-making at the health organisation, HCP, and patient levels influence inequalities in access to DHTs for HCPs and patients. The pandemic

prompted the centralised mobilisation of resources for health organisation and HCPs to access and implement of DHTs. However, the patients still faced uneven access to DHTs, determined by decisions made by individual health services and HCPs. Attention must be paid to ensuring all patients have access to information about what DHTs could support them. There is also a need to increase access to support for less digitally engaged patients so they can benefit from the 'digital first' health service.

List of abbreviations

DHT	Digital Health Technologies
NHS	National Health Service
UK	United Kingdom
IMD	Indices of Multiple Deprivation
GP	General Practitioner
HCP	Health Care Practitioner

Declarations

Ethics approval and consent to participate

All activities were approved by and conducted in accordance with the University of Bath Psychology Research Ethics Committee (PREC reference number: 19-211 and 20-142 respectively) and the Declaration of Helsinki for both the interviews and online survey. The participants received both written and verbal information about the research. Informed consent was collected from all participants. Interview participants provided written consent before the interview was arranged and which was confirmed with verbal consent immediately prior the interview. Those who completed the survey provided informed consent ahead of data collection.

Consent for publication

Not Applicable.

Availability of data and materials

Anonymised datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

None

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Author contributions

ST drafted the manuscript. BA and CD contributed towards drafting and revising the manuscript. ST, CD, BA, SG, GL and BS contributed towards the conception and study design. JL conducted the interviews and developed the initial coding structure. IA was involved in disseminating and collecting the survey data. ST, CD, BA, SG, GL and JL were involved in the analysis and interpretation of findings. All authors read and approved the final version of the paper.

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Supplementary material

Qualitative interviews- topic guide

University of Bath
Department of Psychology
Tel: 01225 38 3251
Ben Ainsworth b.ainsworth@bath.ac.uk
Charlotte Dack c.n.dack@bath.ac.uk

Topic Guide

Introduction and confirmation of consent

First of all, I would like to thank you for taking the time to talk to me today. As you know, I am interested in hearing about your experiences of using digital healthcare tools within your practice.

With your permission I will record the interview so that I am able to transcribe all that was said. If you want to stop the interview or recording at any time, you are free to do so. Once the interview is transcribed, all names and identifying information will be removed to ensure anonymity.

Also, if it is okay with you, I would like to take some brief notes during the interview.

Are you happy to consent to take part in the study and for the interview to be recorded?

Before we begin do you have any final questions about the study?

Before we start, I want to stress that there are no right or wrong answers – I want to hear about *your* experiences.

1. Could you tell me how long you have worked at the practice?

2. What do you think is the purpose of digital healthcare tools?
   Prompt: What are they there to provide?
   Prompt: Benefits vs. disadvantages

3. Could you tell me a bit about any digital healthcare tools that you use/recommend?
   Prompt: What are the different kind of tools (if any) that you use? How do you use them? Who do you use them with? Could you tell me about any tools you like or dislike? What about them do you like or dislike?

4. Can you tell me about the ways that digital healthcare tools affect patient experiences?
   Prompt: some patients more than others

5. 5. Can you tell me about how digital healthcare tools affect your day-to-day work?
   Prompt: time saving / demands on time?

6. What are some of the issues you have experienced when using digital healthcare tools?
   Prompt: Usability; Internet assess; Digital Divide; Digital literacy; Reach everybody?

7. What are your thoughts on the current plans for the NHS 'digital transformation'?
   Prompt: Short/long term benefits/drawbacks

8. What are your thoughts on existing training for using digital tools?
   Prompt: Any unmet training needs? Any additional areas to target?

Online Survey

1. What is your job title?
2. In general, how frequently do you use the following types of digital tools as a healthcare professional in your practice? Please complete each item. (Multiple choice from: Never, Daily, Once a week, Once a month)
    a. Online Appointment system
    b. Skype/ Teams consultations
    c. Remote monitoring technology
    d. Digital note taking
    e. Apps
    f. Text SMS system
    g. Online self-management tools
    h. Other (with free text)
3. What would prevent you from using digital healthcare tools? - Selected Choice
4. What would prevent you from using digital healthcare tools? - Other (Free text)
5. In you practice, how would you describe the patient demographics that you care for? (Age, types of conditions) (Free text)
6. To what extent do you agree with the following statement? - Digital self-management tools benefit me as a healthcare professional in my practice. (Multiple choice, select from: Strongly Disagree, Disagree, Somewhat disagree, Neither agree nor disagree, Somewhat Agree, Agree, Strongly Agree)
    a. Please explain your rating for the question on to what extent do you agree with the statement: 'Digital self-management tools benefit me as a healthcare professional in my practice' (Free text)
7. To what extent do you agree with the following statement? - Digital self-management tools benefit the patient in my practice. (Multiple choice, select from: Strongly Disagree, Disagree, Somewhat disagree, Neither agree nor disagree, Somewhat Agree, Agree, Strongly Agree)
    a. Please explain your rating for the question on to what extent do you agree with the statement: 'Digital self-management tools benefit the patient in my practice?' (Free text)
8. Do you think patients using self-management digital tools affect their ability to take ownership of their own healthcare needs? (Yes/No)
    a. Please explain why. (Free text)

9. To what extent do you agree with the following statement? - Digital self-management tools benefit my relationship with patients in my practice. (Multiple choice, select from: Strongly Disagree, Disagree, Somewhat disagree, Neither agree nor disagree, Somewhat Agree, Agree, Strongly Agree)
10. How do you feel about giving patients more responsibility for their own healthcare by using digital self-management tools? (Free text)
11. Do you think using digital self-management tools in your practice affect the interaction between you and your patients? (Yes/No)
    a. If yes, how? (Free text)
12. Can you describe any experiences where digital tools have created conflicts between you and your patients? (Free text)
13. Has the COVID19 pandemic changed your use of digital tools in your clinical practice? (Yes/No)
    a. Can you describe what these changes are? (Free text)
14. Has there been any barriers to using digital tools in clinical practice during COVID19 Pandemic? (Yes/No)
    a. Please explain why. (Free text)
15. To what extent do you agree with the following statements with regards to using digital tools before COVID19 pandemic? - Digital tools benefited me in my practice. (Multiple choice, select from: Strongly Disagree, Disagree, Somewhat disagree, Neither agree nor disagree, Somewhat Agree, Agree, Strongly Agree)
16. To what extent do you agree with the following statements with regards to using digital tools before COVID19 pandemic? - Digital tools benefited my patients in my practice. (Multiple choice, select from: Strongly Disagree, Disagree, Somewhat disagree, Neither agree nor disagree, Somewhat Agree, Agree, Strongly Agree)
17. To what extent do you agree with the following statements with regards to using digital tools before COVID19 pandemic? - Digital tools allow my patients to take responsibility for their own healthcare. (Multiple choice, select from: Strongly Disagree, Disagree, Somewhat disagree, Neither agree nor disagree, Somewhat Agree, Agree, Strongly Agree)
18. To what extent do you agree with the following statements with regards to using digital tools before COVID19 pandemic? - As a clinician I feel more comfortable giving my patients more responsibility for their own healthcare. (Multiple choice, select from: Strongly Disagree, Disagree, Somewhat disagree, Neither agree nor disagree, Somewhat Agree, Agree, Strongly Agree)

19. To what extent do you agree with the following statements with regards to using digital tools during COVID19 pandemic? - Digital tools benefited me in my practice. (Multiple choice, select from: Strongly Disagree, Disagree, Somewhat disagree, Neither agree nor disagree, Somewhat Agree, Agree, Strongly Agree)
20. To what extent do you agree with the following statements with regards to using digital tools during COVID19 pandemic? - Digital tools benefited my patients in my practice. (Multiple choice, select from: Strongly Disagree, Disagree, Somewhat disagree, Neither agree nor disagree, Somewhat Agree, Agree, Strongly Agree)
21. To what extent do you agree with the following statements with regards to using digital tools during COVID19 pandemic? - Digital tools allow my patients to take responsibility for their own healthcare. (Multiple choice, select from: Strongly Disagree, Disagree, Somewhat disagree, Neither agree nor disagree, Somewhat Agree, Agree, Strongly Agree)
22. To what extent do you agree with the following statements with regards to using digital tools during COVID19 pandemic? - As a clinician I feel more comfortable giving my patients more responsibility for their own healthcare. (Multiple choice, select from: Strongly Disagree, Disagree, Somewhat disagree, Neither agree nor disagree, Somewhat Agree, Agree, Strongly Agree)
23. During COVID19 pandemic, in what ways have you accommodated the patients who do not have access to the digital tools that you used in your clinical practice? (Free text)
24. Age:
25. Gender:
26. Ethnicity - Selected Choice
    a. Ethnicity - Other ethnic group, please specify - Text
27. What are your professional qualifications? (Masters degree, nursing degree, doctor of medicine, QCF level, etc)
28. How long have you been working in your current role? (Year, Month)
29. What is your practice postcode? (Please enter the first half of the postcode: eg. if M33 7AE - then enter M33)

Coding tree

Name	Description	Files	References
Changes in access to and use of DHTs during the pandemic		0	0
Barriers to uptake during COVID		0	0

Name	Description	Files	References
Barriers to access for patients		0	0
COVID led tech uptake leaving some groups behind	e.g. elderly/ digitally isolated	1	1
Not having the necessary equipment		1	4
Not knowing how to use or wanting to use tech		1	3
Patients digital not suitable for	During covid	1	1
Barriers to use for HCPs		0	0
Financial barriers		1	1
Issues with confidentiality		1	2
Knowing what tech to use and recommend		1	1
Managing the huge change		1	2
New systems not supported correctly		1	1
Technical issues with new tech reliance		1	1
Tech not working properly		1	3
Challenges with tech only care	e.g. issues with diagnostics etc.	1	2
Managing relationship in consultation		1	2
Showing patients things		1	1
COVID led to change in perception of tech		1	1
COVID led to change in practice for HCP		1	12
COVID limiting access to support		1	3
COVID prompted increase in tech use		2	9

Name	Description	Files	References
Patients more accepting of tech		1	1
Support to overcome issues		1	7
Providing access to equipment		1	1
Providing Alternative contact for health information or services		1	2
Providing face to face appointments		1	6
Levels of access to DHTs	Different levels where decisions about access to DHTs are made	0	0
Clinician's decisions-making about who DHTs are appropriate for		0	0
Deciding who is suitable for DHTs		5	8
Lack of digital literacy means prioritised for face-to face appointment		3	4
Only recommend DHTs that are credible and approved		0	0
Can only provide access to recommended DHTs		1	1
Determining which sources are credible to share		5	9
Perceptions of who is excluded from tech		0	0
Age based assumptions about digital literacy		13	18
Assess patients' access to digital tech		3	3
DHTs exclude certain patients		1	1
Digital literacy affects self-care		6	8

Name	Description	Files	References
Disability		3	4
DT causes inequality depending complexity of healthcare needs		1	1
Lacking digital access		9	12
Language and culture barriers		2	3
Literacy affects accessing online tools		3	3
Most people have DT access		3	4
Not all patients can use tech	HCPs feel that not all patients can use and benefit from tech	3	3
Preference for DT challenges stereotypes		4	7
Tech access inequality - clinician bias and stereotypes		2	7
Tech access inequality - Literacy and digital literacy		12	17
Who DHTs work for	HCPs perceptions about who DHTs work for	5	6
Tech access inequality - SES		10	15
Technology complicated to explain		1	1
Clinician's Level of understanding and skill using DHTs		1	1
DHT uptake reliant on HCP digital skills		13	17
Tech too complicated to use by HCPs		1	1
HCPs don't know how to use tech		7	9
Age related assumptions about adoption of DHTs		3	4
HCP had perceptions challenged use of tech in their job		1	1

Name	Description	Files	References
Use of DHTs affected by trust and knowledge of features		0	0
HCPs don't trust tech		1	1
HCPs refuse to adopt tech		3	3
Takes time to adapt to new tech in their working practice	Takes clinicians time to learn about new features of tech and how to use it in their work.	3	3
Practice or organisational Level		0	0
All practices adopting tech differently		1	1
DHTs are or are not a priority to health service		2	3
Lack of promotion = poor patient adoption rate		2	2
Strategic decisions about DHT adoption		1	2
Training		0	0
DHT adoption related to peer support and training		12	21
Understanding of tech dependant on skills of people in practice		4	4
No time for DHT training		3	3
Tech training - individualised support and training		10	16
Role of DHTs	HCPs perspectives on the roles of digital health technologies	0	0
For practices in the management of patients		0	0
Adds to workload		10	17
DHT to improve communication between health services		0	0

Name	Description	Files	References
Better MDT communication amongst professionals		12	21
Challenges with referrals		1	1
Different systems are not compatible		12	23
NHS should be one unified system		7	8
Practices need to work together		1	1
DHTs lead to inappropriate appointments	Over sensitive algorithms and digital triage leads to inappropriate appointments	2	3
For planning and streamlining healthcare services	There was a perception from the HCPs that DHTs were useful for resource planning and for streamlining and standardizing practice.	0	0
Accuracy in record keeping		12	17
DT cannot resolve labour shortages		2	3
DT helps resource planning		2	3
DT perceived to be cost-saving measure		1	1
DT streamlines care system		3	3
Lacking control over referral and appointments		3	6
Online triaging mis-assesses clinical needs		5	7
DHTs lead to inappropriate appointments	Over sensitive algorithms and digital triage leads to inappropriate appointments	2	3
Referral tool cumbersome		1	1
Tech helps to make best use of clinicians' time		2	2
Tech provides safer and better governance		4	8

Name	Description	Files	References
Technology aids standardisation, data analysis, evaluation		10	14
Unreliable technology is a nightmare		16	26
Technology is not user friendly		10	13
In patient care		0	0
Digital information easier for patients to access		6	8
Ease of information sharing with patients		9	13
Faster and easier access to healthcare		4	7
Patients want results fast		1	1
Some patients hard to contact		2	3
Technology broadens clinical outreach		1	2
Finding the right information online	They talked about the importance of finding credible sources of info	0	0
Control of info vs finding the right resources	There was a conflict between HCPs feeling that patients having access to health information online was good, but that there was a lack of control over finding the right sources for the right people. Some HCPs described how access digital health tools could increase an individual's autonomy and engagement in their care. Others cited concerns about patients accessing information from unreliable sources.	11	17
Right information for the right people		5	6
Patient misunderstanding		5	9
Patients have greater responsibility towards own healthcare		9	17
Tech and info induce anxiety in patients		6	8

Name	Description	Files	References
Technology saves time in healthcare		12	23
in the interaction between patients and HCPs		0	0
Confidentiality and information security		11	21
Disparity and tension in patient and clinician need		1	2
Digital technology cannot replace the value of in person consultations		11	23
Detracts from human interaction		8	13
Not doing face-to-face means increased clinical risk		1	1
Online patient-clinician relationships are just as good as offline		1	1
Digital tool interferes with human consultation		3	5
How to use the data in consultations		5	6
Transparency conflicts with candidness		3	5
One way messaging-no patient response		6	9
One way communication cuts out patient response		6	7
Online screening and assessment useful		10	22
Information overload for clinicians		2	2
Use for shared decision making		4	11
Role for HCPs		0	0
Deskill the HCPs		3	4

Name	Description	Files	References
HCPs can tailor systems to their needs		2	2
Technology improves staff training and knowledge		8	11

COREQ (COnsolidated criteria for REporting Qualitative research) Checklist

A checklist of items that should be included in reports of qualitative research. You must report the page number in your manuscript where you consider each of the items listed in this checklist. If you have not included this information, either revise your manuscript accordingly before submitting or note N/A.

Topic	Item No.	Guide Questions/Description	Reported on Page No.
Domain 1: Research team and reflexivity			
Personal characteristics			
Interviewer/facilitator	1	Which author/s conducted the interview or focus group?	
Credentials	2	What were the researcher's credentials? E.g. PhD, MD	
Occupation	3	What was their occupation at the time of the study?	
Gender	4	Was the researcher male or female?	
Experience and training	5	What experience or training did the researcher have?	
Relationship with participants			
Relationship established	6	Was a relationship established prior to study commencement?	
Participant knowledge of the interviewer	7	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	
Interviewer characteristics	8	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	
Domain 2: Study design			
Theoretical framework			
Methodological orientation and Theory	9	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	
Participant selection			
Sampling	10	How were participants selected? e.g. purposive, convenience, consecutive, snowball	
Method of approach	11	How were participants approached? e.g. face-to-face, telephone, mail, email	
Sample size	12	How many participants were in the study?	
Non-participation	13	How many people refused to participate or dropped out? Reasons?	
Setting			
Setting of data collection	14	Where was the data collected? e.g. home, clinic, workplace	
Presence of non-participants	15	Was anyone else present besides the participants and researchers?	
Description of sample	16	What are the important characteristics of the sample? e.g. demographic data, date	
Data collection			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	
Repeat interviews	18	Were repeat inter views carried out? If yes, how many?	
Audio/visual recording	19	Did the research use audio or visual recording to collect the data?	
Field notes	20	Were field notes made during and/or after the inter view or focus group?	
Duration	21	What was the duration of the inter views or focus group?	
Data saturation	22	Was data saturation discussed?	
Transcripts returned	23	Were transcripts returned to participants for comment and/or	

Topic	Item No.	Guide Questions/Description	Reported on Page No.
		correction?	
Domain 3: analysis and findings			
Data analysis			
Number of data coders	24	How many data coders coded the data?	
Description of the coding tree	25	Did authors provide a description of the coding tree?	
Derivation of themes	26	Were themes identified in advance or derived from the data?	
Software	27	What software, if applicable, was used to manage the data?	
Participant checking	28	Did participants provide feedback on the findings?	
Reporting			
Quotations presented	29	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	
Data and findings consistent	30	Was there consistency between the data presented and the findings?	
Clarity of major themes	31	Were major themes clearly presented in the findings?	
Clarity of minor themes	32	Is there a description of diverse cases or discussion of minor themes?	

Developed from: Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

Once you have completed this checklist, please save a copy and upload it as part of your submission. DO NOT include this checklist as part of the main manuscript document. It must be uploaded as a separate file.