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# BMJ Open

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

4  
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1  
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3 22 *Abstract*

4 23 **Objectives**

5 24 To explore how HCPs used and made decisions about DHTs in their clinical practice before  
6 25 and during the COVID-19 pandemic.  
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9 27 **Design:**

10 28 Multi-methods study. Semi-structured telephone interviews were conducted prior to the  
11 29 COVID-19 pandemic with a purposive sample of HCPs. An online survey was conducted with  
12 30 HCPs during the pandemic, to ensure that the qualitative findings remained relevant within  
13 31 the rapidly-changing healthcare context. Participants were recruited through HCP networks,  
14 32 snowballing and social media. Data were analysed thematically.  
15  
16 33

17 34 **Setting:**

18 35 Phone interviews and online survey.  
19  
20 36

21 37 **Participants:**

22 38 HCPs represented a range of professions from primary and secondary care across England,  
23 39 with varied socioeconomic deprivation.  
24  
25 40

26 41 **Results:**

27 42 24 HCPs were interviewed, and 16 HCPs responded to the survey. In the interviews, HCPs  
28 43 described three levels where decisions were made, which determined who would have  
29 44 access to what DHTs: health organisation, HCP, and patient levels. These decisions resulted  
30 45 in the unequal implementation of DHTs across health-services, created barriers for HCPs  
31 46 using DHTs in their practice, and influenced HCPs decisions on which patients to supply or  
32 47 discuss DHTs with. In the survey, HCPs described being provided support to overcome some  
33 48 of the barriers at the organisation and HCP level during the pandemic. However, they cited  
34 49 similar concerns to pre-pandemic about barriers patients faced using DHTs (e.g., digital  
35 50 literacy). In the absence of centralised guidance on how to manage these barriers, health-  
36 51 services made their own decisions about how to adapt their services for those who  
37 52 struggled with DHTs.  
38  
39 53

40 54 **Conclusions:**

41 55 Decision-making at the health organisation, HCP and patient level influence inequalities in  
42 56 access to DHTs for HCPs and patients. The mobilisation of centralised information and  
43 57 resources during the pandemic can be viewed as good practice for reducing barriers to use  
44 58 of DHTs for HCPs. However, attention must also be paid to reducing barriers to accessing  
45 59 DHTs for patients.  
46  
47 60

48 61 **Keywords**

49 62 Internet-based intervention; health care disparities; socioeconomic factors; primary care;  
50 63 digital health; health services accessibility; qualitative research  
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## 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.

## 93 BACKGROUND

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

108  
109 DHTs have been found to be effective in supporting patients to self-care for a range of  
110 health conditions (7, 12-15). Health interventions designed specifically to support  
111 disadvantaged groups can be more effective for those groups, thus reducing inequalities (7,  
112 14, 16, 17). However, recent evidence has found that such benefits may be limited for  
113 people from lower socio-economic groups, who do not have the resources (such as time,  
114 finances, technical proficiency) to access and use DHTs (18-20). Less is known about how  
115 HCPs use DHTs for helping patients to manage their own health and wellness, the barriers

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3 116 they face doing so, and the implications this may have for the access to DHTs for their  
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6 117 patients (9, 19, 21). There are indications that HCPs face challenges incorporating DHTs into  
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8 118 their existing systems and practices, and establishing risk and rapport with patients in  
9  
10 119 remote consultations (9, 21). Patients have also reflected that they feel HCPs have limited  
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12  
13 120 knowledge of what self-care DHTs are available and effective (19).  
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18 122 Our multi-methods study was designed to explore how HCPs (e.g., General Practitioners  
19  
20 123 (GPs), nurses, pharmacists) used and made decision about DHTs in their clinical practice  
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22  
23 124 before and during the COVID-19 pandemic. We aimed to 1) understand barriers and  
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25 125 facilitators to the use of DHTs by HCPs, and the implications for the access patients have to  
26  
27 126 DHTs, and 2) whether these changed during the pandemic.  
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## 31 32 33 34 128 METHODS

### 35 36 37 129 **Design**

38 130 This study adhered to the COREQ (Consolidated Criteria for Reporting Qualitative Research)  
39  
40 131 guidelines on the reporting of qualitative research (22). It was a multi-methods study,  
41  
42  
43 132 comprising semi-structured interviews and an online survey with HCPs working in English  
44  
45 133 primary and secondary care services. The interviews were conducted prior to the pandemic  
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48 134 (November 2019-March 2020) and the survey was conducted during the pandemic (July  
49  
50 135 2020-August 2020). Both studies explored how HCPs accessed and used DHT. The  
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52  
53 136 methodological orientation of the study was a mixed inductive and deductive approach (23,  
54  
55 137 24). Ethical approval was granted by the University of Bath's Psychology Research Ethics  
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3 138 Committee for the interviews and survey (PREC reference number: 19-211 and 20-142  
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5  
6 139 respectively).

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8 **140 Interviews**

9 **141 Participants**

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12 142 Participants for the interviews were recruited through a range of networks, including  
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15 143 National Institute of Health and Care Research School of Primary Care Research, community  
16  
17 144 networks, social media (snowballing), and Academic Health Service Networks across  
18  
19  
20 145 England. HCPs were purposively sampled to represent primary and secondary care health  
21  
22 146 professionals from a range of backgrounds from across England, working in locations that  
23  
24  
25 147 varied in their level of socioeconomic deprivation (Table 1). Socio-economic deprivation was  
26  
27 148 determined by collecting the postcode of the health service where the HCP worked, and  
28  
29  
30 149 mapping it to the England Indices of Multiple Deprivation (IMD)(25).

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35 **151 Procedure/Data collection**

36 152 The topic guide (see Supplementary material) was developed through author collaboration,  
37  
38 153 consultation with qualitative experts, and input from Patient and Public Involvement  
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41 154 representatives. The topic guide was piloted and revised for clarity following feedback from  
42  
43 155 two GPs.

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48 157 All interviews were semi-structured and conducted over the telephone by the same  
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51 158 researcher (JL). All participants were provided with written information via email about the  
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53 159 study before agreeing to be interviewed. Participants were informed that the purpose of the  
54  
55 160 study was to explore which DHTs are used by healthcare professionals in their clinical work,  
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57  
58 161 how these tools were used to support their daily tasks (both client and non-client facing),  
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3 162 and their experiences with different DHTs. At the beginning of each interview participants  
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6 163 were given the opportunity to ask questions, were assured of their voluntary participation,  
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8 164 and could withdraw their data until anonymisation and analysis. Participants provided  
9  
10 165 informed consent using an online form before the interview. Interviews were conducted via  
11  
12  
13 166 phone at a mutually convenient time, lasted 17 to 51 minutes (mean = 32 minutes; median  
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15 167 = 30 minutes), and took place in private, quiet settings, often participants' offices or homes.  
16  
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18 168 HCPs received a £70 payment as compensation.  
19

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23 170 Each participant took part in one interview, with no repeat interviews. Short field notes  
24  
25 171 were taken during the interviews. All interviews were audio-recorded, transcribed,  
26  
27 172 anonymised and imported into NVivo Software (NVivo qualitative data analysis Software;  
28  
29 173 QSR International Pty Ltd. Version 1.6.2). Transcripts and findings were not returned to  
30  
31  
32 174 participants for comment or correction. Interviews were undertaken with all willing  
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34 175 participants, with the sample size guided by principles of information power rather than  
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37 176 data saturation (26).  
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### 41 42 178 **Data Analysis**

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45 179 Analysis of qualitative data began shortly after data collection started and was ongoing and  
46  
47 180 iterative. Corrected, anonymised transcripts were coded using NVivo software. An inductive  
48  
49 181 thematic analysis approach was used for the analysis of the qualitative interviews (23),  
50  
51  
52 182 subsequently a deductive approach was taken to investigate similarities and differences  
53  
54 183 between themes emerging from the surveys (24). Initial codes were developed by JL. Five  
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57 184 members of the multidisciplinary research team also coded a sample of transcripts and then  
58  
59 185 met to discuss and develop significant broader patterns of meaning (potential themes). ST

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3 186 organized the codes into final themes, which were agreed upon by the core team (ST, BA,  
4  
5 187 and CD).  
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11 189 ***Research team and reflexivity***  
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14 190 Personal characteristics  
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16 191 JL, a female PhD student in clinical and developmental psychology during data collection,  
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18 192 conducted all interviews. JL received postgraduate training in qualitative methodology and  
19  
20 193 had experience with semi-structured interviews and thematic analysis. She was supervised  
21  
22 194 by senior academics experienced in qualitative research (CD and BA).  
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29 196 Relationship with participants  
30

31 197 There was no prior relationship between the research team and study participants. The  
32  
33 198 participants knew that the study was about the use of DHTs in primary healthcare, and that  
34  
35 199 JL was a student researcher. The position taken by JL was that DHTs have the potential to  
36  
37 200 empower people in self-monitoring and care and facilitate HCPs to share wider range of  
38  
39 201 resources with patients from diverse backgrounds. However, JL felt that there may be  
40  
41 202 barriers in assessing the quality of different DHTs by HCPs, and accessibility regarding both  
42  
43 203 hardware and software issues for patients from more disadvantaged backgrounds.  
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51 205 **COVID-19 Survey**

52 206 As interviews occurred before the first UK COVID-19 lockdown in Mar 2020, we developed  
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54 207 an online survey to capture evolving healthcare delivery, ensuring continued relevance to  
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56 208 the changing context. The survey sought to understand general views on DHTs and  
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58 209 specifically how the COVID-19 pandemic affected their usage. The survey (see  
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3 210 Supplementary materials) included free text responses, multiple choice questions and Likert  
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6 211 scales. Feedback from three GP stakeholders informed the optimisation of the survey.  
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10 213 Participants were invited to complete the survey through advertisements on social media  
11  
12 214 (Twitter) and email, disseminated through academic primary care research networks and  
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14 215 departments. English-speaking HCPs that use DHTs were included in the study, with no  
15  
16 216 further exclusion criteria used for participant recruitment. Data collection took place  
17  
18 217 between July 2020 and August 2020. Informed consent was obtained before survey  
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20 218 participation. Participants were given the option to enter a prize draw for a £50 Amazon gift  
21  
22 219 voucher as an incentive.  
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30 221 ST analysed the free text responses thematically by ST using the coding structure developed  
31  
32 222 during the analysis of the qualitative interview data (included in the coding tree in the  
33  
34 223 Supplementary material). Themes emerging from the survey were discussed and refined by  
35  
36 224 ST, CD and BA.  
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## 43 226 RESULTS

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46 227 In total 24 HCPs were interviewed: 10 GPs, 4 nurses, 8 pharmacists, 1 psychologist and 1  
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48 228 systems manager; their characteristics are outlined in Table 1. Participants approached the  
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50 229 study if they were interested, there were no participants who dropped out of the interview  
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52  
53 230 study. Most of the HCPs were women (63%), in the 31-40 age range (58%), worked in a GP  
54  
55 231 practice (46%), had been in their role for 1-5 years (58%) and had 1-5 years' experience  
56  
57  
58 232 using digital health tools in their practice (67%). The median practice IMD decile was 4  
59  
60

233 (interquartile range 3-8) (25), indicating the participants worked in more deprived areas  
 234 than average for England.  
 235  
 236 22 HCPs consented to take part in the survey, however 3 participants were excluded as they  
 237 did not report their job title and an additional 3 participants were excluded as they did not  
 238 finish the survey. We do not have information on the completion rate of the surveys, as we  
 239 only received surveys that were completed. This left a total of 16 HCPs: 7 GPs, 4 pharmacist,  
 240 2 nurses, 1 dietitian, 1 clinical psychologist and 1 cardiac surgeon (Table 1). There were 9  
 241 women and 7 men, with an age range of 28 to 66 ( $M= 41$ ,  $SD= 11.6$ ) and the years of  
 242 experience ranging from 1 year to 43 years qualified.

243

244 Table 1: Participant demographics

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

245

246

### 247 **Digital Healthcare Tools used**

248 HCPs discussed a range of technologies that they considered to be a DHT, including:

249 treatment algorithms, digital self-care behavioural interventions, email text and video call

250 consultations, correspondence with patients (e.g., practice text message systems), and data

251 storage systems.

252

### 253 **Results from thematic analysis**

254 There were two main themes that emerged from the interviews conducted prior to the

255 pandemic: the role of DHTs in HCPs clinical practice, and decision-making at three levels that

256 determined who got access to what DHTs. There was an additional theme from survey,

257 where HCPs described changes in access to and the use of DHTs during the pandemic. An

258 outline of the themes and subthemes are available in Table 2.

259 Table 2: Themes and subthemes

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

260

### 261 ***Pre-pandemic interviews***

#### 262 Role of digital healthcare tools

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

269

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3 270 Decision-making at three levels that determined who got access to what digital  
4 health tools  
5 271

6 272  
7 273 Prior to the pandemic, three levels were identified where decisions were made about who  
8  
9 274 should have access to what DHTs and what support they would receive to access them.

10  
11  
12 275 These were the 1) health organisation, 2) HCP, and 3) patient levels.  
13

14 276  
15

16  
17 277 *Health Organisation level*

18 278 *Influence of strategic decisions and incentive structures*

19 279 HCPs described how strategic decisions made by individual health services and incentive

20  
21  
22 280 structures created challenges for the adoption and implementation of DHTs. There was

23  
24 281 generally a perception that there was no cohesive digital strategy across healthcare services

25  
26 282 with ‘...all practices are doing slightly different things’ (ID P2). An HCP felt that it was

27  
28 283 challenging for practices to prioritise the adoption of DHTs because they were not

29  
30 284 supported by traditional incentives structures, which would compensate for the time

31  
32 285 involved in managing the new digital treatments and services:  
33

34  
35  
36  
37 286 *‘... [digital health is] not one of the key performance indicators (...) it's not*

38  
39 287 *yet at the point where commissioners are saying, look, you know, you said*

40  
41 288 *to us, you're going to offer digital interventions. Show us by March that*

42  
43 289 *you've offered 2500. (...). it's often commissioners that drives practice*

44  
45 290 *because obviously commissioners are the ones that actually pay for the*

46  
47 291 *services.’ (ID P15)*  
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50  
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52  
53 292 *HCP level*

54 293

55 294 The uptake of DHTs by HCPs and their decision to recommend them to patients, was

56  
57  
58 295 influenced by: the HCP’s digital skills, their knowledge of what DHTs were available and  
59  
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1  
2  
3 296 effective, their perceptions of the quality of DHTs, and the availability of training and  
4  
5  
6 297 informal support for HCPs to use DHTs.

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9  
10 299 *HCP digital skills*

11 300

12 301 HCP use of DHTs in their practice and their ability to recommend them to their patients, was

13  
14  
15 302 reliant on their digital skills. Some HCPs described finding technology '*intuitive and quite*

16  
17  
18 303 *basic*' (ID P17). Others felt a lack of digital skills were a barrier to them supporting patients:

19  
20 304 '*I've actually found that simple things [using DHTs] I don't know how to do, it means that I*

21  
22  
23 305 *can't do my job, just because I've not had the training*' (ID P22).

24  
25 306

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27  
28 307 There was a perception by some of the participants that older HCPs would struggle to learn

29  
30 308 about and use new DHTs, because they '*were not responsive to learning the new ways of*

31  
32  
33 309 *doing things...*' (ID P30).

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35 310

36  
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38 311 *HCP's knowledge of what DHTs were available and effective*

39 312

40 313 HCPs were aware there were lots of DHTs available that may be able to support their

41  
42  
43 314 practice and patients, but many felt they did not have specific knowledge of what they

44  
45 315 should use or how they worked. One participant spoke about how multiple different digital

46  
47  
48 316 systems were being introduced in their practice, that '*have got amazing functionality but we*

49  
50 317 *don't know about it and we don't know how to use it*' (ID P10). Another described how there

51  
52 318 were '*websites and apps that I've got experience of using and are very happy to*

53  
54 319 *recommend*', while other DHTs they had heard of but '*don't know how good they are*' which

55  
56  
57 320 impacts how they '*sell*' DHTs to their patients (ID P8). A participant described how the high

58  
59  
60

1  
2  
3 321 workload for HCPs presented challenges for them to remember what DHTs are available and  
4  
5 322 how to use them in a short consultation:  
6  
7

8  
9 323 *'...people will do the training and then they've got loads of other things do*  
10  
11 324 *it. They'll forget about it. So at the point (...) I'm thinking this client could*  
12  
13 325 *maybe do digital, but I can't remember how to log on.'* (ID P15)  
14  
15  
16

17 326  
18  
19 327 *HCP perceptions about the quality of DHTs*  
20

21 328  
22 329 HCPs made judgements about what DHTs to use or recommend to patients based on their  
23  
24 330 perceptions of the quality or reliability of DHTs. They talked about the challenges in  
25  
26 331 determining which DHTs were trustworthy, and which were *'flawed and quite risky'* (ID  
27  
28 332 P10). Some HCPs talked about being happy to recommend government-led online sources  
29  
30 333 of information, like the National Institute of Clinical Excellence (NICE) website, because it  
31  
32 334 was a *'reputable source'* (ID P13).  
33  
34  
35

36 335  
37  
38 336 There was a sense from some of the HCPs that DHTs could not always be trusted to manage  
39  
40 337 or deliver patient care. One participant felt that if there was something important that  
41  
42 338 needed to be communicated with a patient *'someone needs to phone as well, we can't*  
43  
44 339 *totally trust the technology'* (ID P20). Another recalled incidences where *'systems have just*  
45  
46 340 *gone down and then you're completely stuck'*, making it impossible to access essential  
47  
48 341 patient information (ID P7).  
49  
50  
51

52 342  
53  
54 343 *Access to training and informal support within the organisation or practice*  
55  
56 344 HCPs described how the provision and quality of formal training to use DHTs was variable  
57  
58 345 across health services, and consequently it was *'learn by using'* (ID P4). Some felt formal  
59  
60

1  
2  
3 346 training for DHTs was not accessible for HCPs because they had to *'take time out of your*  
4  
5  
6 347 *practice'* (ID P1), which they did not have. For those who had attended training, some HCPs  
7  
8 348 felt it was useful, while others felt they did not *'meet a broad range of people's learning*  
9  
10 349 *needs'* (ID P13).

11  
12  
13 350

14  
15 351 Many of the HCPs described how they learned about DHTs and their features through other  
16  
17 352 HCPs in the health service where they worked. The availability and quality of this support  
18  
19 353 was not consistent across practices or organisations, and was determined by the level of  
20  
21 354 digital skills of the people working in the individual health service:

22  
23  
24  
25  
26 355 *'...someone in the practice has either figured it out or seen it elsewhere*

27  
28 356 *and then they show someone else and so some people know how to do it.*

29  
30  
31 357 *Some people don't. It's all a bit patchy...'* (ID 10)

32  
33  
34 358 Patient level

35 359 HCPs made judgements about which patients would benefit from DHTs. Their perceptions  
36  
37 360 often influenced whether they recommend DHTs or used them with patients.

38  
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40 361

41  
42  
43 362 *HCP's perceptions of which patients can use and benefit from DHTs*

44  
45 363 HCPs generally believed that DHTs were most suitable for digitally literate, *'young, fit'* (ID  
46  
47 364 P2) individuals, and those who were *'able bodied and mentally able'* (ID P32).

48  
49  
50 365

51  
52 366 HCPs identified patient groups who they thought faced barriers accessing and using DHTs.

53  
54 367 This included patients with *'very low literacy'* (ID P10), *'whose language is not English'* (ID

55  
56 368 P5), and those who *'never embraced the internet or any digital tech'* (ID P32). Some patients  
57  
58  
59  
60

1  
2  
3 369 were viewed as more isolated, lacking support from a *'team or family or carers'* to help  
4  
5  
6 370 them access DHTs (ID P12).  
7

8 371

9  
10 372 Some DHTs placed criteria that excluded vulnerable and underserved groups. For example, a  
11  
12  
13 373 HCPs also spoke about the Babylon app that has: *'excluded a ridiculous number of people*  
14  
15 374 *from being able to use its service (...) like no woman can become pregnant, no one with*  
16  
17 375 *social service needs, no one with mental health problems, so there's many exclusions for*  
18  
19  
20 376 *people with the highest needs.'* (ID P9)  
21  
22

23 377

24  
25 378 There were conflicting opinions about digital health accessibility for people who lived in  
26  
27  
28 379 lower income areas. Some felt most people with lower incomes *'have phone access now*  
29  
30 380 *anyway, so they will rely on their phones and online'* to access health information and  
31  
32 381 support (ID P4). However, concerns were raised that the *'disadvantage of the digital stuff is*  
33  
34 382 *potentially exacerbating health inequalities'* (ID P8). A participant described the intersection  
35  
36  
37 383 between age and deprivation being particularly problematic:  
38  
39

40 384 *'...we work in a relatively deprived area and most to our particularly*  
41  
42  
43 385 *younger patients do have Internet access and you know have mobiles, but*  
44  
45 386 *a lot of our older patients don't'* (ID P8).  
46  
47

48  
49 387 Although many HCPs spoke about how the elderly could be excluded from using DHTs, some  
50  
51 388 had their presumptions about age-related technology uptake challenged by experiences  
52  
53 389 with older patients being adept at using DHTs:  
54  
55

56 390 *'... a chap who was 80 years old, he came into my clinic room (...), he*  
57  
58  
59 391 *opened his tablet and he logged on to his own umm... personal page on his*  
60

1  
2  
3 392 *own practice to give me information. (...) I was like oh gosh that's really*  
4  
5  
6 393 *impressive can I have a look' (ID P20).*  
7

8  
9 394 Conversely, an HCP had found that '*...a lot of young people don't want treatment digitally'*  
10  
11 395 *(ID 15)*, because they were concerned around inadvertent disclosure of stigmatised health  
12  
13 396 conditions:

14  
15  
16  
17 397 *'...they're saying, actually, I don't want something on my phone that my*  
18  
19 398 *mates going to see. And it's got something about anxiety on it or it's got*  
20  
21 399 *something like I'm a family member of somebody with an alcohol problem'*  
22  
23  
24 400 *(ID P15)*  
25

26  
27 401 *HCP's making judgements about who to use DHTs with*

28 402 The perception of HCPs about the appropriateness of DHTs for a specific patient group

29  
30 403 influenced their decisions regarding DHT use. HCPs described how they were less likely to

31  
32 404 communicate with older adults or those with '*mental disabilities*' (ID P9) using DHTs. Several

33  
34 405 HCPs said they were less likely to engage in discussions about or supply DHTs to discuss or

35  
36 406 older patients:

37  
38  
39  
40  
41 407 *'...the older generation are a little bit 'oh no, I don't want to do that', or 'it*  
42  
43 408 *confuses me'. So yeah, I judge who I would discuss apps with and*  
44  
45 409 *technology with age wise...' (ID P32)*  
46

47  
48  
49 410

50  
51 411 A participant stated that their team were targeting '*the younger ones*' in their roll out of an

52  
53 412 app to support people with bowel cancer (ID P25). However, she acknowledged that the

54  
55 413 majority of their '*patients are 70-89*' and were '*not going to be able to use the app*' (ID P25).

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57 414  
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3 415 Some HCPs described how the perception that someone was lacking digital skills, resulted in  
4  
5  
6 416 them being prioritised for face-to-face consultations, when '*clinically, they didn't need that*  
7  
8 417 *priority*' (ID P5). A participant reflected that '*the less digitally enabled person might get*  
9  
10 418 *more of my attention than the more digitally enabled*' (ID P11).

11  
12  
13 419

## 14 15 420 **COVID 19 Survey**

### 16 421 Changes in access to and use of DHTs during the pandemic

17 422 HCPs who completed the survey about their use of DHTs during the pandemic, described a  
18  
19  
20  
21 423 dramatic shift in '*practice to almost completely remote working*' in response to government  
22  
23 424 implemented COVID restrictions (Survey ID 10). They described how: they adapted to this  
24  
25 425 shift, the barriers and facilitators to providing care almost exclusively through DHTs, and  
26  
27 426 their perceptions of the barriers and facilitators for patients accessing care through DHTs  
28  
29 427 during the pandemic.

30  
31  
32  
33 428

### 34 35 429 How HCPs adapted to a remote-led model of care during the pandemic

36  
37  
38 430 Some of the HCPs reflected positively on the shift to the delivery of care through  
39  
40  
41 431 technology. Participants described how being '*forced to engage better with digital*  
42  
43 432 *technology*' (Survey ID 25), made them realise '*the potential of just what you can do by*  
44  
45 433 *phone (and sometimes video)*' (Survey ID 9). An HCP concluded that '*It has changed the way*  
46  
47 434 *we work for the long term, I think in a good way.*' (Survey ID 25). However, several of the  
48  
49  
50 435 HCPs cited similar concerns to pre-pandemic about practising through remote  
51  
52  
53 436 appointments. They found it: '*more difficult to understand a patient's problem and support*  
54  
55 437 *them when you are unable to see them in person and perform certain tests*' (Survey ID 15).

1  
2  
3 438 In addition to hindering the development of an *'appropriate patient physician relationship'*  
4  
5 439 (Survey ID 17).  
6  
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8 440

9  
10 441 Barriers and facilitators to providing care through DHTs during the COVID pandemic  
11

12  
13 442 The barriers to providing care through DHTs during the pandemic described by the HCPs  
14  
15 443 were similar to pre-pandemic. These included *'Internet problems'* (Survey ID 13), issues with  
16  
17 444 DHTs being properly approved and integrated through healthcare services, *'Issues around*  
18  
19 445 *consent and data sharing'* (Survey ID 25), and staff being willing or able to engage with  
20  
21 446 DHTs. For example, a participant described how *'some older staff didn't want to work*  
22  
23 447 *digitally and struggled to accept change'* (Survey ID 10).  
24  
25  
26  
27

28 448

29  
30 449 However, HCPs described having more resources available to overcome these issues during  
31  
32 450 the pandemic compared to prior to the pandemic. An HCP described how their organisation  
33  
34 451 *'facilitated'* the use of DHTs *'more and removed any existing barriers'* (Survey ID 28):  
35  
36

37  
38 452 *'...initially [there was] lots of confusion over how we were going to be able*  
39

40 453 *to offer patient appointments and what apps etc were NHS approved etc.*  
41

42 454 *The local Primary care network were fantastic in supporting local surgeries*  
43

44 455 *in implementing change. Barriers also were financial, but when funding*  
45

46 456 *was granted for extra equipment etc, there was a boom in embracing new*  
47

48 457 *ways of working(...) there was so much change happening at once, that it*  
49

50 458 *was sometimes difficult to keep up with the latest information and what*  
51

52 459 *was available to use. An online network called Teamnet became the 'go to'*  
53  
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1  
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3 460 *site for updated information and technology and government updates.'*

4  
5  
6 461 *(Survey ID 10)*

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8  
9 462 Barriers and facilitators for patients accessing care through DHTs during the COVID  
10  
11 463 pandemic

12  
13  
14 464 The HCPs felt that some patients faced challenges when they were *'forced to adapt and*  
15  
16 465 *resort to digital tools'* in the pandemic (Survey ID 25). However, they felt most patients were  
17  
18 466 able to engage with the new way of accessing health support and were more *'accepting of*  
19  
20 467 *the technologies as there isn't an alternative'* during lockdown periods (Survey ID 6).

21  
22 468  
23  
24 469 For those patients who did face barriers in accessing and using DHTs, the issues described  
25  
26 470 by the HCPs were similar to pre-pandemic. HCPs felt that *'there is still a group of patients*  
27  
28 471 *and conditions for which face to face consulting is preferable'* (Survey ID 9). A participant  
29  
30 472 spoke about *'poorer patients not having internet or not [being] aware of how to use [the*  
31  
32 473 *internet]'* (Survey ID 30). An HCP described how: *'...elderly patients with no mobile phones or*  
33  
34 474 *laptops have felt isolated and victimized, age discrimination really. Some cannot or will not*  
35  
36 475 *embrace technology and want to be seen face to face or can't get phone to connect to video*  
37  
38 476 *call...'* (Survey ID 6)

39  
40 477  
41  
42 478 HCPs highlighted ways in which their services adapted to improve access to health services  
43  
44 479 for those who faced challenges using remote consultations during the pandemic. Most of  
45  
46 480 the HCPs described offering phone consultations, or face-to-face consultations with *'PPE*  
47  
48 481 *equipment'* (Survey ID 30) *'where safety can be maintained'* (Survey ID 28). Some HCPs  
49  
50 482 spoke about how their services made further adjustments to the delivery of their digital  
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3 483 support, by establishing alternative people to contact if the patient did not have good digital  
4  
5 484 skills, or by providing equipment to access services: *'Patients who do not have access to any*  
6  
7  
8 485 *digital tool (mostly elderly) we usually contacted their children etc who would be able to*  
9  
10 486 *assist them'* (Survey ID 15). A participant spoke about how they had *'obtained consent for*  
11  
12 487 *patients who don't have smartphones, to allow them to use a neighbours phone (...) to make*  
13  
14 488 *a video call'* (Survey ID 10). A participant described how their service provided *'mobile*  
15  
16 489 *phones for homeless clients'* (Survey ID 14).  
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## 24 491 DISCUSSION

### 25 492 **Principal findings**

26 493 In our pre-COVID-19 pandemic interviews, HCPs across different healthcare settings in  
27  
28  
29 494 England generally acknowledged the potential benefit of DHTs in enhancing patient access  
30  
31 495 to healthcare services. However, they expressed concerns regarding the appropriateness of  
32  
33 496 DHTs for specific patient populations, viewing face-to-face appointments as superior in  
34  
35 497 certain situations. The HCPs described three levels where decisions were made which  
36  
37 498 determined who would have access to what DHTs. These were: the health organisation,  
38  
39 499 HCP, and patient levels. At the organisation level, HCPs described a lack of cohesive strategy  
40  
41  
42 500 across healthcare services and traditional incentive structures targeting digital health, which  
43  
44 501 resulted in disparities in DHT adoption. At the HCP level, a wide variation in digital skills and  
45  
46 502 knowledge of DHTs created barriers to HCPs using these tools in their practice and  
47  
48 503 recommending them to patients. HCPs described a lack of high-quality centralised  
49  
50  
51 504 information and formal training, and inconsistencies in provision of support across practices  
52  
53  
54 505 or organisations. At the patient level, HCPs held beliefs about groups of patients they felt  
55  
56 506 would benefit from DHTs (e.g., young and fit). These preconceptions influenced HCP's  
57  
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3 507 decisions on whether to introduce DHTs to patients and whether to use these tools for  
4  
5  
6 508 patient communication.  
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10 510 In the survey conducted during the pandemic, the HCPs described an almost complete shift  
11  
12  
13 511 to remote delivery of care. While many barriers to DHT use persisted, HCPs reported  
14  
15 512 receiving significant support to overcome these challenges during the pandemic. This  
16  
17  
18 513 included support from the local Primary Care Networks to implement the shift to digital  
19  
20 514 services, funding for extra equipment, and an online network (e.g., Teamnet) that provided  
21  
22  
23 515 the most up to date information about what DHTs were available.  
24

25 516

26  
27 517 HCPs felt that the majority of their patients were able to adapt to the change in the delivery  
28  
29  
30 518 of services, mostly due to the lack of alternatives during the pandemic. However, similar  
31  
32  
33 519 concerns regarding digital exclusion persisted. To address these issues, HCPs implemented  
34  
35 520 strategies to enhance access to healthcare services for patients facing difficulties with DHTs.  
36  
37 521 This often included offering face-to-face appointments with the HCP wearing full personal  
38  
39  
40 522 protective equipment (PPE) or providing additional support for accessing digital services.  
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#### 43 44 45 524 **Strengths and limitations**

46 525 To the authors knowledge, this is the first study to explore the impact of decision making  
47  
48  
49 526 around the use of DHTs by HCPs on access to DHTs for patients, before and during the  
50  
51 527 COVID-19 pandemic. In addition to our planned qualitative study, we developed and  
52  
53  
54 528 disseminated a questionnaire that explored whether COVID-19 had changed the way that  
55  
56 529 healthcare professionals used DHTs. By doing this, we were able to ensure that our earlier  
57  
58  
59 530 'pre-COVID' work was still relevant to inform future research and policymaking.  
60

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6 532 Complete audio data was recorded for all interviews, and there were no issues with lost  
7  
8 533 data. Double coding of a subset of interviews by five members of the team and ongoing  
9  
10 534 discussion about coding structure ensured the coding scheme was robust. Multiple views of  
11  
12  
13 535 the data promoted confidence in the credibility of the findings (27). A diverse range of  
14  
15 536 experiences and opposing sides of arguments were identified and presented.  
16  
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19 537

20  
21  
22 538 There were challenges recruiting participants, which resulted in relatively small samples for  
23  
24 539 both the interviews and survey. This may have resulted in important experiences related to  
25  
26 540 DHT access and use not being captured. As patients were not included in this study,  
27  
28 541 reflections about the barriers patients experience accessing DHTs are from the HCP's  
29  
30 542 perspective. Consequently, this may not accurately reflect the barriers and facilitators  
31  
32 543 patients experienced accessing DHTs prior to and during the pandemic.  
33  
34  
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36 544

### 37 38 39 545 **Interpretations in the Context of Existing Literature**

40 546 Our study agrees with previous qualitative research conducted in the United States, that  
41  
42  
43 547 emphasised the influence of organisational context on DHT access (28). Puckett et al. (2020)  
44  
45 548 found that inequality in access to diabetes pumps was related to whether the clinic  
46  
47 549 distributed resources equally as standard policy, or whether they provided patients with  
48  
49 550 access dependent on their pre-determined policy/eligibility (e.g. interaction with the health  
50  
51 551 service) (28).  
52  
53

54 552

55  
56  
57 553 Our study found that during and prior to the pandemic, HCPs had concerns about  
58  
59 554 accessibility of online consultations, and made adaptations to support patients who were

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2  
3 555 less digitally literate or did not have internet access. These findings are similar to those of  
4  
5  
6 556 recent qualitative studies conducted before (20), and during the pandemic (29), where HCPs  
7  
8 557 reported that remote consultations could improve access for some groups (e.g. those with  
9  
10 558 caring responsibilities, not able to leave their homes) (20, 29). However, they also had  
11  
12  
13 559 concerns about digital exclusion and accessibility for some patients (20, 29), and described  
14  
15 560 providing face-to-face appointments for those who they perceived to be less able to use the  
16  
17  
18 561 digital services (e.g. older adults) (20).

19  
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22  
23 563 Two YouGov surveys of NHS staff and patients found that while the majority of patients and  
24  
25 564 NHS staff responded positively to the increased use of technology in healthcare during the  
26  
27  
28 565 pandemic, certain groups, including those over 55, individuals with caregivers, or those  
29  
30 566 unemployed, reported negative experiences with DHTs more frequently than the general  
31  
32  
33 567 population(5). This corresponds with the perceptions of the HCPs in our study, that the  
34  
35 568 majority of patients adapted well to delivery of care through technology. But those who  
36  
37  
38 569 were older and had lower incomes faced greater barriers accessing DHTs before and during  
39  
40 570 the pandemic.

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44  
45 572 In our study, some HCPs described having limited knowledge of what DHTs were available  
46  
47 573 and what to recommend to their patients. This corresponds with the findings from a  
48  
49  
50 574 qualitative study exploring digital access for patients with T2D, where participants felt HCPs  
51  
52 575 were not knowledgeable about self-care DHTs (19).

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3 577 **Implications for Research, practice and policy**

4 578 ***Improving digital infrastructure and training of HCPs***

5 579 The centralised response to the pandemic and the way in which barriers to accessing DHTs

6  
7  
8 580 were universally addressed in healthcare services across the United Kingdom described by

9  
10  
11 581 HCPs in our survey, can be seen as an illustration of good practice in tackling inequalities in

12  
13 582 access to DHTs at the organisational and HCP level. A recent white paper the Department of

14  
15 583 Health and Social Care laid out the aim to make the innovations that the COVID pandemic

16  
17  
18 584 accelerated permanent (30). However, it is unclear what support will remain to reduce

19  
20  
21 585 barriers to accessing and using DHTs, and whether this will be universally provided. Future

22  
23 586 support could consist of government funding and incentives, ensuring HCPs have access to

24  
25 587 and are aware of central repositories that provide up-to-date information about evidence-

26  
27  
28 588 based DHTs that they could recommend to their patients (e.g. ORCHA), and support for

29  
30  
31 589 health services to adopt innovations (e.g. Adopting Innovation programme (5)).

32  
33 590

34  
35 591 ***Reducing inequalities in access to DHTs for patients***

36 592 The HCPs in this study did not describe any centralised provision of support to ensure less

37  
38  
39 593 digitally engaged patients had access to DHTs during the pandemic. Instead, individual HCPs

40  
41  
42 594 and health organisations made decisions about who could benefit from DHTs, and what

43  
44 595 support would be offered to reduce barriers to accessing DHTs. By making judgements

45  
46 596 about who can benefit from DHTs, HCPs are potentially preventing some patients from

47  
48  
49 597 being able to benefit from these services, which has implications for inequalities in access to

50  
51  
52 598 healthcare. This is particularly poignant as we move towards the 'digital first' service as laid

53  
54 599 out in the NHS Long Term plan (1). To avoid digital exclusion, through the lack of provision

55  
56 600 of information about DHTs, it could become standard policy that all patients should be

57  
58  
59 601 signposted to evidence based DHTs. This could be sent to patients utilising existing systems

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2  
3 602 (e.g., accuRx) so as not to add additional burden on to HCP, and to circumvent HCPs acting  
4  
5  
6 603 as gatekeepers to DHTs. HCPs could also be provided with information about where to  
7  
8 604 signpost patients for support to access or use DHTs. Digital participation schemes piloted by  
9  
10 605 NHS digital have been successful in reducing inequalities in access to DHTs, by providing  
11  
12  
13 606 people with low digital literacy with support from digital champions (31, 32). Although there  
14  
15 607 are plans to roll these out more widely following the success of the pilots (31), current  
16  
17 608 unequal provision of these services across the UK risks widening digital inequities in areas  
18  
19 609 not served by these schemes. Speeding up the availability of this support could involve the  
20  
21  
22 610 development and roll out of engaging accessible training for digital health champions and  
23  
24  
25 611 access to up-to-date resources these digital champions could refer to.  
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27  
28 612

### 613 **Conclusions**

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

622 **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

623

624 **Declarations**625 **Ethics approval and consent to participate**

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

634

635 **Consent for publication**

636 Not Applicable.

637

638 **Availability of data and materials**

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

641

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643 None

644

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3 6514 652 *Author contributions*

5 653 ST drafted the manuscript. BA and CD contributed towards drafting and revising the  
6 654 manuscript. ST, CD, BA, SG, GL and BS contributed towards the conception and study design.  
7 655 JL conducted the interviews and developed the initial coding structure. IA was involved in  
8 656 disseminating and collecting the survey data. ST, CD, BA, SG, GL and JL were involved in the  
9 657 analysis and interpretation of findings. All authors read and approved the final version of  
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16 664

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21 669 *References*

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- 23 671 1. NHS. NHS Long-term plan. 2019.
- 24 672 2. NICE. Evidence standards framework for digital health technologies  
25 673 <https://www.nice.org.uk/corporate/ecd72018> [cited 2023 18/09/2023]. Available from:  
26 674 <https://www.nice.org.uk/corporate/ecd7>.
- 27 675 3. Sauchelli S. Digitalising diabetes support groups in response to the coronavirus COVID-19  
28 676 outbreak: a collaborative initiative. *Practical Diabetes*. 2020;37(6):208-10a.
- 29 677 4. Sauchelli S, Bradley J, England C, Searle A, Whitmarsh A. Exploring support needs of people  
30 678 living with diabetes during the coronavirus COVID-19 pandemic: insights from a UK survey. *BMJ*  
31 679 *Open Diabetes Research & Care*. 2021;9(1):e002162.
- 32 680 5. Horton T, Hardie T, Mahadeva S, Warburton W. Securing a positive health care technology  
33 681 legacy from COVID-19. London: Health Foundation. 2021.
- 34 682 6. Castle-Clarke S. What will new technology mean for the NHS and its patients: Four big  
35 683 technological trends. *London: King's Fund; 2018. Contract No.: June 2018.*
- 36 684 7. Murray E, Burns J, See TS, Lai R, Nazareth I. Interactive Health Communication Applications  
37 685 for people with chronic disease. *Cochrane Database Syst Rev*. 2005(4):Cd004274.
- 38 686 8. Muñoz RF. Using Evidence-Based Internet Interventions to Reduce Health Disparities  
39 687 Worldwide. *J Med Internet Res*. 2010;12(5):e60.
- 40 688 9. Kilvert A, Wilmot EG, Davies M, Fox C. Virtual consultations: are we missing anything?  
41 689 *Practical Diabetes*. 2020;37(4):143-6.
- 42 690 10. Fleming GA, Petrie JR, Bergenstal RM, Holl RW, Peters AL, Heinemann L. Diabetes digital app  
43 691 technology: benefits, challenges, and recommendations. A consensus report by the European  
44 692 Association for the Study of Diabetes (EASD) and the American Diabetes Association (ADA) Diabetes  
45 693 Technology Working Group. *Diabetes Care*. 2020;43(1):250-60.
- 46 694 11. van Kessel R, Hrzic R, O'Nuallain E, Weir E, Wong BLH, Anderson M, et al. Digital Health  
47 695 Paradox: International Policy Perspectives to Address Increased Health Inequalities for People Living  
48 696 With Disabilities. *J Med Internet Res*. 2022;24(2):e33819.
- 49 697 12. Hutchesson MJ, Rollo ME, Krukowski R, Ells L, Harvey J, Morgan PJ, et al. eHealth  
50 698 interventions for the prevention and treatment of overweight and obesity in adults: a systematic  
51 699 review with meta-analysis. *Obesity Reviews*. 2015;16(5):376-92.



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2  
3 700 13. Yoshida Y, Boren SA, Soares J, Popescu M, Nielson SD, Simoes EJ. Effect of Health  
4 701 Information Technologies on Glycemic Control Among Patients with Type 2 Diabetes. *Current*  
5 702 *Diabetes Reports*. 2018;18(12):130.
- 6 703 14. Turnbull S, Cabral C, Hay AD, Lucas P. Health equity in the effectiveness of web-based health  
7 704 interventions for the self-care of people with chronic health conditions: a systematic review. *JMIR*.  
8 705 2020;Preprint.
- 9 706 15. Turnbull S, Lucas P, Hay AD, Cabral C. Digital Health Interventions for People With Type 2  
10 707 Diabetes to Develop Self-Care Expertise, Adapt to Identity Changes, and Influence Other's  
11 708 Perception: Qualitative Study. *JMIR*. 2020;22.
- 12 709 16. Gustafson DH, Hawkins RP, Boberg EW, McTavish F, Owens B, Wise M, et al. CHES: 10 years  
13 710 of research and development in consumer health informatics for broad populations, including the  
14 711 underserved. *Int J Med Inform*. 2002;65(3):169-77.
- 15 712 17. Turnbull S. The Influence of Digital Self-care Interventions on Health Inequality in High  
16 713 Burden Chronic Health Conditions: University of Bristol; 2019.
- 17 714 18. Western MJ, Armstrong MEG, Islam I, Morgan K, Jones UF, Kelson MJ. The effectiveness of  
18 715 digital interventions for increasing physical activity in individuals of low socioeconomic status: a  
19 716 systematic review and meta-analysis. *International Journal of Behavioral Nutrition and Physical*  
20 717 *Activity*. 2021;18(1):148.
- 21 718 19. Turnbull S, Lucas PJ, Hay AD, Cabral C. The role of economic, educational and social  
22 719 resources in supporting the use of digital health technologies by people with T2D: a qualitative  
23 720 study. *BMC Public Health*. 2021;21(1):293.
- 24 721 20. Turner A, Morris R, Rakhra D, Stevenson F, McDonagh L, Hamilton F, et al. Unintended  
25 722 consequences of online consultations: a qualitative study in UK primary care. *British Journal of*  
26 723 *General Practice*. 2022;72(715):e128.
- 27 724 21. Murphy M, Scott LJ, Salisbury C, Turner A, Scott A, Denholm R, et al. Implementation of  
28 725 remote consulting in UK primary care following the COVID-19 pandemic: a mixed-methods  
29 726 longitudinal study. *British Journal of General Practice*. 2021;71(704):e166.
- 30 727 22. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ):  
31 728 a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*.  
32 729 2007;19(6):349-57.
- 33 730 23. Braun V, Clarke V. Using thematic analysis in psychology. *Qualitative Research in Psychology*.  
34 731 2006;3(2):77-101.
- 35 732 24. Fereday J, Muir-Cochrane E. Demonstrating rigor using thematic analysis: A hybrid approach  
36 733 of inductive and deductive coding and theme development. *International journal of qualitative*  
37 734 *methods*. 2006;5(1):80-92.
- 38 735 25. Gov.uk. English indices of deprivation 2019. In: Ministry of Housing Clg, editor.  
39 736 <https://www.gov.uk/government/statistics/english-indices-of-deprivation-20192019>.
- 40 737 26. Malterud K, Siersma VD, Guassora AD. Sample Size in Qualitative Interview Studies: Guided  
41 738 by Information Power. *Qualitative Health Research*. 2015;26(13):1753-60.
- 42 739 27. Sandelowski M. Sample size in qualitative research. *Research in nursing & health*.  
43 740 1995;18(2):179-83.
- 44 741 28. Puckett C, Wong JC, Daley TC, Cossen K. How organizations shape medical technology  
45 742 allocation: Insulin pumps and pediatric patients with type 1 diabetes. *Social Science & Medicine*.  
46 743 2020;249:112825.
- 47 744 29. Jones B, Scott J. Building The Evidence Base On Video Consultations | The Health  
48 745 Foundation.[online] The Health Foundation, 2020.
- 49 746 30. Health Do, Care S. Integration and innovation: working together to improve health and social  
50 747 care for all. Department of Health and Social Care London; 2021.
- 51 748 31. NHS digital. Digital health hub rolled out across more areas following pilot success.  
52 749 [https://digital.nhs.uk/news/2019/digital-health-hub-rolled-out-across-more-areas-following-pilot-](https://digital.nhs.uk/news/2019/digital-health-hub-rolled-out-across-more-areas-following-pilot-success)  
53 750 [success](https://digital.nhs.uk/news/2019/digital-health-hub-rolled-out-across-more-areas-following-pilot-success); 2019.

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2  
3 751 32. digital N. Widening Digital Participation Programme helps patients improve their health.  
4 752 <https://digital.nhs.uk/news/2018/widening-digital-participation>; 2018.  
5 753  
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## Supplementary material

### Qualitative interviews- topic guide

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#### 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 access; 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 your 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)

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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)

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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

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## 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.
<b>Domain 1: Research team and reflexivity</b>			
<i>Personal characteristics</i>			
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?	
<i>Relationship with participants</i>			
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 interviewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	
<b>Domain 2: Study design</b>			
<i>Theoretical framework</i>			
Methodological orientation and Theory	9	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	
<i>Participant selection</i>			
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?	
<i>Setting</i>			
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	
<i>Data collection</i>			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	
Repeat interviews	18	Were repeat interviews 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 interview or focus group?	
Duration	21	What was the duration of the interviews 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?	
<b>Domain 3: analysis and findings</b>			
<i>Data analysis</i>			
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?	
<i>Reporting</i>			
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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# BMJ Open

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

4  
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1  
2  
3 21 *Abstract*

4 22 *Objectives*

5 23 To explore how Health Care Practitioners (HCPs) made decisions about the implementation  
6 24 of Digital Health Technologies (DHTs) in their clinical practice before and during the COVID-  
7 25 19 pandemic.  
8 26

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10  
11 27 *Design*

12 28 A multi-methods study, comprising semi-structured interviews conducted prior to the  
13 29 COVID-19 pandemic. Supplemented with an online survey, that was conducted during the  
14 30 pandemic with a different sample, to ensure the qualitative findings remained relevant  
15 31 within the rapidly-changing healthcare context. Participants were recruited through HCP  
16 32 networks, snowballing and social media. Data were analysed thematically.  
17 33

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19  
20 34 *Setting*

21 35 Phone interviews and online survey.  
22 36

23 37 *Participants*

24 38 HCPs represented a range of professions from primary and secondary care across England,  
25 39 with varied socioeconomic deprivation.  
26 40

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28  
29 41 *Results*

30 42 24 HCPs were interviewed, and 16 HCPs responded to the survey. In the interviews, HCPs  
31 43 described three levels where decisions were made, which determined who would have  
32 44 access to what DHTs: health organisation, HCP, and patient levels. These decisions resulted  
33 45 in the unequal implementation of DHTs across health-services, created barriers for HCPs  
34 46 using DHTs in their practice, and influenced HCPs decisions on which patients to supply  
35 47 DHTs with. In the survey, HCPs described being provided support to overcome some of the  
36 48 barriers at the organisation and HCP level during the pandemic. However, they cited similar  
37 49 concerns to pre-pandemic about barriers patients faced using DHTs (e.g., digital literacy). In  
38 50 the absence of centralised guidance on how to manage these barriers, health-services made  
39 51 their own decisions about how to adapt their services for those who struggled with DHTs.  
40 52

41  
42  
43 53 *Conclusions*

44 54 Decision-making at the health organisation, HCP and patient level influence inequalities in  
45 55 access to DHTs for HCPs and patients. The mobilisation of centralised information and  
46 56 resources during the pandemic can be viewed as good practice for reducing barriers to use  
47 57 of DHTs for HCPs. However, attention must also be paid to reducing barriers to accessing  
48 58 DHTs for patients.  
49 59

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51  
52 60 *Keywords*

53 61 Internet-based intervention; health care disparities; socioeconomic factors; primary care;  
54 62 digital health; health services accessibility; qualitative research  
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## 6 65 ARTICLE SUMMARY

7 66 **Strengths and limitations of this study**  
8 67

- 9 68
- 10 68 • To ensure our qualitative study conducted just prior to the COVID-19 pandemic were  
11 69 relevant and informative in a 'post-COVID' landscape, we developed and  
12 70 disseminated a questionnaire that explored whether COVID-19 had changed the way  
13 71 that healthcare professionals used DHTs.
  - 14 71 • Double coding of a subset of interviews by five members of the team and ongoing  
15 72 discussion about coding structure ensured the coding scheme was robust.
  - 16 72 • Challenges recruiting participants for both the interviews and the survey, may limit  
17 73 the generalisability of the findings.
  - 18 74 • As patients were not included in this study, reflections about the barriers patients  
19 75 experience accessing DHTs are from the health care practitioner's perspective.
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## 88 BACKGROUND

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

104

105 DHTs have been found to be effective in supporting patients to self-care for a range of  
106 health conditions (8, 13-16). Health interventions designed specifically to support  
107 disadvantaged groups can be more effective for those groups, thus reducing inequalities (8,  
108 15, 17, 18). However, recent evidence has found that such benefits may be limited for  
109 people from lower socio-economic groups, who do not have the resources (such as time,  
110 finances, technical proficiency) to access and use DHTs (19-21). Less is known about how

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3 111 HCPs use DHTs for helping patients to manage their own health and wellness, the barriers  
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6 112 they face doing so, and the implications this may have for the access to DHTs for their  
7  
8 113 patients (2, 10, 20, 22). There are indications that HCPs face challenges incorporating DHTs  
9  
10 114 into their existing systems and practices [18], and establishing rapport with patients  
11  
12  
13 115 in remote consultations (10, 22). Patients have also reflected that they feel HCPs have  
14  
15 116 limited knowledge of what self-care DHTs are available and effective (20).  
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20 118 Our multi-methods study was designed to explore how HCPs (e.g., General Practitioners  
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22 119 (GPs), nurses, pharmacists) used and made decision about DHTs in their clinical practice  
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25 120 before and during the COVID-19 pandemic. We aimed to 1) understand barriers and  
26  
27 121 facilitators to the use of DHTs by HCPs, and the implications for the access patients have to  
28  
29 122 DHTs, and 2) whether these changed during the pandemic.  
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## 36 124 METHODS

### 37 38 39 125 **Design**

40 126 This study adhered to the COREQ (Consolidated Criteria for Reporting Qualitative Research)  
41  
42  
43 127 guidelines on the reporting of qualitative research (23). It was a multi-methods study,  
44  
45 128 comprising semi-structured interviews and an online survey with HCPs working in English  
46  
47 129 primary and secondary care services. The primary study was the semi-structured interviews  
48  
49 130 that were conducted prior to the pandemic (November 2019-March 2020). This was  
50  
51 131 supplemented with the survey, a secondary study that was conducted during the pandemic  
52  
53 132 (July 2020-August 2020) with a different sample. Both studies explored how HCPs accessed  
54  
55 133 and used DHTs. However, the survey also explored how the COVID-19 pandemic affected  
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3 134 HCP attitudes to and usage of DHTs. The qualitative findings from the survey were  
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6 135 compared with the findings from the interviews, in order to explore similarities and  
7  
8 136 differences in DHT use that occurred due to the COVID-19 pandemic, and to ensure that the  
9  
10 137 qualitative findings remained relevant within a rapidly shifting healthcare context. The  
11  
12  
13 138 methodological orientation of the study was a mixed inductive and deductive approach (24,  
14  
15 139 25). Ethical approval was granted by the University of Bath's Psychology Research Ethics  
16  
17  
18 140 Committee for the interviews and survey (PREC reference number: 19-211 and 20-142  
19  
20 141 respectively).

## 23 142 **Interviews**

### 24 143 ***Participants***

25  
26  
27 144 Participants for the interviews were recruited through a range of networks, including  
28  
29 145 National Institute of Health and Care Research School of Primary Care Research, community  
30  
31  
32 146 networks, social media (snowballing), and Academic Health Service Networks across  
33  
34 147 England. We recruited HCPs who represented primary and secondary care health  
35  
36  
37 148 professionals from a range of backgrounds from across England, working in locations that  
38  
39 149 varied in their level of socioeconomic deprivation (Table 1). Socio-economic deprivation was  
40  
41  
42 150 determined by collecting the postcode of the health service where the HCP worked, and  
43  
44 151 mapping it to the England Indices of Multiple Deprivation (IMD)(26).

45  
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### 49 153 ***Procedure/Data collection***

50 154 The topic guide (see Supplementary material) was developed through author collaboration,  
51  
52  
53 155 consultation with qualitative experts, and input from Patient and Public Involvement  
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55 156 representatives. The topic guide was piloted and revised for clarity following feedback from  
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57  
58 157 two GPs.  
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6 159 All interviews were semi-structured and conducted over the telephone by the same  
7  
8 160 researcher (JL). All participants were provided with written information via email about the  
9  
10 161 study before agreeing to be interviewed. Participants were informed that the purpose of the  
11  
12 162 study was to explore which DHTs are used by healthcare professionals in their clinical work,  
13  
14 163 how these tools were used to support their daily tasks (both client and non-client facing),  
15  
16 164 and their experiences with different DHTs. At the beginning of each interview participants  
17  
18 165 were given the opportunity to ask questions, were assured of their voluntary participation,  
19  
20 166 and could withdraw their data until anonymisation and analysis. Participants provided  
21  
22 167 informed consent using an online form before the interview. Interviews were conducted via  
23  
24 168 phone at a mutually convenient time, lasted 17 to 51 minutes (mean = 32 minutes; median  
25  
26 = 30 minutes), and took place in private, quiet settings, often participants' offices or homes.  
27  
28 169 HCPs received a £70 payment as compensation.  
29  
30 170  
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32 171  
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36  
37 172 Each participant took part in one interview, with no repeat interviews. Short field notes  
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39 173 were taken during the interviews. All interviews were audio-recorded, transcribed,  
40  
41 174 anonymised and imported into NVivo Software (NVivo qualitative data analysis Software;  
42  
43 QSR International Pty Ltd. Version 1.6.2). Transcripts and findings were not returned to  
44  
45 175 participants for comment or correction. Interviews were undertaken with all willing  
46  
47 176 participants, with the sample size guided by principles of information power rather than  
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49 177 data saturation (27).  
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## 180 ***Data Analysis***

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

## 191 ***Research team and reflexivity***

### 192 Personal characteristics

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

### 198 Relationship with participants

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

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2  
3 203 resources with patients from diverse backgrounds. However, JL felt that there may be  
4  
5 204 barriers in assessing the quality of different DHTs by HCPs, and accessibility regarding both  
6  
7  
8 205 hardware and software issues for patients from more disadvantaged backgrounds.  
9

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11 206

### 13 207 **COVID-19 Survey**

14 208 As interviews occurred before the first UK COVID-19 lockdown in Mar 2020, we developed  
15  
16  
17 209 an online survey to capture evolving healthcare delivery, ensuring continued relevance to  
18  
19 210 the changing context. The survey sought to understand general views on DHTs and  
20  
21 211 specifically how the COVID-19 pandemic affected their usage. The survey (see  
22  
23 212 Supplementary materials) included free text responses, multiple choice questions and Likert  
24  
25 213 scales. Feedback from three GP stakeholders informed the optimisation of the survey.  
26  
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30  
31 215 Participants were invited to complete the survey through advertisements on social media  
32  
33 216 (Twitter) and email, disseminated through academic primary care research networks and  
34  
35 217 departments. English-speaking HCPs that use DHTs were included in the study, with no  
36  
37 218 further exclusion criteria used for participant recruitment. Data collection took place  
38  
39 219 between July 2020 and August 2020. Informed consent was obtained before survey  
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41 220 participation. Participants were given the option to enter a prize draw for a £50 Amazon gift  
42  
43 221 voucher as an incentive.  
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51 223 ST analysed the free text responses thematically by ST using the coding structure developed  
52  
53 224 during the analysis of the qualitative interview data (included in the coding tree in the  
54  
55 225 Supplementary material). Themes emerging from the survey were discussed and refined by  
56  
57  
58 226 ST, CD and BA.  
59  
60

## 227 **Patient and public involvement**

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

230

## 231 **RESULTS**

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

240

241 22 HCPs consented to take part in the survey, however 3 participants were excluded as they  
242 did not report their job title and an additional 3 participants were excluded as they did not  
243 finish the survey. We do not have information on the completion rate of the surveys, as we  
244 only received surveys that were completed. This left a total of 16 HCPs: 7 GPs, 4 pharmacist,  
245 2 nurses, 1 dietitian, 1 clinical psychologist and 1 cardiac surgeon (Table 1). There were 9  
246 women and 7 men, with an age range of 28 to 66 ( $M= 41$ ,  $SD= 11.6$ ) and the years of  
247 experience ranging from 1 year to 43 years qualified.

248

249 Table 1: Participant demographics

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

250

251

## 252 Digital Healthcare Tools used

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

257

## 258 Results from thematic analysis

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

264 Table 2: Themes and subthemes

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

	<ul style="list-style-type: none"> <li>• Barriers and facilitators to providing care through DHTs during the COVID pandemic</li> <li>• Barriers and facilitators for patients accessing care through DHTs during the COVID pandemic</li> </ul>
--	--

265

## 266 ***Pre-pandemic interviews***

### 267 Role of digital healthcare tools

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

274

### 275 Decision-making at three levels that determined who got access to what digital 276 health tools

277

278 Prior to the pandemic, three levels were identified where decisions were made about who  
 279 should have access to what DHTs and what support they would receive to access them.

280 These were the 1) health organisation, 2) HCP, and 3) patient levels.

281

### 282 *Health Organisation level*

#### 283 *Influence of strategic decisions and incentive structures*

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

1  
2  
3 288 challenging for practices to prioritise the adoption of DHTs because they were not  
4  
5  
6 289 supported by traditional incentives structures, which would compensate for the time  
7  
8 290 involved in managing the new digital treatments and services:  
9

10  
11 291 *'... [digital health is] not one of the key performance indicators (...) it's not*  
12  
13 292 *yet at the point where commissioners are saying, look, you know, you said*  
14  
15 293 *to us, you're going to offer digital interventions. Show us by March that*  
16  
17 294 *you've offered 2500. (...). it's often commissioners that drives practice*  
18  
19 295 *because obviously commissioners are the ones that actually pay for the*  
20  
21 296 *services.'* (ID P15)  
22  
23  
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25

#### 26 297 *HCP level*

28 298  
29 299 The uptake of DHTs by HCPs and their decision to recommend them to patients, was  
30  
31 300 influenced by: the HCP's digital skills, their knowledge of what DHTs were available and  
32  
33 301 effective, their perceptions of the quality of DHTs, and the availability of training and  
34  
35 302 informal support for HCPs to use DHTs.  
36  
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39 303

#### 41 304 *HCP digital skills*

42 305  
43 306 HCP use of DHTs in their practice and their ability to recommend them to their patients, was  
44  
45 307 reliant on their digital skills. Some HCPs described finding technology *'intuitive and quite*  
46  
47 308 *basic'* (ID P17). Others felt a lack of digital skills were a barrier to them supporting patients:  
48  
49 309 *'I've actually found that simple things [using DHTs] I don't know how to do, it means that I*  
50  
51 310 *can't do my job, just because I've not had the training'* (ID P22).  
52  
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56 311  
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2  
3 312 There was a perception by some of the participants that older HCPs would struggle to learn  
4  
5 313 about and use new DHTs, because they *'were not responsive to learning the new ways of*  
6  
7  
8 314 *doing things...'* (ID P30).  
9

10 315

11  
12  
13 316 *HCP's knowledge of what DHTs were available and effective*

14 317

15 318 HCPs were aware there were lots of DHTs available that may be able to support their  
16  
17  
18 319 practice and patients, but many felt they did not have specific knowledge of what they  
19  
20 320 should use or how they worked. One participant spoke about how multiple different digital  
21  
22 321 systems were being introduced in their practice, that *'have got amazing functionality but we*  
23  
24 322 *don't know about it and we don't know how to use it'* (ID P10). Another described how there  
25  
26 323 were *'websites and apps that I've got experience of using and are very happy to*  
27  
28 324 *recommend'*, while other DHTs they had heard of but *'don't know how good they are'* which  
29  
30 325 impacts how they *'sell'* DHTs to their patients (ID P8). A participant described how the high  
31  
32 326 workload for HCPs presented challenges for them to remember what DHTs are available and  
33  
34 327 how to use them in a short consultation:  
35  
36  
37  
38

39  
40 328 *'...people will do the training and then they've got loads of other things do*

41  
42 329 *it. They'll forget about it. So at the point (...) I'm thinking this client could*

43  
44 330 *maybe do digital, but I can't remember how to log on.'* (ID P15)  
45  
46  
47  
48

49 331

50  
51 332 *HCP perceptions about the quality of DHTs*

52 333

53 334 HCPs made judgements about what DHTs to use or recommend to patients based on their  
54  
55  
56 335 perceptions of the quality or reliability of DHTs. They talked about the challenges in  
57  
58 336 determining which DHTs were trustworthy, and which were *'flawed and quite risky'* (ID  
59  
60

1  
2  
3 337 P10). Some HCPs talked about being happy to recommend government-led online sources  
4  
5  
6 338 of information, like the National Institute of Clinical Excellence (NICE) website, because it  
7  
8 339 was a *'reputable source'* (ID P13).  
9

10 340

11  
12  
13 341 There was a sense from some of the HCPs that DHTs could not always be trusted to manage  
14  
15 342 or deliver patient care. One participant felt that if there was something important that  
16  
17 343 needed to be communicated with a patient *'someone needs to phone as well, we can't*  
18  
19 344 *totally trust the technology'* (ID P20). Another recalled incidences where *'systems have just*  
20  
21 345 *gone down and then you're completely stuck'*, making it impossible to access essential  
22  
23 346 patient information (ID P7).  
24  
25  
26

27 347

28  
29  
30 348 *Access to training and informal support within the organisation or practice*  
31 349 HCPs described how the provision and quality of formal training to use DHTs was variable  
32  
33 350 across health services, and consequently it was *'learn by using'* (ID P4). Some felt formal  
34  
35 351 training for DHTs was not accessible for HCPs because they had to *'take time out of your*  
36  
37 352 *practice'* (ID P1), which they did not have. For those who had attended training, some HCPs  
38  
39 353 felt it was useful, while others felt they did not *'meet a broad range of people's learning*  
40  
41 354 *needs'* (ID P13).  
42  
43  
44  
45

46 355

47  
48 356 Many of the HCPs described how they learned about DHTs and their features through other  
49  
50 357 HCPs in the health service where they worked. The availability and quality of this support  
51  
52 358 was not consistent across practices or organisations, and was determined by the level of  
53  
54 359 digital skills of the people working in the individual health service:  
55  
56  
57  
58  
59  
60

1  
2  
3 360 *'...someone in the practice has either figured it out or seen it elsewhere*  
4  
5  
6 361 *and then they show someone else and so some people know how to do it.*  
7  
8 362 *Some people don't. It's all a bit patchy...'* (ID 10)  
9  
10

11 363 Patient level

12 364 HCPs made judgements about which patients would benefit from DHTs. Their perceptions  
13  
14  
15 365 often influenced whether they recommend DHTs or used them with patients.  
16

17 366

18  
19  
20 367 *HCP's perceptions of which patients can use and benefit from DHTs*

21  
22 368 HCPs generally believed that DHTs were most suitable for digitally literate, *'young, fit'* (ID  
23  
24  
25 369 P2) individuals, and those who were *'able bodied and mentally able'* (ID P32).  
26

27 370

28  
29  
30 371 HCPs identified patient groups who they thought faced barriers accessing and using DHTs.

31  
32 372 This included patients with *'very low literacy'* (ID P10), *'whose language is not English'* (ID  
33

34  
35 373 P5), and those who *'never embraced the internet or any digital tech'* (ID P32). Some patients  
36

37 374 were viewed as more isolated, lacking support from a *'team or family or carers'* to help  
38

39  
40 375 them access DHTs (ID P12).  
41

42 376

43  
44  
45 377 Some DHTs placed criteria that excluded vulnerable and underserved groups. For example, a

46  
47 378 HCPs also spoke about the Babylon app that has: *'excluded a ridiculous number of people*

48  
49 379 *from being able to use its service (...) like no woman can become pregnant, no one with*

50  
51  
52 380 *social service needs, no one with mental health problems, so there's many exclusions for*

53  
54 381 *people with the highest needs.'* (ID P9)  
55

56  
57 382  
58  
59  
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1  
2  
3 383 There were conflicting opinions about digital health accessibility for people who lived in  
4  
5  
6 384 lower income areas. Some felt most people with lower incomes *'have phone access now*  
7  
8 385 *anyway, so they will rely on their phones and online'* to access health information and  
9  
10 386 support (ID P4). However, concerns were raised that the *'disadvantage of the digital stuff is*  
11  
12 387 *potentially exacerbating health inequalities'* (ID P8). A participant described the intersection  
13  
14  
15 388 between age and deprivation being particularly problematic:

16  
17  
18 389 *'...we work in a relatively deprived area and most to our particularly*  
19  
20  
21 390 *younger patients do have Internet access and you know have mobiles, but*  
22  
23  
24 391 *a lot of our older patients don't'* (ID P8).

25  
26 392 Although many HCPs spoke about how the elderly could be excluded from using DHTs, some  
27  
28  
29 393 had their presumptions about age-related technology uptake challenged by experiences  
30  
31  
32 394 with older patients being adept at using DHTs:

33  
34  
35 395 *'... a chap who was 80 years old, he came into my clinic room (...), he*  
36  
37 396 *opened his tablet and he logged on to his own umm... personal page on his*  
38  
39  
40 397 *own practice to give me information. (...) I was like oh gosh that's really*  
41  
42 398 *impressive can I have a look'* (ID P20).

43  
44  
45 399 Conversely, an HCP had found that *'...a lot of young people don't want treatment digitally'*  
46  
47 400 *(ID 15)*, because they were concerned around inadvertent disclosure of stigmatised health  
48  
49  
50 401 conditions:

51  
52  
53 402 *'...they're saying, actually, I don't want something on my phone that my*  
54  
55  
56 403 *mates going to see. And it's got something about anxiety on it or it's got*  
57  
58  
59  
60

1  
2  
3 404 *something like I'm a family member of somebody with an alcohol problem'*

4  
5  
6 405 *(ID P15)*

7  
8  
9 406 *HCP's making judgements about who to use DHTs with*

10 407 The perception of HCPs about the appropriateness of DHTs for a specific patient group

11  
12 408 influenced their decisions regarding DHT use. HCPs described how they were less likely to

13  
14  
15 409 communicate with older adults or those with '*mental disabilities*' (ID P9) using DHTs. Several

16  
17 410 HCPs said they were less likely to engage in discussions about or supply DHTs to discuss or

18  
19  
20 411 older patients:

21  
22  
23 412 *'...the older generation are a little bit 'oh no, I don't want to do that', or 'it*

24  
25 413 *confuses me'. So yeah, I judge who I would discuss apps with and*

26  
27  
28 414 *technology with age wise...' (ID P32)*

29  
30  
31 415

32  
33 416 A participant stated that their team were targeting '*the younger ones*' in their roll out of an

34  
35 417 app to support people with bowel cancer (ID P25). However, she acknowledged that the

36  
37 418 majority of their '*patients are 70-89*' and were '*not going to be able to use the app*' (ID P25).

38  
39  
40 419

41  
42  
43 420 Some HCPs described how the perception that someone was lacking digital skills, resulted in

44  
45 421 them being prioritised for face-to-face consultations, when '*clinically, they didn't need that*

46  
47 422 *priority*' (ID P5). A participant reflected that '*the less digitally enabled person might get*

48  
49  
50 423 *more of my attention than the more digitally enabled*' (ID P11).

51  
52  
53 424

## 425 **COVID 19 Survey**

### 426 Changes in access to and use of DHTs during the pandemic

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

433

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

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

445

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

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

1  
2  
3 449 DHTs being properly approved and integrated through healthcare services, *'Issues around*  
4  
5  
6 450 *consent and data sharing'* (Survey ID 25), and staff being willing or able to engage with  
7  
8 451 DHTs. For example, a participant described how *'some older staff didn't want to work*  
9  
10 452 *digitally and struggled to accept change'* (Survey ID 10).

11  
12  
13 453

14  
15 454 However, HCPs described having more resources available to overcome these issues during  
16  
17  
18 455 the pandemic compared to prior to the pandemic. An HCP described how their organisation  
19  
20 456 *'facilitated'* the use of DHTs *'more and removed any existing barriers'* (Survey ID 28):

21  
22  
23 457 *'...initially [there was] lots of confusion over how we were going to be able*  
24  
25  
26 458 *to offer patient appointments and what apps etc were NHS approved etc.*  
27  
28 459 *The local Primary care network were fantastic in supporting local surgeries*  
29  
30  
31 460 *in implementing change. Barriers also were financial, but when funding*  
32  
33 461 *was granted for extra equipment etc, there was a boom in embracing new*  
34  
35  
36 462 *ways of working(...) there was so much change happening at once, that it*  
37  
38 463 *was sometimes difficult to keep up with the latest information and what*  
39  
40  
41 464 *was available to use. An online network called Teamnet became the 'go to'*  
42  
43 465 *site for updated information and technology and government updates.'*

44  
45 466 (Survey ID 10)

46  
47  
48  
49 467 Barriers and facilitators for patients accessing care through DHTs during the COVID  
50  
51 468 pandemic

52  
53  
54 469 The HCPs felt that some patients faced challenges when they were *'forced to adapt and*  
55  
56 470 *resort to digital tools'* in the pandemic (Survey ID 25). However, they felt most patients were

1  
2  
3 471 able to engage with the new way of accessing health support and were more *'accepting of*  
4  
5  
6 472 *the technologies as there isn't an alternative'* during lockdown periods (Survey ID 6).  
7  
8 473  
9  
10 474 For those patients who did face barriers in accessing and using DHTs, the issues described  
11  
12  
13 475 by the HCPs were similar to pre-pandemic. HCPs felt that *'there is still a group of patients*  
14  
15 476 *and conditions for which face to face consulting is preferable'* (Survey ID 9). A participant  
16  
17 477 spoke about *'poorer patients not having internet or not [being] aware of how to use [the*  
18  
19 478 *internet]'* (Survey ID 30). An HCP described how: *'...elderly patients with no mobile phones or*  
20  
21 479 *laptops have felt isolated and victimized, age discrimination really. Some cannot or will not*  
22  
23 480 *embrace technology and want to be seen face to face or can't get phone to connect to video*  
24  
25 481 *call...'* (Survey ID 6)  
26  
27 482  
28  
29  
30 483 HCPs highlighted ways in which their services adapted to improve access to health services  
31  
32 484 for those who faced challenges using remote consultations during the pandemic. Most of  
33  
34 485 the HCPs described offering phone consultations, or face-to-face consultations with *'PPE*  
35  
36 486 *equipment'* (Survey ID 30) *'where safety can be maintained'* (Survey ID 28). Some HCPs  
37  
38 487 spoke about how their services made further adjustments to the delivery of their digital  
39  
40 488 support, by establishing alternative people to contact if the patient did not have good digital  
41  
42 489 skills, or by providing equipment to access services: *'Patients who do not have access to any*  
43  
44 490 *digital tool (mostly elderly) we usually contacted their children etc who would be able to*  
45  
46 491 *assist them'* (Survey ID 15). A participant spoke about how they had *'obtained consent for*  
47  
48 492 *patients who don't have smartphones, to allow them to use a neighbours phone (...) to make*  
49  
50 493 *a video call'* (Survey ID 10). A participant described how their service provided *'mobile*  
51  
52 494 *phones for homeless clients'* (Survey ID 14).  
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67 496 **DISCUSSION**8 497 **Principal findings**

9 498 In our pre-COVID-19 pandemic interviews, HCPs across different healthcare settings in  
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11  
12 499 England generally acknowledged the potential benefit of DHTs in enhancing patient access  
13  
14 500 to healthcare services. However, they expressed concerns regarding the appropriateness of  
15  
16 501 DHTs for specific patient populations, viewing face-to-face appointments as superior in  
17  
18 502 certain situations. The HCPs described three levels where decisions were made which  
19  
20 503 determined who would have access to what DHTs. These were: the health organisation,  
21  
22 504 HCP, and patient levels. At the organisation level, HCPs described a lack of cohesive strategy  
23  
24 505 across healthcare services and traditional incentive structures targeting digital health, which  
25  
26 506 resulted in disparities in DHT adoption. At the HCP level, a wide variation in digital skills and  
27  
28 507 knowledge of DHTs created barriers to HCPs using these tools in their practice and  
29  
30 508 recommending them to patients. HCPs described a lack of high-quality centralised  
31  
32 509 information and formal training, and inconsistencies in provision of support across practices  
33  
34 510 or organisations. At the patient level, HCPs held beliefs about groups of patients they felt  
35  
36 511 would benefit from DHTs (e.g., young and fit). These preconceptions influenced HCP's  
37  
38 512 decisions on whether to introduce DHTs to patients and whether to use these tools for  
39  
40 513 patient communication.

41  
42  
43  
44 514

45  
46 515 In the survey conducted during the pandemic, the HCPs described an almost complete shift  
47  
48 516 to remote delivery of care. While many barriers to DHT use persisted, HCPs reported  
49  
50 517 receiving significant support to overcome these challenges during the pandemic. This  
51  
52 518 included support from the local Primary Care Networks to implement the shift to digital  
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3 519 services, funding for extra equipment, and an online network (e.g., Teamnet) that provided  
4  
5 520 the most up to date information about what DHTs were available.  
6  
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8 521

9  
10 522 HCPs felt that the majority of their patients were able to adapt to the change in the delivery  
11  
12  
13 523 of services, mostly due to the lack of alternatives during the pandemic. However, similar  
14  
15 524 concerns regarding digital exclusion persisted. To address these issues, HCPs implemented  
16  
17  
18 525 strategies to enhance access to healthcare services for patients facing difficulties with DHTs.  
19  
20 526 This often included offering face-to-face appointments with the HCP wearing full personal  
21  
22  
23 527 protective equipment (PPE) or providing additional support for accessing digital services.  
24

25 528

### 28 529 **Strengths and limitations**

29 530 To the authors knowledge, this is the first study to explore the impact of decision making  
30  
31 531 around the use of DHTs by HCPs on access to DHTs for patients, before and during the  
32  
33  
34 532 COVID-19 pandemic in England. In addition to our planned qualitative study, we developed  
35  
36 533 and disseminated a questionnaire that explored whether COVID-19 had changed the way  
37  
38  
39 534 that healthcare professionals used DHTs. By doing this, we were able to ensure that our  
40  
41 535 earlier 'pre-COVID' work was still relevant to inform future research and policymaking.  
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44 536

46 537 Complete audio data was recorded for all interviews, and there were no issues with lost  
47  
48 538 data. Double coding of a subset of interviews by five members of the team and ongoing  
49  
50  
51 539 discussion about coding structure ensured the coding scheme was robust. Multiple views of  
52  
53 540 the data promoted confidence in the credibility of the findings (28). A diverse range of  
54  
55  
56 541 experiences and opposing sides of arguments were identified and presented.  
57  
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3 543 There were challenges recruiting the sample of healthcare professionals, meaning both  
4  
5 544 survey and interviews had (relatively) small samples. However considering both datasets  
6  
7  
8 545 using principles of information power (27), suggests that the findings are still relevant and  
9  
10 546 valuable, although some experiences related to DHT access and use may not have captured.  
11  
12  
13 547 As patients were not included in this study, reflections about the barriers patients  
14  
15 548 experience accessing DHTs are from the HCP's perspective. Consequently, this may not  
16  
17 549 accurately reflect the barriers and facilitators patients experienced accessing DHTs prior to  
18  
19  
20 550 and during the pandemic.  
21  
22

23 551

### 25 552 **Interpretations in the Context of Existing Literature**

26 553 Our study agrees with previous qualitative research conducted in the United States, that  
27  
28  
29 554 emphasised the influence of organisational context on DHT access (2, 29). Puckett et al.  
30  
31 555 (2020) found that inequality in access to diabetes pumps was related to whether the clinic  
32  
33 556 distributed resources equally as standard policy, or whether they provided patients with  
34  
35 557 access dependent on their pre-determined policy/eligibility (e.g. interaction with the health  
36  
37  
38 558 service) (29).  
39

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41 559

42  
43  
44 560 Concerns about the quality and reliability of DHTs cited by the HCPs in the interviews in this  
45  
46 561 study, reflect previous review findings that the majority of commercially available health  
47  
48 562 apps are not evidence based or do not reflect public health guidelines (30). The same review  
49  
50  
51 563 reported that in surveys from Germany and (31) the United States (32, 33) agreed with the  
52  
53 564 HCP views in this study that those who used health apps were more likely to be younger, in  
54  
55 565 good health, higher income, education and health literacy (30). Although some HCPs in our  
56  
57  
58 566 interviews described how their presumptions about age-related technology uptake was  
59  
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2  
3 567 challenged when older patients were highly engaged with DHTs, and younger patients were  
4  
5  
6 568 disinterested in technology.  
7

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10 570 Our study found that during and prior to the pandemic, HCPs had concerns about  
11  
12  
13 571 accessibility of online consultations, and made adaptations to support patients who were  
14  
15 572 less digitally literate or did not have internet access. These findings are similar to those of  
16  
17  
18 573 recent qualitative studies conducted before (21), and during the pandemic (34), where HCPs  
19  
20 574 reported that remote consultations could improve access for some groups (e.g. those with  
21  
22  
23 575 caring responsibilities, not able to leave their homes) (21, 34). However, they also had  
24  
25 576 concerns about digital exclusion and accessibility for some patients (21, 34), and described  
26  
27  
28 577 providing face-to-face appointments for those who they perceived to be less able to use the  
29  
30 578 digital services (e.g. older adults)(21). A multinational survey found that ophthalmologists  
31  
32  
33 579 felt clinical Artificial Intelligence would improve accessibility of eye care services, but were  
34  
35 580 less convinced about whether it would result in improvements in quality or affordability (2).  
36  
37 581 They were unsure about whether the COVID-19 pandemic would increase adoption of  
38  
39  
40 582 digital technology in the health system, or result in the increased in implementation of the  
41  
42  
43 583 technology through investment, training healthcare workers or educating the public (2).  
44

45 584

46  
47 585 Two YouGov surveys of NHS staff and patients found that while the majority of patients and  
48  
49  
50 586 NHS staff responded positively to the increased use of technology in healthcare during the  
51  
52 587 pandemic, certain groups, including those over 55, individuals with caregivers, or those  
53  
54  
55 588 unemployed, reported negative experiences with DHTs more frequently than the general  
56  
57 589 population (6). This corresponds with the perceptions of the HCPs in our study, that the  
58  
59 590 majority of patients adapted well to delivery of care through technology. But those who  
60

1  
2  
3 591 were older and had lower incomes faced greater barriers accessing DHTs before and during  
4  
5  
6 592 the pandemic.

7  
8 593

9  
10 594 In our study, some HCPs described having limited knowledge of what DHTs were available  
11  
12  
13 595 and what to recommend to their patients. This corresponds with the findings from a  
14  
15 596 qualitative study exploring digital access for patients with T2D, where participants felt HCPs  
16  
17  
18 597 were not knowledgeable about self-care DHTs (20).

19  
20 598

### 21 22 23 599 **Implications for Research, practice and policy**

#### 24 600 ***Improving digital infrastructure and training of HCPs***

25 601 The centralised response to the pandemic and the way in which barriers to accessing DHTs  
26  
27  
28 602 were universally addressed in healthcare services across the United Kingdom described by  
29  
30 603 HCPs in our survey, can be seen as an illustration of good practice in tackling inequalities in  
31  
32  
33 604 access to DHTs at the organisational and HCP level. A recent white paper the Department of  
34  
35 605 Health and Social Care laid out the aim to make the innovations that the COVID pandemic  
36  
37  
38 606 accelerated permanent (35). However, it is unclear what support will remain to reduce  
39  
40 607 barriers to accessing and using DHTs, and whether this will be universally provided. Future  
41  
42  
43 608 support could consist of government funding and incentives, ensuring HCPs have access to  
44  
45 609 and are aware of central repositories that provide up-to-date information about evidence-  
46  
47  
48 610 based DHTs that they could recommend to their patients (e.g. ORCHA), and support for  
49  
50 611 health services to adopt innovations (e.g. Adopting Innovation programme (6)).

51  
52 612

#### 53 54 55 613 ***Reducing inequalities in access to DHTs for patients***

56 614 The HCPs in this study did not describe any centralised provision of support to ensure less  
57  
58  
59 615 digitally engaged patients had access to DHTs during the pandemic. Instead, individual HCPs  
60

1  
2  
3 616 and health organisations made decisions about who could benefit from DHTs, and what  
4  
5  
6 617 support would be offered to reduce barriers to accessing DHTs. By making judgements  
7  
8 618 about who can benefit from DHTs, HCPs are potentially preventing some patients from  
9  
10 619 being able to benefit from these services, which has implications for inequalities in access to  
11  
12  
13 620 healthcare. This is particularly poignant as we move towards the 'digital first' service as laid  
14  
15 621 out in the NHS Long Term plan (1). To avoid digital exclusion, through the lack of provision  
16  
17 622 of information about DHTs, it could become standard policy that all patients should be  
18  
19 623 signposted to evidence based DHTs. This could be sent to patients utilising existing systems  
20  
21 624 (e.g., accuRx) so as not to add additional burden on to HCP, and to circumvent HCPs acting  
22  
23 625 as gatekeepers to DHTs. HCPs could also be provided with information about where to  
24  
25 626 signpost patients for support to access or use DHTs. Digital participation schemes piloted by  
26  
27 627 NHS digital have been successful in reducing inequalities in access to DHTs, by providing  
28  
29 628 people with low digital literacy with support from digital champions (36, 37). Although there  
30  
31 629 are plans to roll these out more widely following the success of the pilots (36), current  
32  
33 630 unequal provision of these services across the UK risks widening digital inequities in areas  
34  
35 631 not served by these schemes. Speeding up the availability of this support could involve the  
36  
37 632 development and roll out of engaging accessible training for digital health champions and  
38  
39 633 access to up-to-date resources these digital champions could refer to. Such an approach is  
40  
41 634 in line with recent recommendations to recognise variation in user needs to improve  
42  
43 635 technology adoption and acceptance (38).

51  
52 636**637 Conclusions**

56 638 This research has highlighted how decision-making at the health organisation, HCP, and  
57  
58 639 patient levels influence inequalities in access to DHTs for HCPs and patients. The pandemic  
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3 640 prompted the centralised mobilisation of resources for health organisation and HCPs to  
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6 641 access and implement of DHTs. However, the patients still faced uneven access to DHTs,  
7  
8 642 determined by decisions made by individual health services and HCPs. Attention must be  
9  
10 643 paid to ensuring all patients have access to information about what DHTs could support  
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12  
13 644 them. There is also a need to increase access to support for less digitally engaged patients  
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15 645 so they can benefit from the 'digital first' health service.  
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646 **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

647

648 **Declarations**649 **Ethics approval and consent to participate**

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

658

659 **Consent for publication**

660 Not Applicable.

661

662 **Availability of data and materials**

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

665

666 **Competing interests**

667 None

668

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675

### 676 *Author contributions*

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

683

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688

689

### 690 *References*

691

692 1. NHS. NHS Long-term plan. 2019.

693 2. Gunasekeran DV, Zheng F, Lim GYS, Chong CCY, Zhang S, Ng WY, et al. Acceptance and  
694 Perception of Artificial Intelligence Usability in Eye Care (APPRAISE) for Ophthalmologists: A  
695 Multinational Perspective. *Front Med (Lausanne)*. 2022;9:875242.

696 3. NICE. Evidence standards framework for digital health technologies  
697 <https://www.nice.org.uk/corporate/ecd72018> [cited 2023 18/09/2023]. Available from:

698 <https://www.nice.org.uk/corporate/ecd7>.

699 4. Sauchelli S. Digitalising diabetes support groups in response to the coronavirus COVID-19  
700 outbreak: a collaborative initiative. *Practical Diabetes*. 2020;37(6):208-10a.

701 5. Sauchelli S, Bradley J, England C, Searle A, Whitmarsh A. Exploring support needs of people  
702 living with diabetes during the coronavirus COVID-19 pandemic: insights from a UK survey. *BMJ*  
703 *Open Diabetes Research & Care*. 2021;9(1):e002162.

704 6. Horton T, Hardie T, Mahadeva S, Warburton W. Securing a positive health care technology  
705 legacy from COVID-19. London: Health Foundation. 2021.

706 7. Castle-Clarke S. What will new technology mean for the NHS and its patients: Four big  
707 technological trends. *London: King's Fund*; 2018. Contract No.: June 2018.

708 8. Murray E, Burns J, See TS, Lai R, Nazareth I. Interactive Health Communication Applications  
709 for people with chronic disease. *Cochrane Database Syst Rev*. 2005(4):Cd004274.

710 9. Muñoz RF. Using Evidence-Based Internet Interventions to Reduce Health Disparities  
711 Worldwide. *J Med Internet Res*. 2010;12(5):e60.

712 10. Kilvert A, Wilmot EG, Davies M, Fox C. Virtual consultations: are we missing anything?  
713 *Practical Diabetes*. 2020;37(4):143-6.

714 11. Fleming GA, Petrie JR, Bergenstal RM, Holl RW, Peters AL, Heinemann L. Diabetes digital app  
715 technology: benefits, challenges, and recommendations. A consensus report by the European  
716 Association for the Study of Diabetes (EASD) and the American Diabetes Association (ADA) Diabetes  
717 Technology Working Group. *Diabetes Care*. 2020;43(1):250-60.

718 12. van Kessel R, Hrzic R, O'Nuallain E, Weir E, Wong BLH, Anderson M, et al. Digital Health  
719 Paradox: International Policy Perspectives to Address Increased Health Inequalities for People Living  
720 With Disabilities. *J Med Internet Res*. 2022;24(2):e33819.

721 13. Hutchesson MJ, Rollo ME, Krukowski R, Ells L, Harvey J, Morgan PJ, et al. eHealth  
722 interventions for the prevention and treatment of overweight and obesity in adults: a systematic  
723 review with meta-analysis. *Obesity Reviews*. 2015;16(5):376-92.

- 1  
2  
3 724 14. Yoshida Y, Boren SA, Soares J, Popescu M, Nielson SD, Simoes EJ. Effect of Health  
4 725 Information Technologies on Glycemic Control Among Patients with Type 2 Diabetes. *Current*  
5 726 *Diabetes Reports*. 2018;18(12):130.
- 6 727 15. Turnbull S, Cabral C, Hay AD, Lucas P. Health equity in the effectiveness of web-based health  
7 728 interventions for the self-care of people with chronic health conditions: a systematic review. *JMIR*.  
8 729 2020;Preprint.
- 9 730 16. Turnbull S, Lucas P, Hay AD, Cabral C. Digital Health Interventions for People With Type 2  
10 731 Diabetes to Develop Self-Care Expertise, Adapt to Identity Changes, and Influence Other's  
11 732 Perception: Qualitative Study. *JMIR*. 2020;22.
- 12 733 17. Gustafson DH, Hawkins RP, Boberg EW, McTavish F, Owens B, Wise M, et al. CHES: 10 years  
13 734 of research and development in consumer health informatics for broad populations, including the  
14 735 underserved. *Int J Med Inform*. 2002;65(3):169-77.
- 15 736 18. Turnbull S. *The Influence of Digital Self-care Interventions on Health Inequality in High*  
16 737 *Burden Chronic Health Conditions*: University of Bristol; 2019.
- 17 738 19. Western MJ, Armstrong MEG, Islam I, Morgan K, Jones UF, Kelson MJ. The effectiveness of  
18 739 digital interventions for increasing physical activity in individuals of low socioeconomic status: a  
19 740 systematic review and meta-analysis. *International Journal of Behavioral Nutrition and Physical*  
20 741 *Activity*. 2021;18(1):148.
- 21 742 20. Turnbull S, Lucas PJ, Hay AD, Cabral C. The role of economic, educational and social  
22 743 resources in supporting the use of digital health technologies by people with T2D: a qualitative  
23 744 study. *BMC Public Health*. 2021;21(1):293.
- 24 745 21. Turner A, Morris R, Rakhra D, Stevenson F, McDonagh L, Hamilton F, et al. Unintended  
25 746 consequences of online consultations: a qualitative study in UK primary care. *British Journal of*  
26 747 *General Practice*. 2022;72(715):e128.
- 27 748 22. Murphy M, Scott LJ, Salisbury C, Turner A, Scott A, Denholm R, et al. Implementation of  
28 749 remote consulting in UK primary care following the COVID-19 pandemic: a mixed-methods  
29 750 longitudinal study. *British Journal of General Practice*. 2021;71(704):e166.
- 30 751 23. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ):  
31 752 a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*.  
32 753 2007;19(6):349-57.
- 33 754 24. Braun V, Clarke V. Using thematic analysis in psychology. *Qualitative Research in Psychology*.  
34 755 2006;3(2):77-101.
- 35 756 25. Fereday J, Muir-Cochrane E. Demonstrating rigor using thematic analysis: A hybrid approach  
36 757 of inductive and deductive coding and theme development. *International journal of qualitative*  
37 758 *methods*. 2006;5(1):80-92.
- 38 759 26. Gov.uk. English indices of deprivation 2019. In: Ministry of Housing Clg, editor.  
39 760 <https://www.gov.uk/government/statistics/english-indices-of-deprivation-20192019>.
- 40 761 27. Malterud K, Siersma VD, Guassora AD. Sample Size in Qualitative Interview Studies: Guided  
41 762 by Information Power. *Qualitative Health Research*. 2015;26(13):1753-60.
- 42 763 28. Sandelowski M. Sample size in qualitative research. *Research in nursing & health*.  
43 764 1995;18(2):179-83.
- 44 765 29. Puckett C, Wong JC, Daley TC, Cossen K. How organizations shape medical technology  
45 766 allocation: Insulin pumps and pediatric patients with type 1 diabetes. *Social Science & Medicine*.  
46 767 2020;249:112825.
- 47 768 30. Grundy Q. A Review of the Quality and Impact of Mobile Health Apps. *Annual Review of*  
48 769 *Public Health*. 2022;43(1):117-34.
- 49 770 31. Ernsting C, Dombrowski SU, Oedekoven M, Kanzler M, Kuhlmeier A, Gellert P. Using  
50 771 smartphones and health apps to change and manage health behaviors: a population-based survey.  
51 772 *Journal of medical Internet research*. 2017;19(4):e101.

- 1  
2  
3 773 32. Carroll JK, Moorhead A, Bond R, LeBlanc WG, Petrella RJ, Fiscella K. Who uses mobile phone  
4 774 health apps and does use matter? A secondary data analytics approach. Journal of medical Internet  
5 775 research. 2017;19(4):e125.  
6 776 33. Krebs P, Duncan D. Health app use among us mobile phone owners: A national survey. JMIR  
7 777 Mhealth and Uhealth, 3 (4), e101. 2015.  
8 778 34. Jones B, Scott J. Building The Evidence Base On Video Consultations | The Health  
9 779 Foundation.[online] The Health Foundation, 2020.  
10 780 35. Health Do, Care S. Integration and innovation: working together to improve health and social  
11 781 care for all. Department of Health and Social Care London; 2021.  
12 782 36. NHS digital. Digital health hub rolled out across more areas following pilot success.  
13 783 [https://digital.nhs.uk/news/2019/digital-health-hub-rolled-out-across-more-areas-following-pilot-](https://digital.nhs.uk/news/2019/digital-health-hub-rolled-out-across-more-areas-following-pilot-success)  
14 784 [success](https://digital.nhs.uk/news/2019/digital-health-hub-rolled-out-across-more-areas-following-pilot-success); 2019.  
15 785 37. digital N. Widening Digital Participation Programme helps patients improve their health.  
16 786 <https://digital.nhs.uk/news/2018/widening-digital-participation>; 2018.  
17 787 38. Shachak A, Kuziemy C, Petersen C. Beyond TAM and UTAUT: Future directions for HIT  
18 788 implementation research. Journal of Biomedical Informatics. 2019;100:103315.  
19 789

## Supplementary material

### Qualitative interviews- topic guide

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#### 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. 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 access; 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?*

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5 Online Survey

- 6 1. What is your job title?
- 7
- 8 2. In general, how frequently do you use the following types of digital tools as a healthcare  
9 professional in your practice? Please complete each item. (Multiple choice from: Never,  
10 Daily, Once a week, Once a month)
- 11 a. Online Appointment system
- 12 b. Skype/ Teams consultations
- 13 c. Remote monitoring technology
- 14 d. Digital note taking
- 15 e. Apps
- 16 f. Text SMS system
- 17 g. Online self-management tools
- 18 h. Other (with free text)
- 19
- 20
- 21
- 22
- 23
- 24
- 25
- 26 3. What would prevent you from using digital healthcare tools? - Selected Choice
- 27
- 28 4. What would prevent you from using digital healthcare tools? - Other (Free text)
- 29
- 30 5. In you practice, how would you describe the patient demographics that you care for? (Age,  
31 types of conditions) (Free text)
- 32
- 33 6. To what extent do you agree with the following statement? - Digital self-management tools  
34 benefit me as a healthcare professional in my practice. (Multiple choice, select from:  
35 Strongly Disagree, Disagree, Somewhat disagree, Neither agree nor disagree, Somewhat  
36 Agree, Agree, Strongly Agree)
- 37
- 38 a. Please explain your rating for the question on to what extent do you agree with the  
39 statement: 'Digital self-management tools benefit me as a healthcare professional  
40 in my practice' (Free text)
- 41
- 42
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- 44
- 45 7. To what extent do you agree with the following statement? - Digital self-management tools  
46 benefit the patient in my practice. (Multiple choice, select from: Strongly Disagree, Disagree,  
47 Somewhat disagree, Neither agree nor disagree, Somewhat Agree, Agree, Strongly Agree)
- 48
- 49 a. Please explain your rating for the question on to what extent do you agree with the  
50 statement: 'Digital self-management tools benefit the patient in my practice?' (Free  
51 text)
- 52
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- 55 8. Do you think patients using self-management digital tools affect their ability to take  
56 ownership of their own healthcare needs? (Yes/No)
- 57
- 58 a. Please explain why. (Free text)
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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

For peer review only

## 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.
<b>Domain 1: Research team and reflexivity</b>			
<i>Personal characteristics</i>			
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?	
<i>Relationship with participants</i>			
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 interviewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	
<b>Domain 2: Study design</b>			
<i>Theoretical framework</i>			
Methodological orientation and Theory	9	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	
<i>Participant selection</i>			
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?	
<i>Setting</i>			
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	
<i>Data collection</i>			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	
Repeat interviews	18	Were repeat interviews 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 interview or focus group?	
Duration	21	What was the duration of the interviews 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?	
<b>Domain 3: analysis and findings</b>			
<i>Data analysis</i>			
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?	
<i>Reporting</i>			
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.**