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Did COVID-19 reduce the digital divide? A systematic review

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ABSTRACT

Aim: This research paper aims synthesise literature evaluating how the increased use of digital health during the COVID-19 pandemic has impacted equitable access to healthcare in the United Kingdom (UK).
Methods: A systematic literature review was adopted to get a broad overview of the impact of digital exclusion in the UK. To enable a structured analytical approach a three-domain framework was adopted ((1) digital access, digital literacy, and digital assimilation), and two specific groups were selected to investigate (older people and people with a lower socioeconomic status (SES)).
Results: This review identified 17 relevant papers, of which 5 considered SES and 16 age, concerning equitable healthcare access via digital health in the UK. Three-domain framework analysis found that increased use of digital health during the COVID-19 pandemic had digitally excluded some groups, particularly people with a lower SES. 25 % of included studies identified negative outcomes associated with equitable access for older people, a figure which increased to 60 % in the lower SES analysis. Digital access and literacy were identified as key issues in the lower SES population, meanwhile behavioural factors, such as bounded learning and hassle costs, were identified as a key barrier in older adults. Notably, this review identified some studies where these barriers were effectively overcome, meaning that digital health was able to improve care access and experience for some older adults. This study also identified some cases where the use of digital health supported care to be effectively prioritised.
Conclusion: Digital inclusion must become a higher policy priority in the UK. In the meantime, health systems should be mindful of potentially digitally excluded groups and ensure alternate modes of care (e.g. in-person and telephone) are effectively prioritised for those that need it most.

Introduction

Digital health or health technologies are umbrella terms that describe a wide range of health and care services delivered through information and communication technologies [1]. Examples include remote monitoring and consultation services (e.g. virtual care, telehealth, telemedicine, telecare), tools for self-management, electronic health records (EHRs), health information systems, and health data analytics [2]. The last decade has seen skyrocketing investment and proliferation of health technologies across the world, particularly heightened by social distancing measures brought in to help manage the COVID-19 pandemic [2–9]. Health digitisation is built on an implicit belief that digital health has the potential to radically improve healthcare through reducing infection risk, providing greater flexibility and personalisation, increasing efficiency, supporting clinical decision making and better collaboration across organisations [2,10–16].

However, to date, evidence suggests the persistence of disparities in access to technology resources, connectivity, accessibility, and digital skills across geographies and between different groups within societies, a phenomenon known as the digital divide [17,18]. This can lead to wide variation in access to care and outcomes, which paves the way to health inequities [19,20]. Digital exclusion can be seen on the international stage, where disparities between tech investment and adoption are seen between low- and middle-income countries compared to high-income countries; and on the national stage(s), where specific groups are disproportionately impacted by lack of digital access and digital literacy (such as migrants, older persons, women, people on low incomes, rural communities, disabled people, and children) [21,22]. In

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2021, Amina Mohammed (the United Nations' (UN) Deputy Secretary-General) remarked that the digital divide risked becoming the 'new face of inequality' since almost half the world's population (3.7 billion people, the majority in developing countries) are still offline [22,23]).

Despite the acknowledged inequities in digital access and utilisation, the COVID-19 pandemic prompted rapid development and adoption of health technologies across the globe [2–9]. Many have raised concerns about the sustainability of these practices, which were often adopted at speed with little or no input from patient stakeholders, lack of forethought about financial reimbursement mechanisms and insufficient regulatory standards [24,25].

Reviewing the literature identified only one literature review evaluating the impact of COVID-19 on the digital divide in health [26]. This was a rapid review which identified only 9 studies (6 in the United States (US), 2 in Italy and 1 in the United Kingdom (UK)). Digital exclusion was considered against population factors such as ethnicity [5], not speaking English as a first language [1], patient vulnerability [1], income [1] and age [1] (26). The review's findings indicated that pre-existing disparities in access to and utilisation of digital health were amplified by COVID-19 [26], but the studies' expansive research focus meant that country and population-specific policy(s) and practice implications were not offered. Additionally, whilst this study had strengths in terms of the analytic approach and topic, the search strategy adopted had fundamental issues and has not been updated since July 2021 to evaluate the ongoing impacts of the COVID-19 pandemic.

This paper therefore seeks to address these issues by narrowing the research focus to specific populations in the UK, improving the search strategy and updating the search to include studies published until November 2024.

As with many countries around the world, the digital divide was a problem in the UK before the COVID-19 pandemic [27,28]. Disproportionately impacted groups included older people, people of a lower socioeconomic status (SES), people with disabilities, and people living in rural areas [27,29–33]. This study chose to focus on former two populations because they make up the largest populations of people most impacted by digital exclusion. As of 2023, around 3.9 million people over 65 (31 % of this age group) did not use the internet at home, whilst 310,000 (4 %) of people aged 35–44 did [33]. Similarly, 2.4 million (21 %) of people living in households from the lowest SES did not use the internet at home compared with 690,000 (6 %) in the highest SES [33].

The heterogeneity between these two population sub-groups provides an important backdrop for analysis, since the impact of the pandemic and health needs vary considerably between each group. People with a lower SES tend to have complex health and social needs, owing to a wide array of social determinants laying the foundations for poorer health outcomes [34–38]. Further, evidence suggests that low SES populations were disproportionately impacted by the COVID-19 pandemic, due to changing health behaviours (increasing alcoholism, smoking, and domestic violence), educational disparity impacting low-income families and the consequences of economic fallout [34,39,40]. These factors create substantial barriers to accessing healthcare for people from a lower SES, and likely meant that the shift towards remote consultations, mandated by NHS England, had a negative impact on this population's ability to access appropriate care and support.

In contrast, older adults tend to experience more long-term chronic health conditions and co-morbidities, including a higher prevalence of mobility issues [41,42]. This, along with their clinically vulnerable status which put them at higher risk of complications from the COVID-19 virus, as well as the disproportionately higher number of older people living in rural, compared to urban areas, likely created significant incentives for older people to follow government guidelines and access care online wherever possible [42].

The Unified Theory of Acceptance and Use of Technology (UTAUT) framework, can be used to consider potential barriers to accessing digital health technologies which can impact these population subgroups [43]. This framework proports that adoption of digital technologies is underpinned by performance expectancy (how much a person believes the technology will help them improve their performance), effort expectancy, social influence and facilitating conditions (such as access to technology, skills, and support) [43]. These ideas will be explored in more detail in the discussion.

Methods

Search strategy

To our knowledge, there are no systematic reviews evaluating the impact of COVID-19 on the digital divide in health in the UK. Hence, to address this gap, and to develop a broad picture of the impact of digital exclusion on health in the UK, a systematic review was selected for this analysis, informed by the "Cochrane Handbook for Systematic Reviews of Interventions" [44]. Key terms identified included: digital health AND COVID-19 AND equitable access AND UK (Appendix A and B). The search was limited to include articles published in the period 2020—2024, because the focus of this systematic review is on changes to digital healthcare relating to COVID-19, which was first identified in the UK on 29 January 2020 [45]. The search was run on Medline OVID, Embase OVID, PsycINFO and Cinahl, and was filtered to include articles published in the English Language only, since the focus of this review is on the UK where the official language is English. The reference lists of review articles were also searched for additional relevant papers (snowball approach); however, no further references were identified using this methodology.

Eligibility criteria

Studies were considered for inclusion if they evaluated the impact of digital health interventions on specific interest groups, those being older people (defined as people aged ≥60 years old in the majority of included studies [46]) and people with a lower SES (defined as people in quintile 1 within the Index of Multiple Deprivation (IMD) or social grade C2DE according to the National Readership Survey (NRS)) [47,48] (Appendix C). Included studies evaluated a minimum of 50 participants aged ≥18 years, whereby outcomes associated with digital health interventions were evaluated quantitively, in terms of patient access, digital literacy, experience and/or utilisation associated with the use of digital health (see section 2.4). Study designs included were any involving primary data collection~~,~~ conducted in the UK, in any care setting, from 2020 onwards. The process followed the four stages of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA): identification, screening, eligibility, and final inclusion ((49), Appendix D).

Data extraction and quality assessment

A template was developed for data extraction which included: study characteristics, participant demographics, the study objective, intervention(s), outcomes. Studies were also assessed for quality and journal impact factor. [44]. During data extraction compiled lists of studies were shared with professors at the LSE and discussed, to double-check the accuracy of included article information and the relevance of selected articles.

Data analysis and synthesis

Results were differentiated according to study populations (older people or people with a lower SES), and important study characteristics were drawn out for comparison, study (urban/rural), care setting (urgent/non-urgent), and study design. Study outcomes were highly variable, hence a narrative analysis was undertaken using a three-domain framework (Table 1, which is consistent with the work of Loh et al. and Litchfield et al.) [26,50]. It is worth noting that digital assimilation is a

Table 1
Three-domain framework for interpreting the digital divide in healthcare.

Domain	Definition	Construct	Definition
Digital access	The ability to access the necessary hardware, software and internet services associated with the utilisation of digital technologies [51].	The types of devices available.	The nature and functionality of the digital device [17].
		The ease with which devices can be accessed.	How readily individuals can access digital devices [17,52].
		The autonomy and reliability of internet connectivity.	The degree of independence with which the internet can be reliably accessed [53,54].
Digital literacy	The degree of sophistication with which individuals are able to use digital technologies [55].	Digital skill set.	The confidence and ability of an individual to use a variety of digital technologies [56].
		Types of digital usage.	The ways in which digital technologies are used [57].
Digital assimilation	The degree to which digital technologies are incorporated and used in everyday life [51,58],	Engagement with/utilisation of digital technologies.	The degree to which individuals use digital technologies to enhance social connections and values [59].
		Social support.	Social connections that facilitate an individual's engagement with digital technologies [56].
		Harnessing digital outcomes.	Experience with technology and ability to contextualise the use of digital technologies to achieve quantifiable outputs [60,61].

particularly broad domain, which considers patient experience and/or utilisation, and in some cases the impact of telehealth on patient health outcomes was also considered.

To provide a simplified overview of the impact of telehealth on outcomes, we summarised outcome findings according to whether they were associated with negative, mixed (positive and negative), neutral or positive outcomes in the study population of interest. For example, where study outcomes indicated a negative association between telehealth and engagement with health services, this was summarised as negative. The overall impact was summarised as a combination of the assessment of outcomes for all domains. For example, if study outcome (s) were associated with having a negative impact on older adults in one domain, and positive in another, the overall impact would be mixed.

Table 2
Overview of study characteristics and relevant study outcomes using the three-domain framework for people from a lower SES.

Study	Location	Intervention	Study Design	Outcomes associated with digital access, literacy and/or assimilation
Sounderajah et al. (2021) [62]	UK wide	Digital health strategies used against COVID-19	Cross-sectional survey	Digital Access: Negative • Ownership of laptops, computers and smartphones declined with social grade (89 % in AB compared to 75 % in DE, where the social grade was categorised using the NRS); • Use of a personal digital device to access COVID-19 specific information declined with sociodemographic (48 % in AB compared to 33 % in DE) and level of educational attainment. Digital Literacy: Negative • Lower social grades (net confidence: 55 %) were found to be less confident than higher social grades (net confidence: 68 %) in distinguishing reliable digital COVID-19 information. Digital Assimilation: Negative • Lower social grades were less inclined to access COVID information digitally than those from higher social grades when assessing public readiness for digital health strategies against COVID-19.
Gleeson et al. (2024) [63]	Derbyshire	Smoking cessation service online vs in-person	Retrospective cross-sectional study	Digital Assimilation: Negative • Engagement with a smoking service which moved online in March 2020 was compared to the in-person service (January 2018 to July 2022). • For both the number of quit dates set and the number of 4-week quits, there was evidence of an immediate decrease in both older service users and the least deprived, but not in their respective comparison groups. There were no variations between subgroups in the number of quit dates set as a percentage of episodes opened.
Abbott et al. (2021) [64]	Birmingham	Virtual weight management programme (WMP)	Cross-sectional study using survey and database	Digital Assimilation: Neutral • After adjusting for gender, deprivation, and BMI; social deprivation was not identified as a factor associated with declining the virtual weight management group. (quintile 1, most deprived, OR 1; Q2 OR 0.84 95 % CI 0.236–3.034 p-value 0.798; Q5 OR 1.278, 95 % CI 0.217–7.529 p-value 0.786).
Joy et al. (2020) [65]	Oxford	Reorganisation of primary care for older adults during COVID-19	Cross-sectional database study	Digital Assimilation: Mixed • There was an overall decrease in appointments, but a relative increase in both face-to-face and telephone consultations in people from IMD quintile 1 compared with those in IMD quintile 5 (least deprived) (5.2 % relative increase and 7.7 % relative increase, respectively).
Swystun et al. (2022) [66]	Oxford	Urgent Eyecare Service (CUES) - teleconsultation vs F2F	Cross-sectional survey	Digital Assimilation: Negative • Virtual eyecare uptake was lower in patients living in the most (IMD decile 1), relative to least (IMD decile 10), socioeconomically deprived areas. • Though notably, regression analysis revealed that patients who attended a face-to-face consultation were 4.66 times more likely to be correctly managed [Exp (β) = 5.66], relative to those solely managed virtually. • A total of 27 % (170/629) and 6.3 % (28/445) of patients managed virtually and in person, respectively, did not have their acute eye problem resolved.

Results

Selection of studies

The search returned 1149 articles (280 Medline OVID, 435 Embase OVID, 317 PsycINFO and 119 Cinahl), the PRISMA strategy was applied ending in a total of 17 included articles (Appendix D).

Of the 17 studies included, 4 considered both age and socioeconomic status associated with equitable access to healthcare, 1 considered socioeconomic status only and 12 considered age only. Hence, a total of 5 considered the relationship between socioeconomic status and equitable access to healthcare, and 16 studies considered age. Studies were assessed for bias, random error/chance, and confounding, and given an overall quality assessment. All included studies had an overall quality assessment of 4 (out of 10) or above.

Research findings

People with a lower SES

5 studies considered access to digital healthcare for people from a lower SES during the COVID-19 pandemic, which are outlined in Table 2 which includes study characteristics and relevant study outcomes. These are summarised below.

The number of quantitatively assessed participants included in the studies ranged from 315 [64] to 3851,304 [65]. Lower SES was defined either using IMD decile (4 studies) or the NRS which classes working class as C2DE. In all studies SES was compared between cohorts of patients with a different SES.

Of the 5 studies identified, 1 was UK-wide, 3 were in Urban areas (1 in Birmingham and 2 in Oxford), and 1 was in rural Derbyshire. 3 studies were in a non-urgent care setting, this included a community weight management programme (WMP), smoking cessation programme and access to digital health strategies used against COVID-19. 2 were in urgent care settings (1 was in primary care, and 1 in an urgent eyecare service).

All studies were cross-sectional, with 2 drawing on surveys, 1 a survey and database, and 2 cross-sectional database studies. All 5 studies assessed digital assimilation, the outcomes assessed were the rates of different consultation types (i.e. telephone, videocall, and/or face to face) in 4 studies, self-assessed behavioural factors such as preference, awareness, and engagement in 2, and appointment outcome or impact on care in 2 studies. Some studies assessed multiple outcomes associated with digital assimilation. Only 1 study considered digital access and literacy through a survey asking about access to devices and comfort with using digital information to make health decisions.

Older people

16 studies considered older adults access to digital healthcare during the COVID-19 pandemic. These are detailed in Table 3 which includes the study intervention, location, study design, and relevant study outcomes using the three-domain framework. The study characteristics and study outcomes are summarised below.

The number of quantitatively assessed participants included in the studies ranged from 53 [76] to 3851,304 [65]. Older age was generally defined as $\geq$60 (in 8 studies), but 3 studies defined older as $\geq$65, 4 as $\geq$70, and 1 as $\geq$50. In the majority of cases, age category cohorts were considered comparatively with younger generations, but in two studies participants were exclusively over the age of 69 [76], and 70 [65].

All studies identified were undertaken in the UK, 6 were in Urban areas (2 in London, 2 in Birmingham, 1 in Oxford, 1 in Bristol), 4 were in Rural areas (2 were in Devon and Cornwall, 1 in Derbyshire, and 1 in Maidstone), 5 were UK-wide and 1 did not specify the location in the UK.

Most studies were in the non-urgent care setting, where care urgent care is defined as care for non-life-threatening illnesses or injuries that need urgent attention and non-urgent care is defined as needing treatment when time permits. Non-urgent settings included rheumatology (3 studies), ophthalmology (1 study), outpatient care (1 study), geriatric perioperative (1 study), a community weight management programme (WMP) (1 study), health care access for older adults with comorbidities (1 study), an online smoking cessation programme (1 study) and access to digital health strategies used against COVID-19 (2 studies). Urgent care settings included primary care (2 studies), mental healthcare (1 study), and oncology (1 study). 1 study was not care setting specific and considered more general use of remote health services in older adults.

Most studies assessed the remote delivery of care (13 studies) either using database information and/or through administering a survey. Whereas 3 studies evaluated association between telehealth and certain factors, for example, care utilisation (face-to-face/telephone/online) and frailty (1 study), behavioural factors and continued use of online services (1 study), and a more general survey assessing perspectives towards digital health strategies used against COVID-19 (1 study).

The majority of studies were cross-sectional (11 studies), utilising a survey (8 studies), survey and database (1 study), or database only (2 studies), compared to 5 cohort studies which used either a survey (3 studies), survey and database (1 study), or database only (1 study). All 16 studies assessed digital assimilation, though notably the method and outcomes associated with assimilation were varied considerably between studies and included rates of different consultation types (i.e. telephone, videocall, and/or face to face) (6 studies), self-assessed behavioural factors such as preference, awareness and engagement (7 studies), self-reported satisfaction with remote care (4 studies), and appointment outcome or impact on care (4 studies) where the assessment style was variable. Some studies are counted twice against these groupings due to including multiple relevant study outcomes. 6 studies assessed digital access, all using survey data, 3 considered this by assessing access to/or prevalence of devices, and 3 considered ease of joining or reasons for not accessing remote care. 3 studies considered digital literacy using survey data, similarly 2 gathered this information by asking reasons for joining or not joining remote care, while another study enquired into patient comfort using digital information to make health decisions.

Comparing population sub-groups

Of the 5 studies considering the impact of digital health on people from a lower SES, only 1 considered digital access and digital literacy, and this found negative outcomes associated with these two domains. All 5 studies presented outcomes associated with digital assimilation, where 3 found negative, 1 mixed and 1 neutral outcomes. The overall impact was therefore summarised as 3 studies detailing a negative impact on people from a lower SES (60 %), 1 a mixed impact (20 %), and 1 a neutral impact (20 %). This is summarised in Table 4 below.

When summarising study outcomes in older adults, of the 6 studies considering digital access, 4 had negative, and 2 mixed outcomes; of the 3 considering digital literacy 3 found negative outcomes; and, of the 16 considering digital assimilation, 6 found negative, 7 mixed, 1 neutral, and 2 positive outcomes were identified. This may be summarised as 4 studies detailing a negative impact on older adults (25 %), 11 presenting a mixed picture (68.8 %), and 1 a neutral impact (6.2 %) (Table 4).

Discussion

The results of this systematic review suggest that increased use of digital health during the COVID-19 pandemic resulted in increased digital division and inequity in healthcare access for some groups in the UK. Since 25 % of included studies identified negative outcomes associated with equitable access for older people in the UK, this figure increases to 60 % in the low SES analysis (Table 4). These findings are consistent with prior evidence which identified amplification of pre-existing disparities in access to and utilisation of healthcare services during the COVID-19 pandemic, particularly impacting older people, those of lower SES and the disabled [18,26,27,29,81,82].

This study also identified some more nuanced findings which have

Table 3
Overview of study characteristics and relevant study outcomes using the three-domain framework for older adults.

Study	Location	Intervention	Study Design	Outcomes associated with digital access, literacy and/or assimilation
Sounderajah et al. (2021) [62]	UK wide	Digital health strategies used against COVID-19	Cross-sectional survey	Digital Access: Mixed • Access to computers/laptops was stable across age groups (87 % in the 18–39 age group, and 85 % in 60+). • Smartphone ownership declined in the 60+ age group (94 % 16–39 compared to 75 % 60+). Digital Literacy: Negative • Participant comfort with using digital information to make health decisions was lower in those over 60 (net comfort: 57 %) compared to those between 18 and 39 (net comfort: 78 %). Digital Assimilation: Negative • Likelihood to access COVID-19 information on their personal digital device declined with age (50 % in 18–39 compared to 30 % in those aged above 60). • People aged over 60 (net preference: 21 %) were less inclined than those between 18 and 39 (net preference: 60 %) to access COVID-19 information from digital versus non-digital sources.
Gleeson et al. (2024) [63]	Derbyshire	Smoking cessation service online vs in-person	Retrospective cross-sectional study	Digital Assimilation: Negative • Engagement with a smoking service which moved online in March 2020 was compared to the in-person service (January 2018 to July 2022). • For both the number of quit dates set and the number of 4-week quits, there was evidence of an immediate decrease in both older service users and the least deprived, but not in their respective comparison groups. There were no variations between subgroups in the number of quit dates set as a percentage of episodes opened.
Sloan et al. (2022) [67]	UK-wide	Telemedicine in rheumatology	Cross-sectional survey	Digital Assimilation: Mixed • Patients and clinicians rated telemedicine worse than face-to-face consultations in almost all categories, although >60 % found it more convenient. • Most results from a study evaluating remote rheumatology didn't show any disadvantage for older adults, the only statistically significant difference in views of telemedicine between age groups was in terms of convenience (a low negative correlation between age and convenience of (0.14, P 0.01).
Wang et al. (2021) [68]	UK-wide	Healthcare utilisation for older adults with comorbidities in the UK during COVID-19	Cross-sectional survey	Digital Assimilation: Mixed • When assessing healthcare utilisation for older adults with comorbidities, age was not significantly associated with telephone or VCs during the COVID-19 pandemic but was significantly associated with in-person consultations [69]. • This negative association between age and in-person consultations was found non-linear as indicated by the coefficients on age squared.
Jones et al. (2021) [70]	Location in the UK not specified	Rheumatology telemedicine (via either telephone or VC)	Cross-sectional survey	Digital Access: Negative • Accessibility for patients to make video calls decreased with age and less than half of over 65-year-olds had the means to conduct consultations in this way in a rheumatology outpatient study. Digital Assimilation: Negative • Only a minority of over 65-year-olds agreed that video consultations would be useful and effective.
Grant et al. (2021) [71]	London	Oncology teleclinics introduced during COVID-19	Cross-sectional survey	Digital Assimilation: Neutral • No statistical correlation was identified between age and willingness to have teleclinics in oncology telemedicine (Pearson's R, $p = 0.33$) [72].
Raizada et al. (2021) [73]	Birmingham	Telephone consultations in rheumatology	Cross-sectional survey	Digital Access: Mixed • The prevalence of smartphones was higher among younger patients (16–29 years: 100 %; 30–49 years: 97.8 %) than among those in the older cohort (50–69 years: 86.1 %; >70 years: 68.4 %) [$P < 0.001$]. Digital Assimilation: Negative • Overall, an equal number of patients would prefer telephone clinics or face-to-face consultations for their next routine appointment. When divided by age group, the majority who preferred the telephone clinics were <50 years old [10.075, P.0.018].
Golash et al. (2021) [74]	Maidstone	Telephone or video ophthalmology appointments	Cohort study using survey	Digital Assimilation: Mixed • Correlation between age and preference of consultation type was observed, with 62.5 % of patients aged >65 years requesting regular face-to-face reviews compared to only 18.8 % of 25–64-year-olds. • Despite this, high levels of satisfaction and convenience were associated with telephone consultations cross-generation. Satisfaction scores of 10/10 were given by 71.3 % of telephone and 72.5 % of video consultation patients.

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Table 3 (*continued*)

Study	Location	Intervention	Study Design	Outcomes associated with digital access, literacy and/or assimilation
				• Further, 55 % of telephone and 82.5 % of video consultation patients felt face-to-face reviews would not have changed the appointment outcome.
Bradwell et al. (2022) [75]	Devon and Cornwall	VCs in a rural, older adult, and outpatient care setting at a National Health Service Trust.	Cohort study using survey	Digital Access: Negative • Most patients accessed their VC alone (806/955, 84.4 %) except for those aged ≥71 years (23/58, 40 %), with ease of joining VCs negatively associated with age ($P < 0.001$). Digital Assimilation: Negative • Despite more difficulties joining, older adults were most likely to be satisfied with the technology (46/58, 79 %). • Most patients (890/955, 93.2 %) reported having good (210/955, 22 %) or very good (680/955, 71.2 %) experience with VCs and felt listened to and understood (904/955, 94.7 %). • Patients (848/955, 88.8 %) and staff (419/521, 80.5 %) felt able to communicate everything they wanted, although patients were significantly more positive than staff ($P < 0.001$). Patient satisfaction with communication was positively associated with technical performance satisfaction ($P < 0.001$).
Joughin et al. (2021) [76]	Bristol	Geriatric perioperative	Cohort study using survey	Digital Access: Negative • Approximately half (52.2 %) of the 53 respondents who participated in a geriatric perioperative video consultation (all aged >69) required help accessing equipment— usually from family members; four (17.4 %) experienced difficulties logging on to Attend Anywhere. Digital Literacy: Negative • Of the 38 patients who requested telephone consultation, 60 % cited reasons including: technical issues ($n = 6$); lack of digital literacy ($n = 5$); lack of equipment ($n = 4$); no internet access ($n = 3$); visual impairment ($n = 3$); convenience ($n = 1$); not receiving software link ($n = 1$). Digital Assimilation: Positive • Thirty-nine (73.6 %) participants in a geriatric perioperative clinic (all aged >69) reported being able to hear and understand the clinician throughout the whole consultation, 24.5 % most of the time. For video consultations, 60.9 % ($n = 14$) could see the doctor all of the time, 13.0 % most of the time, 8.7 % less than half of the time and 4.3 % not at all. Of those that reported any shortfall in being able to hear or understand the clinician, 24 % had hearing impairment, and 23 % visual impairment. • Forty-eight (90.6 %) participants reported understanding the reason for the consultation and felt better able to manage and understand their condition. • Fifty-one (96.2 %) either agreed or strongly agreed with the opinion and ask questions during the consultation'. Over half (54.7 %) of respondents rated the quality of the consultation as excellent; 32.1 % very good; 9.4 % good; 1.9 % poor.
Abbott et al. (2021) [64]	Birmingham	Virtual weight management programme (WMP)	Cross-sectional study using survey and database	Digital Access: Negative • After adjusting for gender, deprivation, and BMI; Older patients (OR 0.966, [95 % CI 0.944, 0.989] were less likely to accept the virtual group. The most frequent reason for declining taking part (89.8 %) was lack of internet access and/or lack of digital skills. Digital Literacy: Negative • After adjusting for gender, deprivation, and BMI; Older patients (OR 0.966, [95 % CI 0.944, 0.989] were less likely to accept the virtual group. The most frequent reason for declining taking part (89.8 %) was lack of internet access and/or lack of digital skills. Digital Assimilation: Negative • After adjusting for gender, deprivation, and BMI; Older patients (OR 0.966, [95 % CI 0.944, 0.989] were less likely to accept the virtual group.
Jones et al. (2022) [77]	Devon and Cornwall	GP online services	Cohort study using survey and database	Digital Assimilation: Negative • Online consultation rates were similar for all ages for online GP services in Devon and Cornwall, despite the comparative need being greater in older generations [47]. This suggests there was reduced utilisation of the online GP services evaluated in this study by elderly patients. • Satisfaction scores with online GP scores were slightly higher among those under the age of 65 compared with older patients [47] (4.1 vs 4.0; $t = 5.2$; $p < 0.001$).
Patel et al. (2021) [78]	London	Remote mental healthcare	Cohort study using database	Digital Assimilation: Mixed • Following the onset of the pandemic, the frequency of in-person contacts was significantly reduced compared with that in the previous year (β coefficient: −5829.6 contacts, 95 % CI −6919.5 to −4739.6, $p < 0.001$), while the frequency of remote contacts significantly increased (β coefficient: 3338.5 contacts, 95 % CI 3074.4 to 3602.7, $p < 0.001$).

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Table 3 (*continued*)

Study	Location	Intervention	Study Design	Outcomes associated with digital access, literacy and/or assimilation
				• Rates of remote consultation were lower in older adults than in working age adults, children, and adolescents. • Prescription rates across generations remained similar to pre-pandemic levels; suggesting care was effectively prioritised.
Joy et al. (2020) [65]	Oxford	Reorganisation of primary care for older adults during COVID-19	Cross-sectional database study	Digital Assimilation: Mixed • Increasing frailty was associated with increased rates of face-to-face consultations despite the re-organisation of remote primary care services for older adults in Oxford (severe frailty versus fit IRR 1.64, 95 % CI=1.61 to 1.67) [53]. • There was an overall reduction in appointments during the study period, there was a relative increase in consultations for the frailest, suggesting that care was prioritised for the elderly (27.1 % drop in appointments).
Chen et al. (2024) [79]	UK wide	Online health consultation services	Cross-sectional survey	Digital Assimilation: Mixed • This research assessed behavioural factors for continuing to use online health consultation services after COVID-19 restrictions lifted and found evidence to support a positive correlation with expectation confirmation, system quality, information quality, self-efficacy and perceived health risk. • Notably, however, older adults were underrepresented in this research.
Panchal et al. (2021) [80]	UK wide	NHS Contact Tracing App	Cross-sectional survey	Digital Assimilation: Mixed • This study showed that while the 'NHS COVID-19′ app was viewed positively, there remained issues regarding participants' perceived knowledge of app functionality, potentially affecting compliance. • This analysis revealed differing proportions of demographics between the survey response sample and the UK national demographics across age, gender and location, likely due to self-selection biases, with the largest difference in the proportion of participants aged 50+ years sampled (17.7 % vs 47.5 %). • It appeared that a higher percentage of participants aged 50+ years, totalling 89 (64.9 %) participants did not read all information presented in the app compared with the younger groups ($p < 0.0001$), • When participants who had downloaded the app were asked how intuitive the app navigation was, many were satisfied with the design aspects, as 591 (71.6 %) stated the app's navigation was intuitive.

Table 4
Summary of outcomes using the three-domain framework for each population subgroup.

Study	Assessment of outcomes associated with equitable access to digital health for people with a lower SES				Assessment of outcomes associated with equitable access to digital health for older people			
	Digital access	Digital literacy	Digital assimilation	Overall impact	Digital access	Digital literacy	Digital assimilation	Overall impact
Sounderajah et al. (2021) [62]	Negative	Negative	Negative	Negative	Mixed	Negative	Negative	Mixed
Gleeson et al. (2024) [63]	–	–	Negative	Negative	–	–	Negative	Negative
Sloan et al. (2022) [67]					–	–	Mixed	Mixed
Wang et al. (2021) [68]					–	–	Mixed	Mixed
Jones et al. (2021) [70]					Negative	–	Negative	Negative
Grant et al. (2021) [71]					–	–	Neutral	Neutral
Raizada et al. (2021) [73]					Mixed	–	Negative	Mixed
Golash et al. (2021) [74]					–	–	Mixed	Mixed
Bradwell et al. (2022) [75]					Negative	–	Positive	Mixed
Joughin et al. (2021) [76]					Negative	Negative	Positive	Mixed
Abbott et al. (2021) [64]	–	–	Neutral	Neutral	Negative	Negative	Negative	Negative
Jones et al. (2022) [77]					–	–	Negative	Negative
Patel et al. (2021) [78]					–	–	Mixed	Mixed
Joy et al. (2020) [65]	–	–	Mixed	Mixed	–	–	Mixed	Mixed
Chen et al. (2024) [79]					–	–	Mixed	Mixed
Panchal et al. (2021) [80]					–	–	Mixed	Mixed
Swystun et al. (2022) [66]	–	–	Negative	Negative				

received limited attention so far. Specifically, this study elucidates the greater impact of digital exclusion on low-income groups compared to older populations and considers scenarios where digital health improved care and/or meant that care could be effectively prioritised. Research from the ONS adds some weight to this observation since data from 2011 to 2018 identified a narrowing gap in the proportion of older compared to younger internet users in the UK [27]. Potential reasons for this study finding are explored below.

Lower SES populations tend to have more complex health needs and were disproportionately impacted in a number of ways by the COVID-19 pandemic, including changing health behaviours, educational disparity, and economic influences [34–40]. This research identified a higher proportion of studies documenting negative outcomes associated with the lower SES population with respect to adoption of digital health

technologies during the COVID-19 pandemic. For example, Sounderajah et al. (2021) [62] found a reduction in ownership of digital devices in lower SES, as well as reduced confidence to distinguish reliable digital information, and lower inclination to access COVID-19 information digitally (Table 2). This lack of engagement was echoed across a number of studies [63,66], though notably Abbott et al. (2021) [64] did not identify social deprivation as a factor associated with declining to attend a virtual weight management group.

This review identified 11 fewer studies investigating the lower SES population compared to older adults, a finding which may also reflect the disadvantage that shifting models of care towards a digital health default model had on people from a lower SES. Lack of health data which is adequately representative has the potential to further exacerbate existing health inequalities [83]. This study finding perhaps elucidates a broader issue relating to a lack of research and targeted policy to support this hard-to-reach group with complex health needs.

That said, Joy et al's study (2020) [65] into the reorganisation of care for older adults, indicated that whilst shifts towards digital health interventions may increase inequity in some cases, in others, this meant care could be effectively prioritised for those that need it, due to the relative increase in-person and telephone appointments for people from a lower SES. This finding was echoed for older adults, and a similar observation was made by Patel et al. [78] who found that prescription rates remained stable before and after mental healthcare moved online. These observations indicate the importance of blended care models, noting that the technology first approach can alleviate pressure on the system, allowing care to be prioritised for those that need it.

When considering studies assessing the impact of shifting to digital care models during the COVID-19 on older adults, a number of studies identified negative outcomes in older adults such as lower comfort accessing digital health information and reduced likelihood of accessing COVID-19 information online (compared to younger generations) [62], reduced engagement with remote services [65,63,77,80], reduced satisfaction with remote services [67], and access issues [70,73,75] (Table 3). However, this review also identified three cases where older adults were able to overcome initial barriers to accessing digital health technologies to achieve positive outcomes, such as high levels of satisfaction and convenience [74,75] and high quality consultations [76]. This finding is important, and may be explained using the UTAUT framework and behavioural theories such as bounded learning and hassle costs (theories which acknowledge that the process of learning and synthesising new information can be time-consuming and create a cognitive burden, a hassle that individuals tend to avoid) [43,84,85].

This study echoed prior research and found that a lack of digital access and reduced digital literacy can act as important barriers to digital uptake in older adults [42,86]. This population subgroup is also impacted by several additional 'hassle costs' including higher prevalence of sensory impairments, and dispositional factors, such as a conservative mindset, lack of motivation, and security and privacy fears [69,72,86–91]. The "digital-first" approach adopted during the COVID-19 pandemic was likely a tipping point triggering rapid changes in behaviour [92], along with a number of other influencing factors such as fear associated with being a clinically vulnerable group, rurality and mobility issues, and broader shifts in performance expectancy, effort expectancy and social influence (UTAUT) motivated by the broader integration of technology into everyone's lives as a means of connecting with friends and family during the pandemic [43,69,72,86–91]). Joughin et al. (2021) [76], for example, noted that approximately half (52.2 %) of the 53 respondents who participated in a geriatric perioperative video consultation required help accessing equipment; and similarly, Bradwell et al. (2022) [75] noted that older adults had more issues joining video calls and tended to require support with accessing them. These findings are important as they demonstrate the value that digital health could bring to older adults, who tend to have long-term health conditions, mobility issues and live more rurally, and the need to deliver behaviourally attuned digital health policy which considers how hassle costs and bounded learning can be overcome.

Sustaining a "digital first" approach could likely play some role in "nudging" older adults to adopt health technologies, helping to shift the status quo [93–95]. Along with interventions such as provision of technology and connectivity, improved usability and accessibility, and digital skills training can go some way to address bounded learning and hassle costs in this population [86,93]. This research also identified the importance of broader behavioural incentives which can be social, fear or expectancy based. Behaviourally informed interventions have proven effective in the UK's smoking cessation strategy, where significantly more smokers in the incentives group than control group were found to stop smoking [96].

These points are addressed to some extent in NHS England's "Framework for Inclusive Digital Healthcare" [31] which goes some way to addressing the challenges identified in this research. It sets out five domains for action including: access to devices and data, accessibility, and ease of using technology, skills and capability, beliefs and trust, and leaderships and partnerships. The need to strategically target different excluded groups (including people from a lower SES and older adults) is identified, with case studies explicitly considering how to improve digital access for families experiencing digital poverty, an encourage belief and trust in technology as a key focus in older adults. Though, notably, whilst NHS England have set-out a targeted strategy to address digital inclusion in health, it remains the case that the government has "no credible strategy" to tackle digital exclusion, nor to monitor the impact on excluded individuals [97]. This is an important oversight, not least because of more recent calls from Kaihlanen et al., amongst others, to widen the definition of social determinants of health to recognise digital access and skills; due to their impact on financial stability, social participation, and ability to access education and healthcare [57,58,87].

Study strengths and weaknesses

To our knowledge, this is the only systematic review evaluating the impact of increased use of digital health on inequitable access to healthcare in the UK; a key strength of this study. Further to this, the research findings largely corroborate with existing research, strengthening results and the analytical approach that was undertaken.

That said, this review is not without limitations. Firstly, systematic analysis was undertaken primarily by one researcher and the outcomes of included studies were not heterogenous, therefore author bias may have impacted study selection, analysis, and narrative presentation of findings, though this was minimised through consultation with the professors at the LSE [44]. Secondly, this review included only 17 studies, only 5 of which analysed equitable digital access in people with a lower SES; hence, the possibility of chance or random error in these findings must be considered [98]. Thirdly, equitable access to healthcare is a complex concept, influenced by a multitude of factors such as geography, waitlists, user charges, health-seeking behaviours, and demand; factors further implicated by global disruption from the COVID-19 pandemic [19,39,99]. Whilst some of these factors were considered in the discussion, a more detailed analysis could be achieved by focussing on only one population sub-group and gaining direct access to NHS trust databases. Fourthly, the majority of included studies did not include outcomes for "digital access" or "digital literacy", and the outcomes associated with "digital assimilation" were broad, and often drawn from self-selected online surveys; these factors may have skewed results, an observation which has been reflected on further in the research implications. Finally, the researchers' approach to quality assessment of studies could have been improved by using industry-recognised framework(s) such as those provided by the Critical Appraisal Skills Programme (CASP) [100].

Conclusion

The rapid expansion of digital health during 2020 allowed care to be

sustained despite strict social distancing guidelines. Technology also provided mechanisms to share COVID-19 safety information and educational tools and created online socially connected communities. Despite this, evidence suggests certain populations remain victims of digital exclusion, leading to a doubling down on existing social disparities and inequitable access to healthcare, particularly impacting people from a lower SES. As ambitions for increased digital healthcare are set out by the UK government, digital inclusion must become a higher priority on this agenda. In the meantime, however, health systems should be mindful of potentially digitally excluded groups and ensure alternate modes of care (e.g. in-person and telephone) are effectively prioritised for those that need it most.

Policy and research recommendations

The results of this analysis do not contradict current UK strategy to further maximise the role of digital health in the UK, as some benefits associated with increased digital health were identified. Study findings do, however, emphasise the need to "proceed with caution" supported by an updated national digital inclusion strategy to ensure health system digitisation does not result in a doubling down on existing inequalities. This strategy should explore tailored responses to digitally excluded groups, and in the meantime, health systems should also ensure blended approaches to care are optimised to minimise the impact of digital exclusion.

From a research perspective, there is a growing interest in digital exclusion in healthcare [26,101–103]. The current pace of change in digital health (which is set to continue based on targets set out in government strategy) underlines the importance of developing a shared language to evaluate and share best practice(s). To this end, health researchers and service managers would benefit from developing a more universal framework for assessing the outcomes of digital health interventions, meaning results can be transferred and compared more easily between different care settings. Separating the digital assimilation domain into behavioural components (such as performance and effort expectancy, and social influence), capturing raw data on consultation type (telephone/videocall/face-to-face), and appointment outcome, and noting broader confounding factors (such as geography, waitlists, user charges, health-seeking behaviours, and demand; as well as the broader direct and indirect impacts of COVID-19, if evaluating studies during 2020) would allow more granular comparisons and nuance to be drawn from study findings [39,40,43,84,85,104–109]. Additionally, this review identified a lack of research into the impact of digital health adoption on people from a lower SES, as well as cases where digital health supported effective prioritisation of care. We therefore recommend further research into the digital exclusion of people from a lower SES and mechanisms to optimise blended (digital and non-digital) models of care to promote health equity.

Public interest summary

This paper sets out a systematic literature review evaluating the impact of COVID-19 on the digital divide in the United Kingdom (UK) in older people and people with a lower socioeconomic status (SES).

A three-domains approach was adopted to analyse the study outcomes of 17 papers according to [1] digital access, [2] digital literacy, and [3] digital assimilation.

Study findings suggest that increased use of digital health during the COVID-19 pandemic increased digital exclusion in some groups. Digital access and literacy were identified as key issues in the lower SES population, meanwhile behavioural factors, such as bounded learning and hassle costs, were identified as a key barrier in older adults.

As the government sets out ambitions for increased digital healthcare in the UK, digital inclusion must become a higher priority on this agenda, and care must be effectively prioritised for those that need it most.

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References

[1] NICE. Evidence standards framework for digital health technologies | our programmes | what we do | about [Internet]. NICE; 2018. NICE[cited 2022 Jan 24]. Available from, https://www.nice.org.uk/about/what-we-do/our-programmes/evidence-standards-framework-for-digital-health-technologies.
[2] Barbabella F., Melchiorre M., Quattrini S., Papa R., Lamura G. How can eHealth improve care for people with multimorbidity in Europe? 2017.
[3] Lieneck C, Garvey J, Collins C, Graham D, Loving C, Pearson R. Rapid Telehealth Implementation during the COVID-19 Global Pandemic: a Rapid Review. Healthc Basel Switz 2020 Nov 29;8(4):517.
[4] OECD. European union. health at a glance: europe 2020: state of health in the eu cycle [Internet]. OECD; 2020 [cited 2022 Jan 24]. (Health at a Glance: Europe). Available from: https://www.oecd-ilibrary.org/social-issues-migration-health/health-at-a-glance-europe-2020_82129230-en.
[5] H1 2021 digital health funding: another blockbuster year…in six months. Rock Health [Internet] 2021 [cited 2022 Sep 6]Available from: https://rockhealth.com/insights/h1-2021-digital-health-funding-another-blockbuster-year-in-six-months/.
[6] The rise of health technology, Life sciences, McKinsey & Company [Internet]. [cited 2022 Sep 5]. Available from: https://www.mckinsey.com/industries/life-sciences/our-insights/the-rise-of-health-technology.
[7] Chandra M, Kumar K, Thakur P, Chattopadhyaya S, Alam F, Kumar S. Digital technologies, healthcare and Covid-19: insights from developing and emerging nations. Health Technol 2022;12(2):547–68.
[8] Evans C. The coronavirus crisis and the technology sector. Bus Econ Clevel Ohio 2020;55(4):253–66.
[9] Webster P. Virtual health care in the era of COVID-19. Lancet Lond Engl 2020 Apr 11;395(10231):1180–1.
[10] Fisk M, Livingstone A, Pit SW. Telehealth in the Context of COVID-19: changing Perspectives in Australia, the United Kingdom, and the United States. J Med Internet Res 2020 Jun 9;22(6):e19264.
[11] Asthana S, Jones R, Sheaff R. Why does the NHS struggle to adopt eHealth innovations? A review of macro, meso and micro factors. BMC Health Serv Res 2019 Dec 21;19(1):984.
[12] Lupton D. Critical Perspectives on Digital Health Technologies. Sociol Compass. 2014;8(12):1344–59.
[13] Vayena E, Haeusermann T, Adjekum A, Blasimme A. Digital health: meeting the ethical and policy challenges. Swiss Med Wkly 2018 Jan 16;148:w14571.
[14] Nuffield Trust. Delivering the benefits of digital health care [Internet]. 2016. Feb. Available from: https://www.atmedics.com/wp-content/uploads/2016/02/nuffield-trust-delivering-the-benefits-of-digital-care-17-02-2016.pdf.
[15] Perakslis E, Ginsburg GS. Digital Health—The Need to Assess Benefits, Risks, and Value. JAMA 2021 Jan 12;325(2):127–8.
[16] Meskó B, Drobni Z, Bényei É, Gergely B, Győrffy Z. Digital health is a cultural transformation of traditional healthcare. Mhealth 2017 Sep 14;3:38.
[17] Selwyn N. Reconsidering political and popular understandings of the digital divide, 6. New Media Soc; 2004. p. 341–62.
[18] Good Things Foundation. Digital inclusion in health and care: lessons learned from the NHS widening digital participation programme (2017-2020). 2020.
[19] Chang WC. The meaning and goals of equity in health. J Epidemiol Community Health 2002 Jul 1;56(7):488–91.
[20] Fisher K, Magin P. The telehealth divide: health inequity during the COVID-19 pandemic. Fam Pract 2021 Dec 29:cmab173.

[21] United Nations. Roadmap for digital cooperation [Internet]. 2020. p. 39. JunAvailable from: https://www.un.org/en/content/digital-cooperation-roadmap/assets/pdf/Roadmap_for_Digital_Cooperation_EN.pdf.

[22] Release United Nations Press. With Almost Half of World's Population Still Offline, Digital Divide Risks Becoming 'New Face of Inequality. Deputy secretary-general warns general assembly. UN Press; 2021 [Internet][cited 2022 Sep 5]. Available from: https://press.un.org/en/2021/dsgsm1579.doc.htm.

[23] Roser M, Ritchie H, Ortiz-Ospina E. Internet. Our world data [Internet]. 2015 Jul 14 [cited 2022 Sep 5]; Available from: https://ourworldindata.org/internet.

[24] de Wet C, Bowie P, O'Donnell C. The big buzz': a qualitative study of how safe care is perceived, understood and improved in general practice. BMC Fam Pract 2018;19(1):83. Jun 9.

[25] Kaufman G, McCaughan D. The effect of organisational culture on patient safety. Nurs Stand R Coll Nurs G B 1987 2013;27(43):50–6. Jul 26.

[26] Litchfield I, Shukla D, Greenfield S. Impact of COVID-19 on the digital divide: a rapid review. BMJ Open 2021 Oct 1;11(10):e053440.

[27] ONS. Exploring the UK's digital divide. Office for National Statistics; 2019 [Internet][cited 2022 Sep 5]. Available from: https://www.ons.gov.uk/peoplepopulationandcommunity/householdcharacteristics/homeinternetandsocialmediausage/articles/exploringtheuksdigitaldivide/2019-03-04.

[28] Government Digital Service. Government digital inclusion strategy [Internet]. GOV.UK; 2014 [cited 2022 Sep 5]Available from: https://www.gov.uk/government/publications/government-digital-inclusionstrategy/government-digital-inclusion-strategy.

[29] Good Things Foundation. Digital exclusion and health inequalities [Internet]. 2021. Aug. Available from: https://www.goodthingsfoundation.org/wp-content/uploads/2021/08/Good-Things-Foundation-2021- %E2 %80 %93-Digital-Exclusion-and-Health-Inequalities-Briefing-Paper.

[30] Basis Research. Increasing motivation to use digital health and social care services: a behavioural science perspective [Internet]. 2022 [cited November 2024] Available from: https://www.basisresearch.com/nhs-england-digital-inclusion-1.

[31] NHS England. Inclusive digital healthcare: a framework for NHS action on digital inclusion [Internet]. March 2024. [cited November 2024] Available from: https://www.england.nhs.uk/long-read/inclusive-digital-healthcare-a-framework-for-nhs-action-on-digital-inclusion/.

[32] The Kings Fund. Supporting digital inclusion in health care [Internet]. March 2023 [cited November 2024] Available from: https://www.kingsfund.org.uk/insight-and-analysis/projects/digital-equity.

[33] House of Lords. Digital exclusion [Internet]. June 2023 [cited November 2024] Available from: https://publications.parliament.uk/pa/ld5803/ldselect/ldcomm/219/219.pdf.

[34] BMA. Mitigating the impact of Covid-19 on health inequalities [Internet]. 2021. Available from: https://www.bma.org.uk/media/3944/bma-mitigating-the-impact-of-covid-19-on-health-inequalities-report-march-2021.pdf.

[35] A perfect storm - health inequalities and the impact of COVID-19, Local Government Association [Internet]. [cited 2022 Sep 6]. Available from: https://www.local.gov.uk/perfect-storm-health-inequalities-and-impact-covid-19.

[36] Marmot. Fair Society, Healthy Lives. The marmot review. 2010 [Internet] Available from: https://www.parliament.uk/globalassets/documents/fair-society-healthy-lives-full-report.pdf.

[37] Leonard T, Hughes AE, Pruitt SL. Understanding how low-socioeconomic status households cope with health shocks: an analysis of multi-sector linked data. Ann Am Acad Pol Soc Sci 2017;669(1):125–45.

[38] Wang J, Geng L. Effects of Socioeconomic Status on Physical and Psychological Health: lifestyle as a Mediator. Int J Environ Res Public Health 2019;16(2):281.

[39] Direct and indirect health impacts of COVID-19 in england: emerging omicron impacts [Internet]. GOV.UK; 2021 [cited 2022 Sep 6]Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1018698/S1373_Direct_and_Indirect_Health_Impacts_of_C19_Detailed_Paper_.pdf.

[40] The Health Foundation. Unequal pandemic, fairer recovery [Internet]. 2021. JulAvailable from: https://reader.health.org.uk/unequal-pandemic-fairer-recovery.

[41] ONS. Profile of the older population living in England and Wales in 2021 and changes since 2011. [Internet]. April 2023. [cited November 2024] Available from: https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/ageing/articles/profileoftheolderpopulationlivinginenglandandwalesin2021andchangessince2011/2023-04-03.

[42] Mubarak F, Suomi R. Elderly Forgotten? Digital Exclusion in the Information Age and the Rising Grey Digital Divide. INQUIRY: The Journal of Health Care Organization, Provision, and Financing 2022:59. https://doi.org/10.1177/00469580221096272.

[43] Marikyan, D.& Papagiannidis, S. (2023) Unified Theory of Acceptance and Use of Technology: a review. In S. Papagiannidis (Ed), TheoryHub Book. Available at https://open.ncl.ac.uk /ISBN: 9781739604400.

[44] Higgins J, Thomas J, Chandler J, Cumpston M, Li T, Page M, et al. Cochrane handbook for systematic reviews of interventions version 6.3. 2nd Edition. Chichester (UK): John Wiley & Sons; 2019.

[45] Lillie PJ, Samson A, Li A, Adams K, Capstick R, Barlow GD, et al. Novel coronavirus disease (Covid-19): the first two patients in the UK with person to person transmission. J Infect 2020;80(5):578–606.

[46] Singh S, Bajorek B. Defining 'elderly' in clinical practice guidelines for pharmacotherapy. Pharm Pract 2014;12(4):489.

[47] Francis-Devine B. Constituency data: indices of deprivation. 2020. Sep 21 [cited 2022 Sep 5]; Available from: https://commonslibrary.parliament.uk/constituency-data-indices-of-deprivation/.

[48] Social grade | national readership survey [Internet]. [cited 2022 Sep 5]. Available from: https://www.nrs.co.uk/nrs-print/lifestyle-and-classification-data/social-grade/.

[49] Page MJ, Moher D, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. PRISMA 2020 explanation and elaboration: updated guidance and exemplars for reporting systematic reviews. BMJ 2021;372:n160.

[50] Loh YAC, Chib A. Reconsidering the digital divide: an analytical framework from access to appropriation. Inf Technol Amp People 2021 [Internet][cited 2022 Sep 5]; Available from: https://www.academia.edu/45055327/Reconsidering_the_Digital_Divide_An_analytical_framework_from_access_to_appropriation.

[51] Wei KK, Teo HH, Chan HC, Tan BCY. Conceptualizing and testing a social cognitive model of the digital divide. Inf Syst Res 2011;22(1):170–87.

[52] The first-level digital divide shifts from inequalities in physical access to inequalities in material access - Alexander JAM van Deursen. Jan AGM van Dijk 2019 [Internet]. [cited 2022 Sep 5]. Available from: https://journals.sagepub.com/doi/full/10.1177/1461444818797082.

[53] Lim SS. Home, school, borrowed, public or mobile: variations in young singaporeans' internet access and their implications. Scopus 2009 [Internet] [cited 2022 Sep 5]; Available from: https://scholarbank.nus.edu.sg/handle/10635/21828.

[54] Towards a unified Media-User Typology (MUT): a meta-analysis and review of the research literature on media-user typologies: computers in Human Behavior: Vol 26, No 5 [Internet]. [cited 2022 Sep 5]. Available from: https://dl.acm.org/doi/10.1016/j.chb.2010.02.008.

[55] Hargittai E, Piper AM, Morris MR. From internet access to internet skills: digital inequality among older adults, 18. Univers Access Inf Soc; 2019. p. 881–90.

[56] DiMaggio P, Hargittai E, Neuman WR, Robinson JP. Social Implications of the Internet. Annu Rev Sociol 2001;27(1):307–36.

[57] Fernández-de-Álava M, Quesada-Pallarès C, García-Carmona M. Use of ICTs at work: an intergenerational analysis in Spain /Uso de las TIC en el puesto de trabajo: un análisis intergeneracional en España. Cult Educ. 2017;29(1):120–50.

[58] Kirk CP, Swain SD, Gaskin JE. I'm Proud of It: consumer Technology Appropriation and Psychological Ownership. J Mark Theory Pract 2015;23(2):166–84.

[59] Stewart J. The social consumption of information and communication technologies (ICTs): insights from research on the appropriation and consumption of new ICTs in the domestic environment. Cogn Technol Work 2003;5:4–14.

[60] Selwyn N, Gorard S, Furlong J. Whose Internet is it Anyway?Exploring Adults' (Non)Use of the Internet in Everyday Life. Eur J Commun - EUR J COMMUN 2005;20:5–26.

[61] Haugerud T. Student Teachers Learning to Teach: the Mastery and Appropriation of Digital Technology. Nord J Digit Lit 2011;6(4):226–38.

[62] Sounderajah V, Clarke J, Yalamanchili S, Acharya A, Markar SR, Ashrafian H, et al. A national survey assessing public readiness for digital health strategies against COVID-19 within the United Kingdom. Sci Rep 2021;11(1):5958.

[63] Gleeson H, Earnshaw J, Craig C, Hodson C, Szatkowski L. Evaluation of the impact of the COVID-19 pandemic on a smoking cessation service in Derbyshire: an interrupted time series analysis. PLoS One 2024;19(6):e0303876. https://doi.org/10.1371/journal.pone.0303876. PMID: 38843162; PMCID: PMC11156325.

[64] Abbott S, Parretti HM, Hazlehurst J, Tahrani AA. Socio-demographic predictors of uptake of a virtual group weight management program during the COVID-19 pandemic. J Hum Nutr Diet 2021;34(3):480–4.

[65] Joy M, McGagh D, Jones N, Liyanage H, Sherlock J, Parimalanathan V, et al. Reorganisation of primary care for older adults during COVID-19: a cross-sectional database study in the UK. Br J Gen Pract 2020;70(697):E540–7.

[66] Swystun AG, Davey CJ. A prospective evaluation of the clinical safety and effectiveness of a COVID-19 Urgent Eyecare Service across five areas in England. Ophthalmic Physiol Opt J Br Coll Ophthalmic Opt Optom 2022;42(1):94–109.

[67] Sloan M, Lever E, Harwood R, Gordon C, Wincup C, Blane M, et al. Telemedicine in rheumatology: a mixed methods study exploring acceptability, preferences and experiences among patients and clinicians. Rheumatol Oxf Engl 2022;61(6):2262–74.

[68] Wang J, Spencer A, Hulme C, Corbett A, Khan Z, Vasconcelos Da Silva M, et al. Healthcare utilisation and physical activities for older adults with comorbidities in the UK during COVID-19. Health Soc Care Community 2021 [Internet] Available from: http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emexa&NEWS=N&AN=636872781.

[69] Jiang Y, Sun P, Chen Z, Guo J, Wang S, Liu F, et al. Patients' and healthcare providers' perceptions and experiences of telehealth use and online health information use in chronic disease management for older patients with chronic obstructive pulmonary disease: a qualitative study. BMC Geriatr 2022;22(1):9.

[70] Jones MT, Arif R, Rai A. Patient Experiences With Telemedicine in a National Health Service Rheumatology Outpatient Department During Coronavirus Disease-19. J Patient Exp 2021;8:23743735211034972.

[71] Grant M, Hockings H, Lapuente M, Adeniran P, Saud RA, Sivajothi A, et al. Learning from Crisis: a Multicentre Study of Oncology Telemedicine Clinics Introduced During COVID-19. J Cancer Educ Off J Am Assoc Cancer Educ 2021 [Internet]Available from: http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emexb&NEWS=N&AN=635518777.

[72] Ancker JS, Witteman HO, Hafeez B, Provencher T, Van de Graaf M, Wei E. You get reminded you're a sick person: personal data tracking and patients with multiple chronic conditions. J Med Internet Res 2015;17(8):e202.

[73] Raizada SR, Cleaton N, Bateman J, Mulherin DM, Barkham N. Are telephone consultations here to stay in rheumatology? Rheumatol Adv Pract 2021;5(1): rkaa071.
[74] Golash V, Athwal S, Khandwala M. Teleophthalmology and COVID-19: the patient perspective. Future Healthc J 2021;8(1):E54–9.
[75] Bradwell H, Baines R, Edwards KJ, Stevens S, Atkinson K, Wilkinson E, et al. Exploring Patient and Staff Experiences With Video Consultations During COVID-19 in an English Outpatient Care Setting: secondary Data Analysis of Routinely Collected Feedback Data. JMIR Form Res 2022;6(3):e30486.
[76] Joughin A, Ibitoye S, Crees A, Shipway D, Braude P. Developing a virtual geriatric perioperative medicine clinic: a mixed methods healthcare improvement study. Age Ageing 2021;50(4):1391–6.
[77] Jones RB, Tredinnick-Rowe J, Baines R, Maramba IDC, Chatterjee A. Use and usability of GP online services: a mixed-methods sequential study, before and during the COVID-19 pandemic, based on qualitative interviews, analysis of routine eConsult usage and feedback data, and assessment of GP websites in Devon and Cornwall, England. BMJ Open 2022;12(3):e058247.
[78] Patel R, Irving J, Brinn A, Broadbent M, Shetty H, Pritchard M, et al. Impact of the COVID-19 pandemic on remote mental healthcare and prescribing in psychiatry: an electronic health record study. BMJ Open 2021;11(3):e046365.
[79] Chen A, Chu WM, Peng N. Promoting new users' online health consultation services usage behavior strategically. Health Mark Q 2024;41(2):214–39. https://doi.org/10.1080/07359683.2024.2340196. Apr-JunEpub 2024 Apr 18. PMID: 38634614.
[80] Panchal M, Singh S, Rodriguez-Villegas E. Analysis of the factors affecting the adoption and compliance of the NHS COVID-19 mobile application: a national cross-sectional survey in. EnglandBMJ Open 2021;11:e053395. https://doi.org/10.1136/bmjopen-2021-053395.
[81] Consumer Digital Index [Internet]. [cited 2022 Sep 6]. Available from: https://www.lloydsbank.com/banking-with-us/whats-happening/consumer-digital-index.html.
[82] OII | oxis: oxford internet surveys [Internet]. [cited 2022 Sep 6]. Available from: https://www.oii.ox.ac.uk/research/projects/oxis/.
[83] Ibrahim H, Liu X, Zariffa N, Morris AD, Denniston AK. Health data poverty: an assailable barrier to equitable digital health care. Lancet Digit Health 2021;3(4): e260–5. https://doi.org/10.1016/S2589-7500(20)30317-4.
[84] Kahneman D, Knetsch JL, Thaler RH. Anomalies: the Endowment Effect, Loss Aversion, and Status Quo Bias. Journal of Economic Perspectives 1991;5(1): 193–206.
[85] Gobet F, Lane P. Bounded Rationality and Learning 2012:482–4.
[86] Bertolazzi A, Quaglia V, Bongelli R. Barriers and facilitators to health technology adoption by older adults with chronic diseases: an integrative systematic review, 24. BMC Public Health; 2024. p. 506.
[87] Søraa RA, Nyvoll P, Tøndel G, Fosch-Villaronga E, Serrano JA. The social dimension of domesticating technology: interactions between older adults, caregivers, and robots in the home. Technol Forecast Soc Change 2021;167: 120678.
[88] Portz JD, Bayliss EA, Bull S, Boxer RS, Bekelman DB, Gleason K, et al. Using the technology acceptance model to explore user experience, intent to use, and use behavior of a patient portal among older adults with multiple chronic conditions: descriptive qualitative study. J Med Internet Res 2019;21(4):e11604.
[89] Herkert C, Graat-Verboom L, Gilsing-Fernhout J, Schols M, Kemps HMC. Home-based exercise program for patients with combined advanced chronic cardiac and pulmonary diseases: exploratory study. JMIR Form Res 2021;5(11):e28634.
[90] Smaerup M, Laessoe U, Grönvall E, Henriksen JJ, Damsgaard EM. The use of computer-assisted home exercises to preserve physical function after a vestibular rehabilitation program: a randomized controlled study. Rehabil Res Pract 2016; 2016:7026317.
[91] Middlemass JB, Vos J, Siriwardena AN. Perceptions on use of home telemonitoring in patients with long term conditions - concordance with the Health Information Technology Acceptance Model: a qualitative collective case study. BMC Med Inf Decis Mak 2017;17(1):89.
[92] Schelling TC. Dynamic models of segregation. J Math Sociol 1971;1(2):143–86. Jul 1.
[93] Foster MV, Sethares KA. Facilitators and barriers to the adoption of telehealth in older adults: an integrative review. Comput Inform Nurs 2014;32(11):523–33. https://doi.org/10.1097/CIN.0000000000000105. quiz 534-5PMID: 25251862.
[94] Sunstein C, Thaler RH. Nudge: improving decisions about health, wealth, and happiness. New Haven: Yale University Press; 2008.
[95] Connolly G, Srivastava D. How can we optimise healthcare delivery in the wake of the COVID-19 pandemic? The rise of digital health solutions in England. In: Costa-Font J, Galizzi M, editors. Behavioural economics and policy for pandemics: insights from responses to COVID-19. Cambridge: Cambridge University Press; 2024. p. 348–68.
[96] Tappin D, Bauld L, Purves D, Boyd K, Sinclair L, MacAskill S, McKell J, Friel B, McConnachie A, de Caestecker L, Tannahill C, Radley A, Coleman T. Cessation in Pregnancy Incentives Trial Team. Financial incentives for smoking cessation in pregnancy: randomised controlled trial. BMJ 2015;350:h134. https://doi.org/10.1136/bmj.h134. PMID: 25627664.
[97] Communications and Digital Committee. The Government has "no credible strategy" to tackle digital exclusion. [Internet]. June 2023. [cited November 2024] Available from: https://committees.parliament.uk/committee/170/communications-and-digital-committee/news/196028/the-government-has-no-credible-strategy-to-tackle-digital-exclusion/.
[98] Bovbjerg M.L. Random Error. 2020 Oct 1 [cited 2022 Sep 6]; Available from: https://open.oregonstate.education/epidemiology/chapter/random-error/.
[99] Goddard M, Smith P. Equity of access to health care services: theory and evidence from the UK. Soc Sci Med 2001;53(9):1149–62. 1982Nov.
[100] Brice R. CASP CHECKLISTS [Internet]. CASP - Critical Appraisal Skills Programme. [cited 2022 Sep 6]. Available from: https://casp-uk.net/casp-tools-checklists/.
[101] Watts G. COVID-19 and the digital divide in the UK. Lancet Digit Health 2020;2 (8):e395–6.
[102] Lee J.G.L., LePrevost C.E., Harwell E.L., Bloss J.E., Cofie L.E., Wiggins M.F., et al. Coronavirus pandemic highlights critical gaps in rural Internet access for migrant and seasonal farmworkers: a call for partnership with medical libraries. J Med Libr Assoc JMLA. 108(4):651–5.
[103] Covid-19 is increasing digital inequality: we need human connectivity to close the digital divide [Internet]. [cited 2022 Sep 6]. Available from: https://blogs.law.ox.ac.uk/research-and-subject-groups/oxfordshire-digital-inclusion-project/blog/2020/04/covid-19-increasing.
[104] Adjekum A, Blasimme A, Vayena E. Elements of Trust in Digital Health Systems: scoping Review. J Med Internet Res 2018;20(12):e11254.
[105] Agley J, Xiao Y. Misinformation about COVID-19: evidence for differential latent profiles and a strong association with trust in science, 21. BMC Public Health; 2021. p. 89.
[106] Filkuková P, Ayton P, Rand K, Langguth J. What Should I Trust? Individual Differences in Attitudes to Conflicting Information and Misinformation on COVID-19. Front Psychol 2021 [Internet][cited 2022 Sep 6];12. Available from: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.588478.
[107] Ipsos MORI. The Health Foundation. Public perceptions of health and social care in light of COVID-19. The Health Foundation; 2020. May[Internet][cited 2022 Sep 6]Available from: https://www.health.org.uk/publications/reports/public-perceptions-of-health-and-social-care-in-light-of-covid-19-may-2020.
[108] Propper C, Stoye G, Zaranko B. The Wider Impacts of the Coronavirus Pandemic on the NHS*. Fisc Stud 2020;41(2):345–56.
[109] Guckert M, Milanovic K, Hannig J, Simon D, Wettengl T, Evers D, et al. The Disruption of Trust in the Digital Transformation Leading to Health 4.0. Front Digit Health [Internet] 2022 [cited 2022 Sep 6];4. Available from: https://www.frontiersin.org/articles/10.3389/fdgth.2022.815573.

Further Reading

[110] Bryce Carol, O'Connell Matthew DL, Dale Jeremy, Underwood Martin, Atherton Helen Online and telephone access to general practice: a cross-sectional patient survey. BJGP Open 2021;5(4). doi:10.3399/BJGPO.2020.0179. BJGPO.2020.0179.