



Equity within digital health technology within the WHO European Region: a scoping review

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Equity within digital health technology within the WHO European Region: a scoping review

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For further information please contact the WHO Data and Digital Health Unit (euhiudata@who.int) or the Regional Center for Studies on the Development of the Information Society of the Brazilian Network Information Center (<https://cetic.br/en/contato/>).

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Abbreviations and acronyms

DHT	digital health technology
EU	European Union
PROGRESS PLUS	place of residence; race/ethnicity,culture/language; occupation; gender/sex; religion; education; socioeconomic status; social capital, plus other characteristics
SARS-CoV-2	severe acute respiratory syndrome coronavirus 2 (causing COVID-19)

Executive summary

Health-care providers are increasingly using digital health technology (DHT) to enable patients and the public to manage their health and engage with health-care systems; a process that rapidly accelerated as the COVID-19 pandemic shifted services online. The uptake and development of digital health systems has the potential for widespread benefits through more efficient and targeted health care. Yet a focus on digital approaches may inadvertently widen existing inequities in health if known inequalities in access, use and engagement with digital technology are not considered and addressed. Equitable patient-centred approaches are at the centre of the proposed action plan for digital health for the WHO European Region.

This scoping review explores the extent of inequities in digital health across a comprehensive range of specific characteristics. It also identifies key areas that need to be considered when integrating digital health into health-care systems to ensure equity.

While there are many different definitions of digital health, for the purpose of this report the WHO definition was used: “the field of knowledge and practice associated with the development and use of digital technologies to improve health”. This will include digital consumers using a range of connecting devices and will encompass other digital technologies such as artificial intelligence, big data and robotics.

A scoping review identified 22 relevant quantitative and mixed-method reviews and meta-analyses published between 2016 and May 2022. Inequalities in access, use and engagement with digital technology were mapped against the PROGRESS PLUS framework: place of residence; race/ethnicity, culture/language; occupation; gender/sex; religion; education; socioeconomic status; and social capital; plus age, disability or complex needs (e.g. homelessness or substance misuse).

Consistent evidence was found of the higher use of DHT:

- ▶ in urban compared with rural areas;
- ▶ in individuals of white ethnic origin and English speakers compared with those from ethnic minorities and those with language barriers;
- ▶ in individuals with higher education;
- ▶ in individuals with higher economic status; and
- ▶ in younger individuals compared with older adults.

Better access to DHT was found in individuals without any disability or complex health needs, and those of white ethnic origin and English speakers.

This is one of the most comprehensive scoping reviews of equity in DHT, collating evidence across three dimensions of digital health (access, use and engagement) and 10 domains of equity as defined by the PROGRESS PLUS framework. By considering the role of equity within each of dimensions of digital health, the findings can help to inform future development and

integration of digital technology into health-care system policy and practice within the WHO European Region.

Some cross-cutting themes were identified by this scoping review and reflect key areas for future development.

Interaction between equity domains. There was a tendency for reviews to consider singular domains of equity with few examining relationships between domains; for example, differences in use by urban and rural populations did not take account of differences in population demographics or health needs. A systematic approach using a common framework to monitor and report differences in the uptake and engagement with DHT for a population would enable more rapid learning in digital health innovation and inequalities.

Classification of DHT. There was considerable heterogeneity in how types of DHT were described, including assistive technologies, web-based platforms and monitoring systems. In addition, there are a number of classification tools, including that developed by WHO and used in this review. Adoption of a common approach to DHT classification would help to collate actionable evidence on digital health innovation and inequalities.

Lack of information on access. Few reviews examined access as an underlying driver of inequalities in digital health, with those considering it tending to be limited to technology and connectivity issues by place of residence. Given that those in greatest health need (older people, marginal groups, people with an existing disability) are those less likely to have access to digital platforms for health, examining the intersectionality (interconnectedness of different social classifications as no social identity category exists in isolation) between access and equity is important to protect against widening inequalities in digital health systems. Consequently, mapping inequities in digital infrastructure will support efforts to address this potential barrier to accessing DHT.

Digital literacy as a key driver. A number of reviews focused on differences in use and engagement across equity domains and identified digital literacy as a key driver. There are many digital skills initiatives for patients and health professionals across countries, including community and patient hubs, local government measures and opportunities to learn what works. Equity in digital health is impacted by interactions across diverse social and demographic factors, yet this was only considered by two of the identified reviews. Research needs to incorporate analyses to help in understanding intersectionality of factors contributing to equity in digital health and for identifying effective approaches to address knowledge, skills and confidence in the use of DHT by those most in need.

Content and design of DHT in relation to user needs. Multilayered interventions need to be considered to meet the unique needs of different populations, particularly vulnerable populations including those with disabilities or language barriers. Good engagement with DHT will vary with the clinical condition (within mental and physical

health conditions), the health service need being addressed (clinician contact, health information) and the characteristics of the population group (demographics, digital literacy, social factors or preferences). Inclusive and participatory design approaches, such as co-design and co-production, are required to ensure that DHT approaches have usability and meet needs across population groups. A structured framework is required for evaluation and reporting for DHT and equity across the full range of potential users.

National standards and guidelines. There are a range of national standards and guidelines that emphasize the need to consider equity when developing and implementing digital technologies into the policy and practice of health-care systems. For example, the National Institute for Health & Clinical Excellence in the United Kingdom has produced an evidence standards framework for DHT that covers design, value, performance, deployment and equity. The equity component has the requirement that, if DHT claims to address health or care inequality, it should show evidence of challenging identified health inequalities or improving access to care among hard-to-reach populations. Collation and sharing of good examples of approaches that health and care systems are currently taking to address equity in the development and introduction of DHT will help the expansion of effective DHT for all.



Introduction

The digitalization of society is not a new process but has been significantly accelerated by rapid spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and the resulting COVID-19 pandemic (1). The development and adoption of digital technology in health and care systems is forging ahead, potentially revolutionizing complex systems to improve population health across the globe (2). Studies suggest that the expected benefits to health and care systems include delivering more efficient and effective care closer to patients and targeting scarce resources in a better way using precision medicine, big data and artificial intelligence (3,4). The expected benefits to individuals include more rapid access to information and personalized care, more control and empowerment for their own health. However, these benefits are not shared equally by everyone (5).

While there are many different definitions of digital health, for the purpose of this report the definition from WHO is used (6).

The field of knowledge and practice associated with the development and use of digital technologies to improve health. Digital health expands the concept of e-health to include digital consumers, with a wider range of smart-devices and connected equipment. It also encompasses other uses of digital technologies for health such as the Internet of things, artificial intelligence, big data and robotics.

Given the global interest in digital health, WHO has recognized the need to strengthen the international approach to digital health implementation and set out a vision within the Global Health Strategy on Digital Health 2020–2025 (6):

to accelerate the development and adoption of appropriate, accessible, affordable, scalable and sustainable person-centric digital health solutions to prevent, detect and respond to epidemics and pandemics, developing infrastructure and applications that enable countries to use health data to promote health and well-being and to achieve the health-related Sustainable Development Goals.

Based on this global strategy, the WHO Regional Office for Europe has developed a digital health action plan with four strategic priorities: (i) development of evidence-informed guidance to support decision-making; (ii) enhancing in-country capacity; (iii) development of networks and knowledge exchange; and (iv) identification of patient-centred solutions (7). Part of this process is to encourage Member States to build a repository of good practice, strengthen health equity approaches and gender equality, and develop integrated solutions to monitor and evaluate digital health policies and interventions (8).

Yet, an emphasis on DHT raises concerns about the potential impact on underlying inequalities in health and well-being and the need to mitigate against these at an early stage (9). Patterns in the access, skill and levels of engagement with digital technology vary across populations, with older people, women and those with potentially greater health needs and/or who are

marginalized less likely to have access to digital technology, the skills to use it or motivation to engage with digital platforms (10). For example, a lack of accessible opportunities to develop knowledge, skills and confidence in the use of digital technology has been associated with lower use among older adults, women, migrants, ethnic minorities, rural communities and homeless and disabled people (11). Furthermore, there is a high level of intersectionality¹ between many of these factors that further exacerbates inequalities in digital health (12). There are also persistent differences in access to and use of technology to manage health between communities and geographical areas across the Region (1). These differences manifest as lower reported use among those with poorer underlying health, even after taking into account age and other sociodemographical factors (10).

Access and skills are not the only barriers to use digital health resources. Levels of engagement with and motivation to use digital technology are also highly variable between population groups. Factors cited include fear of discrimination and concerns that face-to-face services, valued for their social contact, will be replaced (13,14). Other important barriers are lack of agency and empowerment, which tend to affect women, particularly those from ethnic minority backgrounds (15,16). Such differences between population groups have been termed “the digital divide”, and digital exclusion is increasingly recognized as a determinant of inequality worldwide (1). Greater understanding of the role of inequity in people’s ability to access, use and engage with digital health is needed so that a more equitable future for digital health can be developed, ensuring no one is left behind.

In response to this challenge and the proposed action plan for digital health for the WHO European Region, WHO commissioned Public Health Wales (United Kingdom) to undertake a scoping review to explore the extent of inequities in digital health and to understand better the potential drivers and implications for health equity. The findings presented here will be considered by the WHO European Region, along with those from a systematic review of the impact of digital health interventions on women’s health-related outcomes, at a meeting in early 2023. The meeting will help to inform future developments towards integrating digital technology into health-care practices, systems and policy for the benefit of all.

1 Intersectionality is defined as the interconnectedness of different social classifications (e.g. ethnicity, race, gender and disability) and recognises that no social identity category exists in isolation from the others.



Methodology

The key review questions

1. What inequities have been identified in access, use and engagement with digital health?
2. What are the drivers for and the impact of inequities in digital health?
3. What actions are needed to integrate DHT into health-care systems to enhance equity?

Terminology

Digital health equity

Within this report, equity is explored through three key components of digital health (10): access, use and engagement.

Access: the ability to access the resources required for digital health depends on an Internet connection and having digital devices such as a smartphone, computer or tablet. Access to digital technology can also operate at a collective level, where geography, finance and infrastructure may impose limits.²

Use: there will be variations in the ability of different groups that have access to resources to actually use DHT. For example, individuals with lower digital literacy levels or digital skills would not be able to use the technology to the same extent as those with higher levels of digital literacy.

Engagement: variations will occur in the level of engagement with digital health by individuals who have access to and can use digital technology. For example, differences among those who prefer to engage with health services via digital or non-digital platforms.

Digital health interventions

WHO has created a shared language to describe digital health interventions organized by the targeted primary users, be they clients, health-care providers, system managers or data services (17). Given that the focus of this review is on the connections between service users and health-care providers, this report focuses on a subsection of the types of digital health interventions described by WHO (Table 1).

² For the purposes of this review, it has also been identified that the availability of appropriate online tools needs to be addressed.

Table 1. Digital health intervention groups in the WHO classification

Group	Types of digital health intervention
Clients (service users)	<ul style="list-style-type: none">▶ Targeted client communication▶ <i>Untargeted client communication</i>▶ <i>Client to client communication</i>▶ <i>Citizen-based reporting</i>▶ Personal health tracking▶ On-demand information services to clients▶ <i>Client financial transactions</i>
Health-care providers	<ul style="list-style-type: none">▶ Client identification and registration▶ Client health records▶ Health-care provider decision support▶ Tele-medicine▶ Health-care provider communication▶ Referral coordination▶ Health worker activity planning and scheduling▶ <i>Health-care provider training</i>▶ Prescriptions and medication management▶ <i>Laboratory diagnostic and management</i>

Note: italic indicates interventions not relevant to this review because they do not involve interactions between health-care professionals and patients for the purpose of providing health care.

Source: WHO, 2018 (17).

Search strategy and study selection

This scoping review uses the methodology outlined by Arksey and O'Malley (18) with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews checklist used as guidance (19).

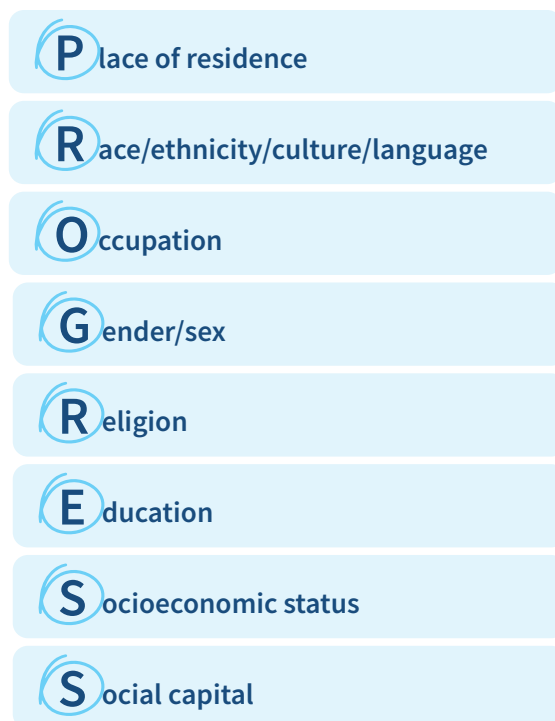
Searches of databases found an initial 404 papers, which were supplemented by 62 from grey literature searches (see Annex 1 for details of the methodology and the inclusion and exclusion criteria). A further search was made for primary research conducted in the WHO European Region countries from 2018 to May 2022 to help to fill gaps in areas where no secondary research was identified. A final set of 22 reviews was used for data extraction and thematic mapping.

Data extraction and analysis

Data were extracted to capture the following information: (i) author and publication date; (ii) participant characteristics; (iii) interventions and exposures; (iv) included study features; (v) equity outcomes; and (vi) solutions, limitations and evidence gaps.

As this is a scoping review the evidence was not critically appraised, but information on review quality was captured where it was available.

The results were thematically mapped against the PROGRESS PLUS framework (20) to capture data on equity of access, use and engagement with DHT. The framework indicates the different characteristics in which health inequities may be experienced. PROGRESS is an acronym used to identify characteristics that stratify health opportunities and outcomes:



PROGRESS PLUS expands this definition to cover other characteristics such as age, disability or complex needs (e.g. minority groups, homelessness or substance misuse).

As the elements of PROGRESS PLUS are not independent of each other, care was taken to capture any intersectional information reported. For this review, religion was included in the race/ethnicity/culture/language element of the PROGRESS PLUS framework. A potential direction of effect was considered to exist where $\geq 75\%$ of the reviews discussing an equity domain noted evidence of inequity pointing in the same direction.

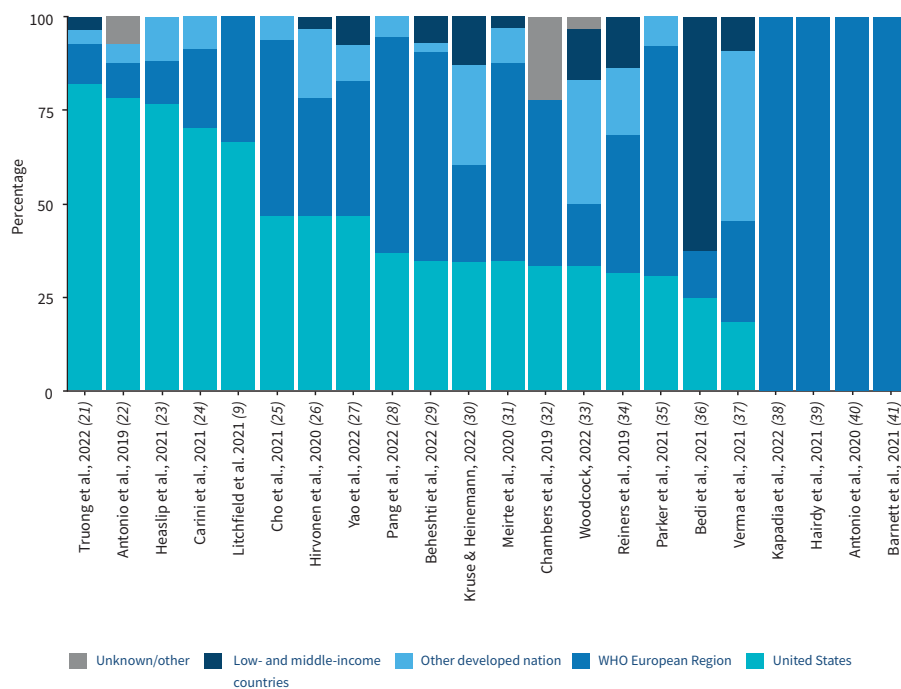


Findings

This section summarizes the evidence from 22 reviews (see Annex 1) for inequity in access, use and engagement with DHT, structured by the PROGRESS PLUS criteria. Annex 2 provides details of the included reviews.

Despite excluding reviews where the questions were specific to countries outside the WHO European Region, almost half the studies in the included reviews come from the United States of America (49.4%), followed by Europe (33.9%), other developed countries (e.g. Australia, Canada) (11.3%) and low- and middle-income countries (5.4%) (Fig. 1) (9,21–38).

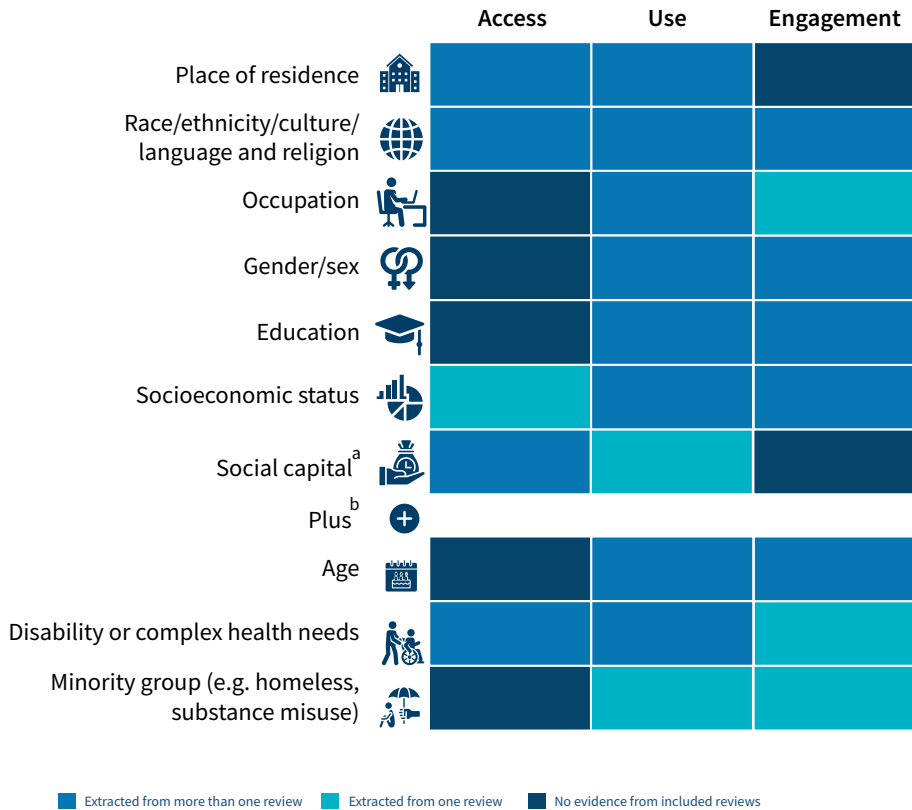
Fig. 1. Geographical distribution of primary evidence from each of the included reviews



Note: geographical information could not be obtained for three reviews as two were reviews of reviews and one did not report this (see Annex 1 for more details).

The number of reviews that described inequity across each of the equity and digital technology domains is illustrated in Fig. 2 (further details are available in Annex 1).

Fig. 2. Number of reviews describing evidence of inequalities in each of the digital health areas (access, use, engagement) by equity domain



^aNo evidence was found within the included reviews concerning social capital; however, evidence of a mixed effect was obtained from two primary studies.

^bPersonal characteristics (e.g. marital status), features of relationship (e.g. smoking parents, excluded from school), time-dependent relationship (e.g. leaving hospital, respite care, other instance where a person may be temporarily disadvantaged).

The evidence will now be described for the role of each equity domain against the digital technology components (access, use and engagement). Given that the evidence found was largely from North American studies (Fig. 1), the included data are supplemented with European-specific information on digital equity from other sources (e.g. grey literature and single studies) to help in considering the findings within a WHO European Region context.

Place of residence



Overview: place of residence

Place of residence largely describes the difference in access and use of digital technology between urban and rural areas. This element of PROGRESS PLUS is an important determinant of health as many of the differences in health outcomes could be removed if the necessary infrastructure were put in place (20). Estimates from a Eurostat study that included the European Union (EU), the European Economic Area and Switzerland indicated that 8% of the urban population remains digitally excluded, rising to as high as 15% in rural areas. Notable differences were found in different regions, with lower Internet rates in rural southern and eastern Europe (62–75%) compared with urban areas (82–87%) (1). The majority of highly digitally skilled people were found in northern and north-western Europe, with over 50% of individuals possessing above basic digital skills (1). By contrast, less than 20% of individuals reported having above basic digital skills in south-eastern Europe (1). Furthermore, 81% of individuals in the EU accessed the Internet daily in cities compared with 70% in rural areas (42).

Multiple reviews explored access to digital health services in underserved rural areas and examined the difference in use between urban and rural areas. However, no evidence was found reporting a link between urban/rural residence and level of engagement with DHT (Fig. 2).

Access

Three reviews included studies examining the effect of place of residence on access to health care facilitated through digital technology (29,36,39). They all reported that DHT in rural communities improved access to and participation in health services. For example, digital technology increased access to tele-health services for patients with cleft palate living in rural areas (36). Similarly, access to digital health services increased in rural and remote patients with viral hepatitis C through tele-mentoring in primary care (39). Finally, tele-medicine improved access to high-quality smoking cessation treatment among rural communities in the United States (29).

Use

Five reviews described trends in digital health use between rural and urban areas across different population groups including the general population (22,24), socioeconomic and disadvantaged groups (35), patients with chronic diseases (34) and older adults with cancer (37). Among disadvantaged populations, those living in urban areas are more likely to have more telephone consultations and higher use of digital methods to contact primary care compared with their rural counterparts (35). Use of patient portals and e-health has been found to be lower in rural areas than in urban areas (22,24,34). In addition, in older adults (≥ 65 years), those living in more rural areas were found to have lower digital health literacy levels than those living in more urban areas (37). It is important to note that not all reviews looking at differences by place of residence accounted for demographical and health differences between populations.

Engagement

No reviews were found that explored differences in levels of engagement with DHT by place of residence.

Race/ethnicity/culture/language and religion



Overview: race/ethnicity/culture/ language and religion

The COVID-19 pandemic has interacted with existing ethnicity and socioeconomic status divisions, exacerbating social and health inequalities in high-income countries (43). To mitigate the unequal burden on the marginalized members of society, there has been a shift towards providing health care remotely (38). However, the advantages of DHT have not applied equitably, particularly for historically marginalized population groups, including ethnic minorities and migrant communities. People facing language barriers live at the intersection of multiple social, economic and cultural disadvantages that contribute to being digitally excluded (38,44).

Evidence was found of differences in access to, use of and engagement with DHT by race or ethnicity. However, there was little evidence relating to language and none to culture and religion (Fig. 2). Most evidence on race, ethnicity and language came from studies conducted in the United States.

Access

One review found that patients from ethnic minorities with mental ill health in high-income countries faced barriers to accessing digital health services. Despite tele-health services having been shown to be beneficial for depression in ethnic minorities, difficulties with access led to fewer sessions being completed compared with those for white ethnic groups (41).

One review reported that language may influence access to DHT as patients reported being challenged by patient portals not offering the patients' preferred language (22). In addition, two reviews noted one primary study each reporting higher use of DHT among English-speaking patients (9,24).

Use

There is evidence of the use of DHT by ethnicity (9,22,24,32,34,35,38,40) and immigration status (35). Five reviews concluded that participants from a white ethnic background are more likely to use DHT (such as tele-medicine or patient portals) compared with Black, Hispanic and Asian ethnic groups in the United States (9,22,24,32,40). Quantitative data from one mixed-methods review looking at immigrant populations in Denmark and Italy reported that host residents had a higher telephone consultation use than immigrant groups (35).

However, two reviews reported mixed results with no overall direction of effect established because of conflicting evidence (38) or no identified evidence of inequity (34). Overall, the preponderance of studies included in these reviews reported that patients of white ethnic background were more likely to use DHT than those from ethnic minorities. It is worth mentioning that not all primary studies included in the reviews accounted for structural inequalities (differences in income or Internet access) or adjusted for health needs, other barriers to seeking health care (such as stigma), socioeconomic variables or other important confounders such as language skills (38).

Engagement

Evidence was conflicting for the association between race/ethnicity and engagement with digital health. Six reviews were identified, none of which explored culture or religion in this context (9,21,22,25,34,38). Three of these reviews found evidence that participants of white ethnic background showed higher acceptance of, as well as greater engagement and satisfaction with, digital health resources (home-based electronic self-reporting systems and e-health) compared with individuals from ethnic minorities (22,25,34). One review by Truong et al. found that patients from ethnic minorities with mental health issues reported higher satisfaction with telephone triage over typical care than their white counterparts (21). Another review focusing on the United Kingdom reported mixed findings regarding the acceptability of and preference for digital services between ethnic groups (38). In the review carried out by Litchfield et al. in 2021, only one primary study found no difference in cancellation rates of teleconsultations based on race or ethnicity (9).

There is a paucity of research exploring the influence of language barriers on engagement with digital health services.

Occupation



Overview: occupation

Estimates from Eurostat suggest that employed people have higher levels of digital skills compared with unemployed individuals. This is likely the result of being exposed to a digital environment, which, in turn, contributes to easier assimilation of digital technologies and greater digital skills development (1). For example, data from the United Kingdom's largest study of digital engagement shows that, during the COVID-19 pandemic, 34% of individuals in desk-based occupations reported that their Internet use (including for work and leisure) increased substantially, compared with 24% of those employed in manual jobs and 25% of those not in work (45). Although time online is not necessarily an indicator of greater digital capability, it does suggest confidence and comfort, which could mean that office-based workers are more likely to adapt to digital technology and, therefore, to DHT.

There is a paucity of evidence examining the association between occupation and the three dimensions of digital health. Only a few reviews were found examining the influence of occupation on digital health use and acceptance of DHT (Fig. 2).

Access

No reviews were identified that examined the association between occupation and access to DHT.

Use

Two reviews reported the relationship between occupation and digital health use (32,34). One review found primary evidence that indicated being in employment (versus being unemployed) made no significant difference to e-health use among patients with chronic diseases, including those with diabetes (34). However, a second review among the general population from developed countries found evidence that e-consultation users were more likely to be in employment than non-users (32). Sociodemographical factors could explain these mixed results, as the first review (32) concluded that users of digital health services were also more likely to be younger and female while the second one (34) included older population with chronic diseases.

Engagement

Only one review reported the effect of employment status on the acceptance of DHT; this was among people with cancer (25). It reported no conclusive evidence, based on data from two primary studies.

Gender/sex



Overview: gender/sex

There is a large gap in digital adoption and usage among women compared with men across all ages (46). Gender differences are more pronounced in older age, in marginalized communities such as ethnic minorities and among those with a disability (47,48). They are also more prominent in countries with lower digital inclusion, particularly southern and eastern Europe, the western Balkans and central Asia (48). This gender gap in digital access is accompanied by a gender gap in meaningful digital use. For example, women use a limited range of digital services and use digital services less often and less intensively compared with men (46). However, evidence from high-income countries indicates that women tend to use digital technologies more frequently than men to access health-related information (48) and to support their health, including activities related to mental well-being and social support (49–51). Addressing the digital gender gap is critical to realizing the significant potential health benefits that digital technologies can bring for women, their communities and the broader society (52).

Nonetheless, the digital gender gap is important because if it remains unaddressed, it has the potential to exacerbate health inequalities.

Not all reviews included in this scoping review disaggregated data from men and women but several reviews examined the influence of gender/sex on the use of and engagement with DHT.

Access

There is considerable evidence of a clear digital divide by gender reflecting many underlying sociocultural factors (53). However, this scoping review with its specific focus on digital health found no reviews that examined gender difference in access to DHT (Fig. 2).

Use

The difference in digital use between men and women was reported in eight reviews, covering the general population (9,24,32,33), patients with chronic conditions (34,40,54) and socioeconomic and disadvantaged groups (35). Four reviews (32,33,35,40) reported higher use of DHT in women as did six of nine studies in the review by Carini et al. (24). Of the remaining three studies reported by Carini et al. (24), one found higher use of online health technology in men compared with women and two found no differences. No difference in the use of DHT between men and women was reported by Litchfield et al. (9). Finally, two reviews observed differing use between men and women by type of DHT (34,54). For example, women used e-health applications (risk assessment and management applications) more often than men.

Engagement

Two reviews reported mixed evidence for the association between gender and engagement with DHT among people with cancer (25) and people with chronic diseases (34). Men showed higher acceptance and use of electronic self-reporting systems (two primary studies) (25) and tele-monitoring (two primary studies) (34) compared with women. However, this higher acceptance in men was not consistent across all interventions, with evidence indicating that women were more engaged and satisfied with digital health applications compared with men (three primary studies) (34).

Education



Overview: education

Along with income, education is a strong predictor of variations in health (20). Evidence indicates that those with lower levels of education could be less comfortable with or unable to access DHT. This could be explained by low access, poor skills and less use among those with a lower level of education (55). Findings from the Eurostat survey indicate that students have the highest levels of above-basic skills (68.2%) as a result of being exposed to digital technology from a young age (1).

Only a few reviews looked at education as a factor influencing access to and engagement with DHT (Fig. 2).

Access

No reviews were identified examining an association with access to services (Fig. 2).

Use

Five reviews looked at a possible association between education and use of digital health care, within the general population (24,33), patients with chronic conditions (22,34) and patients mainly with cancer or musculoskeletal conditions (31). In four of these reviews, most primary studies concluded that individuals with higher education used digital health services (self-scheduling, patient portals and e-health technologies) more often than those with lower education levels (22,24,31,33). Inconclusive evidence was found by Reiners et al. (34), with 50% of included studies indicating that education was not associated with the use of digital health.

Engagement

Two reviews reported that higher education leads to higher acceptance and engagement in DHT among patients with cancer (25) and with chronic diseases (34). However, Chambers et al. (32) noted that, in one primary study, patients with low to medium levels of education were motivated more towards indirect e-consultation (involving contact with a health professional via email) to reduce uncertainty.

Socioeconomic status



Overview: socioeconomic status

Socioeconomic status is an important influence on an individual's health status (20). There is evidence suggesting that social and digital exclusion are interlinked, with poverty being a leading cause of the digital divide worldwide (56). People suffering economic disadvantage perceive fewer benefits from online health services even when differences in access, skills and use are accounted for (57). The Eurostat survey found that households in the most deprived income quartile report a lower Internet connectivity rate (73%) compared with those in the least deprived quartile (99%). Data indicated that low income is similarly associated with lower levels of Internet access, with the most deprived income quartile reporting overall access to the Internet of 33–96%, compared with 96–100% for the least deprived quartile (1).

The scoping review identified evidence examining differences in access, use and engagement with socioeconomic status (Fig. 2).

Access

A single review explored sociodemographical factors influencing access to digital health among people with chronic diseases (34). The review concluded that lower income is associated with limited availability and access to Internet health-care resources. One primary study within this review reported that geographical influence is often related to socioeconomic status.

Use

Five reviews considered associations between socioeconomic status and the use of digital health services. Reviews investigated usage trends among the general population (9,33), disadvantaged groups (35) and patients with chronic conditions (22,40). In the general population, low socioeconomic status was found to be a driver of low adoption rates of automated patient self-scheduling (33). A relationship between low income and decreased use of patient portals was identified in one review (22). Similarly, individuals living in postcodes in the United Kingdom with low-income populations had lower adoption rates of tele-medicine (9). Higher income was associated with greater enrollment and use of patient portals among patients with chronic conditions (40). One review found mixed results, with three primary studies finding no difference between socioeconomic factors and the use of remote consultations with a general practitioner, and two indicating that more-affluent patients were more likely than less-affluent patients to use DHT (35).

Engagement

The association between socioeconomic status and engagement with digital health is mixed. Two reviews explored engagement in patients with chronic diseases (34) and in the general population (9). The reviews identified two primary studies indicating that people with higher incomes tended to have more interest in digital health than those with lower income. However, four primary studies with quantitative data reported that income was not a factor influencing engagement or satisfaction with e-health (9,34).



Social capital



Overview: social capital

Social capital refers to social relationships and networks and represents the degree of social cohesion that exists in communities. It is the processes between people that establish networks, norms and social trust and which facilitate coordination and cooperation for mutual benefits (20,58). Evidence has found a strong causal link between social capital and health in 14 EU countries (59). A proposed mechanism for this is improved access to health information and greater promotion of access to and utilization of health services (59). However, evidence examining the association between social capital and digital health use, access and engagement is limited.

The search did not identify any reviews examining the relationship between social capital and DHT access, use and engagement; consequently, a focused search for primary literature was conducted to provide some insight. Two primary studies conducted in European countries were identified (Fig. 2) (60,61).

Access

Both studies examined the effect of social capital on access to digital health. One study, carried out in Italy, found differences in the successful completion of tele-visit rates in older patients with dementia, who underwent neurological evaluation via video call during the COVID-19 period of restricted movements (60). Tele-visits performed in the presence of a caregiver of a younger generation had a higher success rate than for those without a younger generation caregiver ($P < 0.001$). The authors suggested that this finding is mainly linked to the ability of younger people to use technology, describing them as digital natives (people who have grown up in the digital age), whereas caregivers of the same generation as patients were described as digital immigrants (people who have acquired familiarity with digital systems as adults). The main barrier to access was patient difficulty in establishing a connection; this issue was more prevalent than a lack of hardware (76.4% and 23.5% of failed tele-visits, respectively). Another study, carried out in Belgium, France and Germany, found that partnership status (living in a partnership or not living in a partnership) was not associated with physical access to personal health records (61).

Use

Only one study reported the effect of social capital measures on use of DHT (61). Survey data identified social influence and social support as strong predictors of regular use of digital medical records among adult patients offered personal health record services.

Engagement

Evidence for an association between social capital and engagement with digital health was reported in one study (61). The number of individuals in a patient's social network was not associated with a desire to access to personal health records.

Age



Overview: age

The WHO European Region is experiencing ageing-related challenges that are hindering the move to a digitally inclusive society. For example, ageing brings with it health challenges that make it difficult to learn digital skills or use them fully (62). Despite evidence indicating that, as a result of the COVID-19 pandemic, more older adults are online than ever before (45,63), older adults continue to be more digitally excluded than their younger counterparts (1,10,49), particularly those living in rural communities (34,64). In the Eurostat survey, 33% of those aged 55–74 years possessed at least basic digital skills compared with 80% of young adults aged 16–24 years. Higher digital skills were most common in younger individuals (16–24 years) and least in adults aged 65–74 years (60.4% and 5.7%, respectively) (1).

Age is one of the factors that influences access to, use of and engagement with DHT. Several reviews were identified that examined the association between age and the use of and engagement with DHT (Fig. 2).

Access

Despite existing evidence indicating that connectivity is lower for older adults than it is for younger people (10,49), no review that examined age differences in access to DHT was identified.

Use

Twelve reviews examined the association between use of DHT and age. Reviews focused on the general population (9,22,24,32,33), patients with chronic disease (34,40), patients mainly with cancer or musculoskeletal conditions (31), those aged 50–70 years with or without chronic conditions (26), patients with cancer (25,37) and socioeconomic and disadvantaged groups (35). In eight reviews, lower use was found among adults aged 50 years or older compared with younger people (22,25,26,31–34,40). Three reviews found mixed results or no difference by age (9,24,35). However, one of these reviews observed a difference in the age groups that used different types of intervention (35); for example, older adults were more likely to use telephone consultations, while Internet-based consultations were more likely to be used by younger individuals. The most commonly reported reason for lower use of digital health resources (electronic patient-reported outcome measures) in older adults was lower health literacy (31,37).

Engagement

Five reviews reported that older adults were less likely to engage with DHT than younger adults. These reviews included older adults from the general population (33), patients with chronic disease (34) or with cancer (25), those aged 50–70 years with or without chronic conditions (26) and older adults with cancer (28). Three reviews concluded that older adults had less preference or interest in tele-medicine (28,33,34), with concern over losing contact with health-care professionals (34) and privacy and security concerns (24). However, Hirvonen et al. found some evidence that older adults had greater sustained interest compared with younger adults once they had adopted the technology (26), and Cho et al. found no association with age and DHT engagement (25).



Disability or complex needs



Overview: disability or complex needs

Around one in four people in the EU has a long-term physical, mental, intellectual or sensory impairment (65). Disability is often ignored as a potential reason for digital exclusion, but it is a major cause of diversity and inequality in society (57,66). Disability-related digital divides have been found to differ by type of disability. For example, individuals whose disability is related to language and understanding report the greatest difficulties using the Internet (66,67). Nonetheless, some people with disabilities (such as those with a hearing impairment) and those with complex health needs are more likely to take advantage of digital technology to manage their health. For example, the use of digital technology has improved health outcomes among people with cancer (68) and musculoskeletal conditions and functional disabilities (69). There is also evidence that digital health interventions can improve the management of mental health in people with chronic diseases (70).

Evidence of an association between the access to and use of digital health services among people with disability and complex needs was identified (Fig. 2).

Access

Three reviews reported on associations between disabilities and access to digital health (22,25,31). One review indicated that access and navigation barriers to patient portals existed for those with physical, visual, neurocognitive and intellectual disabilities (22). Barriers also existed in patients with brain tumours, who struggle to use electronic self-reporting systems because of loss of hand strength and poor memory, as well in older adults with visual impairments (25). Quantitative evidence indicated that patients with cancer and musculoskeletal conditions who did not have Internet availability preferred paper-based questionnaires for patient-reported outcome measures over the electronic version (31).

Use

Three reviews found evidence examining the relationship between complex health needs and use of DHT (24,27,40). High illness burden, depression, moderate to severe asthma and well-controlled diabetes were all positively associated with patient portal usage, while schizophrenia and schizoaffective disorders were negatively associated with portal usage. However, use of DHT to manage health varied depending on the chronic condition or disability and on the number of comorbidities (24,40). Consequently, it is not possible to determine the direction of effect.

Engagement

No review that examined the association between individuals with disability or complex needs and engagement with DHT was identified.

Marginalized groups such as homeless or substance misuse



Overview: marginalized groups

There is little evidence exploring how digital technology is used to promote health and well-being for socially marginalized and underserved population groups such as the homeless or those with substance use disorders (23,71). Exploring how it can support the health of vulnerable members of society is crucial, as homelessness has increased since the late 2000s in 24 out of the 28 Member States of the EU in 2019 (72). In addition, substance misuse continues to be a public health concern in the WHO European Region, with important differences between countries (73).

There is limited evidence exploring the three dimensions of DHT among marginalized and underserved populations. Only a few reviews explored the association between use and engagement with DHT among people experiencing homelessness and those with substance misuse.

Access

Included reviews did not find any evidence about the influence of homelessness or substance misuse on access to DHT.

Use

One review looked specifically at the use of DHT to promote health and well-being among homeless individuals (23). Homeless people are twice as likely to seek health advice online if they are using class A drugs, and young homeless people who indicated they had a mental illness were five times more likely to seek help online.

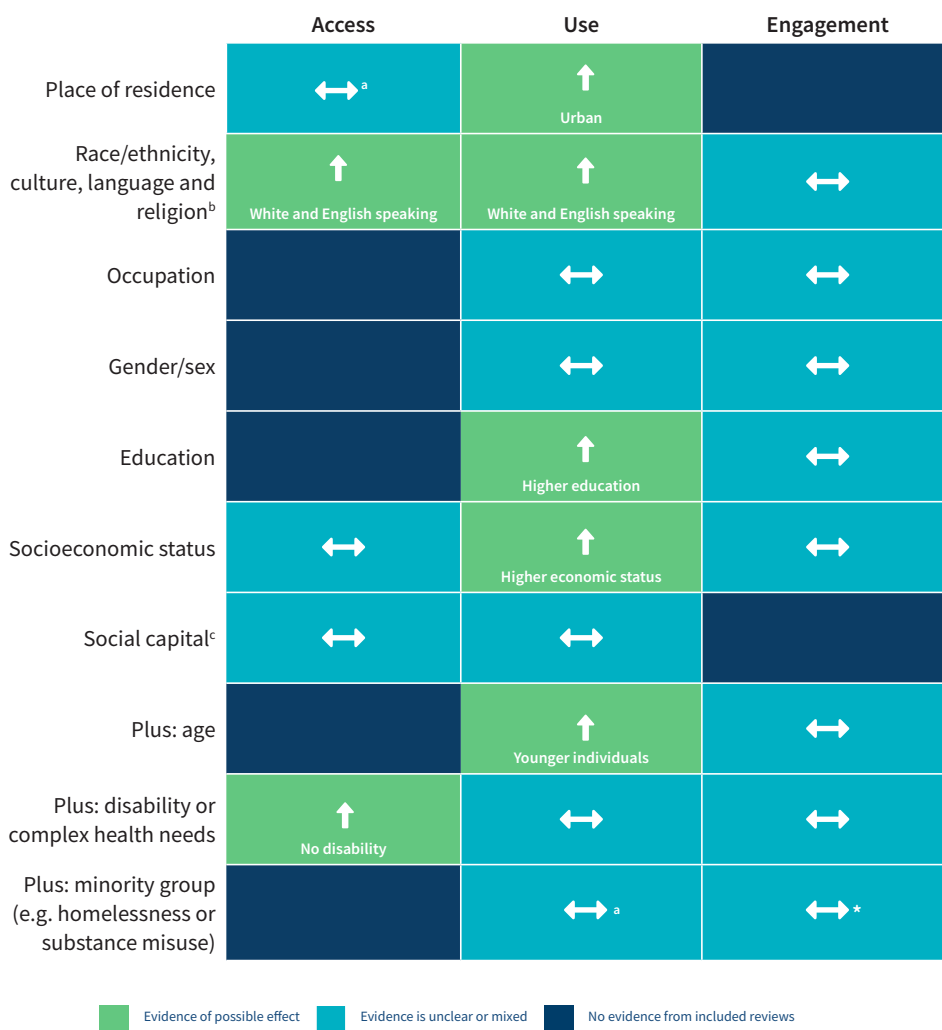
Engagement

A mixed-methods review found one quantitative study exploring engagement among patients with opioid addiction with remote consultations (35). Telephone appointments improved engagement with primary care in patients with opioid addiction compared with face-to-face consultations (59% and 48%, respectively).

Summary of the findings

The data described above are summarized for direction of effect in a heat map (Fig. 3). Table A1.3 in Annex 1 gives a detailed summary of the number of reviews reporting significant differences in inequity based on PROGRESS PLUS element versus the total number of reviews that investigated this inequity indicator in relation to access, use and engagement.

Fig. 3. Heat map indicating the direction of effect found in the reviews



Note: a potential direction of effect was considered to exist where ≥ 75% of the reviews discussing an equity domain noted evidence of inequity pointing in the same direction.

^aSome evidence indicated that provision of digital health care increased an individual's ability to access health care.

^bReligion was included in the race/equity/culture/language element of PROGRESS PLUS.

^cNo evidence was found within the included reviews concerning social capital; however, evidence of a mixed effect was obtained from two primary studies.



Discussion

This is one of the most comprehensive scoping reviews of equity in DHT, collating evidence across three dimensions of digital health (access, use and engagement) and 10 domains of equity as defined within the PROGRESS PLUS framework.

By considering the role of equity within each dimension of digital health, the findings can help to inform future development and integration of digital technology into health-care systems, policy and practice within the WHO European Region.

This section of the report summarizes the evidence within each equity domain, reflects on the limitations of the evidence collated and identifies cross-cutting themes and key areas for future development.

Key findings

Specific inequities identified in this review and requiring action, include the following based on the PROGRESS PLUS groups.

Place of residence

Access to health care facilitated through digital technology has shown to have beneficial health outcomes for rural communities (29,36,39). However, barriers to full adoption and use of DHT must be addressed to tackle digital health inequities. In rural areas, people experience multiple disadvantages that prevent them from harnessing DHT to tackle the long-standing health disparities between rural and urban areas. Cumulative factors influence access, use and engagement with online health services for rural communities. For example, people are not only digitally excluded because of inadequate infrastructure but they may also experience a lack of affordable Internet and devices, as well as poor digital skills related to low income and/or lack of education (27,34). The biggest barriers reported in reviews were access to technology and connectivity issues (29,36). Potential solutions include increasing participation to fund infrastructure and encouraging new connectivity models in the Region. A mix of regional and national policy measures has been proposed to bridge the rural–urban digital divide (74,75).

Mapping information and communication technology infrastructure is helping to identify gaps and support policy and investment decisions. For example, mapping these data against the requirements of rural communities has the potential to identify needs and support long-term infrastructure investment (76). Additionally, mapping local initiatives currently helping people to access technological support and training could provide local knowledge important in the planning of digital health services (77). Providing effective advice and training for patients in rural communities and ensuring that health professionals are well equipped and trained to provide online health services are both likely to increase adoption (78). Consideration should also be given to social network support and technology integration into everyday life in rural areas, particularly for rural older adults, with family members playing a supportive role in the use of

digital health (34). It is also important to develop digital health literacy educational materials in close collaboration with service users and recognize the potential benefits of collective action (79). Embedding rural community stakeholders in the planning and development process will help in tailoring and modifying digital health literacy education to address the unique barriers among rural communities (80).

Race/ethnicity/culture/language and religion

The design of culturally appropriate DHT is essential, as culture influences many aspects of an individual's health care, including trust and rapport (81). Involving members of these communities in the planning and design of online health services will ensure that services are credible to the groups involved (10). Embedding key community stakeholders or gatekeepers is also crucial to improve engagement from these communities (82). Overcoming barriers and challenges to e-health should address the need for digital literacy and for linguistically appropriate online information for ethnic minorities and migrant groups (21). It is notable that some of the language-related solutions are so-called quick wins, which may be more easily resolved than are issues related to underlying differences by ethnicity, race and culture. Further research is also needed to explore the effect of language barriers and the relationship between religion and other characteristics, such as gender and culture, on access to, use of and engagement with DHT (12,81). Addressing security and trust issues is crucial to increase the adoption among these communities (10,83). Finally, there is a need to gather usage data routinely to increase our knowledge of factors contributing to engagement.

Education and occupation

Provision of educational resources, including those aimed at improving digital literacy, is needed to help those who are less well educated to engage with DHT (37). Community and patient hubs (84) where information is provided in a variety of formats (30,38) and simplifying digital health information could improve access. Although there is a paucity of evidence examining the relationship between occupation and the use of, access to and engagement with DHT, occupation could be seen as an important marker of digital skills. However, digital skills are not enough for people to benefit from online web-based health services; a broader set of digital health literacy skills is needed to properly use such resources (85). Digital health literacy needs to be addressed across the spectrum of engagement (86). This includes increasing user ability via education and training, but also designing and tailoring digital health approaches to suit individual needs, particularly for those who are socioeconomically disadvantaged and those with lower levels of digital literacy, including those employed in low-skilled occupations. Ensuring that DHT is user friendly (with a simple interface design) and accessible should be considered by those designing such technologies. Provision of educational material at recommended reading levels or using visual and audio information, animations and links to additional resources could also support people with poorer digital and e-health literacy skills (86).

Gender/sex

The evidence found was mixed but factors such as type of technology and health status (such as having a long-term condition) may play a role in the use of DHT among women (31,34,40). Few studies in the included reviews provided gender-disaggregated data or considered other intersectional factors such as socioeconomic status, ethnicity or race. These data are needed to better understand digital health inequities (52). Although there is evidence indicating that in high-income countries women use the Internet more frequently than men to access health-related

resources (25,34,48,49), the majority of available tools do not address women's needs and priorities (12). Therefore, there is a need to develop more inclusive and gender-responsive digital training that focuses on the specific needs of women (12,15). Consideration should also be given to understanding and addressing the harmful gender norms, practices and stereotypes that prevent women from engaging in digital technology, particularly women from marginalized backgrounds, those living in deprived areas, those with disabilities and those from ethnic minorities (52). Finally, women should also participate in the planning and development of DHT to ensure that this addresses their needs (12,15).

Socioeconomic status

Provision should be made to enable individuals of lower socioeconomic status to access, use and engage with digital health care. Examples include targeting community hub support and resources (provision of Internet access) for disadvantaged groups (30), changes to service provision (such as clinic times) that may enable low-income groups to access digital services around their employment, and user-centred design for future DHT (10). Consideration should also be given to incorporating recommendations for some of the other characteristics associated with lower socioeconomic status (such as education, health and digital literacy, ethnic minority populations) to encompass successful support more fully at a system level (40).

Age

Technical literacy, availability of technology and connectivity are the age-related barriers cited most often. The offer of public programmes to assist those with these difficulties (36,37,57) and the opportunity to learn alongside other older users (working in pairs or having older volunteers who are confident digital users as champions) are potential solutions (63,87). Community centres that provide access to computers, classes on computers and a dedicated broadband connection can all contribute to supporting older adults (30). In addition, social and cultural practices among older adults should be considered when designing and implementing DHT (64). Finally, DHT should provide individuals with transparent privacy policies and comply with data governance regulations and security protocols to address safety concerns.

Disability or complex needs

Although there is a growing body of evidence showing the benefits of DHT for people with disability or complex needs, no single solution can cover every eventuality, and more work is needed to design, test and evaluate the efficacy of innovative digital health solutions for people with disabilities or complex needs (88). Security, trust and transparency should be considered when developing online digital health resources for vulnerable groups of the population, such as those with mental ill health (89). Improved community services and a strong social network could also improve access to, use of and engagement with digital technologies (84).

Marginalized groups

There is little evidence of the impact of online health services on health outcomes and measures of quality of care among vulnerable subgroups of the population, such as the homeless or those with substance misuse conditions. Service evaluation is needed to assess the benefits and harms to these and other population groups. These evaluations should take a cumulative risk approach to understand better the impact of multiple disadvantages and clinical complexity. Research should distinguish between types of online service and indicate what works, when and for whom (35).

Limitations of the review

This review was restricted to a scoping review of quantitative evidence and only includes reviews and grey literature published in English. While the searches were not limited by language, only two reviews published in languages other than English were identified, neither of which met the criteria for inclusion. As is common with scoping review methodology, an assessment of the methodological robustness of the included reviews was not conducted; however, of those that conducted critical appraisal (12 out of 22 reviews), the overall quality of the studies was reported to be low. These reviews cited methodological weaknesses, including a lack of blinding, small sample sizes, not accounting for all confounders and only including participants who had access to digital technologies; these were further compounded by low participation rates.

Much of the evidence that provides contextual information on barriers to and facilitators of equity in digital health is provided in the qualitative literature and, therefore, outside the scope of this review. In addition, most evidence in the included reviews comes from outside the WHO European Region. What European evidence there is comes almost entirely from high-income western European countries. Consequently, generalizability is problematic and applicability to low- or middle-income countries within the Region is likely to be limited.

The lack of available evidence in some areas prevented the complexities of inequities within digital health care being mapped fully against all relevant elements of PROGRESS PLUS. Although an attempt was made to fill some of these gaps with primary studies conducted in the Region, further evaluation is required. In addition, the general lack of an intersectional lens in almost all the included reviews restricted a holistic insight into inequities in digital health care.

Key areas for future development

A number of cross-cutting themes were identified in this scoping review. These are summarized below with key areas for future development given for each.

- ▶ Most reviews examined digital health across singular domains of equity. The approach to reporting quantitative data was highly variable and few accounted for relationships between domains (for example, differences in use by urban and rural populations did not take account of differences in population demographics or health needs). A systematic approach to reporting the population studied would help to enable more rapid learning in digital health innovation and inequalities.
 - ▷ Develop a common framework to monitor and report differences in the uptake and engagement with DHT across equity domains.
- ▶ There was considerable heterogeneity in how the types of DHT were described (for example, assistive technologies, web-based platforms or monitoring systems). Although WHO has developed a classification tool (17), which was used in this review, there are a number of other tools available.
 - ▷ Adopt a common framework to define DHT to support the collation of evidence of impact to direct action.
- ▶ Few reviews that examined access as an underlying driver of inequalities in DHT were identified. This tended to be limited to technology and connectivity issues by place of residence. Given that those in greatest health need (older people, marginal groups, people with an existing disability) are those less likely to have access to digital platforms for health, examining the intersectionality between access and equity is important to protect against widening inequalities in digital health systems.

- ▷ Map inequities in digital infrastructure, recognize and address this potential barrier to accessing DHT.
- ▶ A number of reviews focused on differences in use and engagement across equity domains and reflected digital literacy as a key driver. There are many digital skills initiatives for patients and health professionals, globally, regionally and within countries; these include community and patient hubs, local government and opportunities to learn what works (Table 2) (90–102). However, digital health and equity is a function of interactions across much more diverse social and demographical factors, yet only two reviews (27,34) mentioned interrelated factors that accentuate digital health inequities. To obtain a full picture of the drivers of use and engagement with DHT, research needs to incorporate intersectional analyses (12,15,16,82) to account for the complex systems and interactions at play (12,52).
 - ▷ Collate evidence of effective approaches to address knowledge, skills and confidence in the use of DHT targeted to those most in need.
 - ▷ Increase understanding of the intersectionality of factors contributing to equity in digital health.
- ▶ A number of reviews reflected on the importance of DHT addressing user needs in both content and design (24,26,30,31,34,35,40). The need for multilayered interventions to meet the unique needs of vulnerable populations was also highlighted (82). It was clear that successful engagement varies with factors such as the clinical condition itself (mental and/or physical health issues), the health service need being addressed (clinician contact, health information) and the characteristics of the population group (demographics, digital literacy, social factors or preferences). These effects demonstrate the importance of both co-production and co-design of DHT and a structured framework to evaluate it along with differences in uptake, engagement and outcomes by population groups.
 - ▷ Use inclusive and participatory design approaches to ensure DHT meets needs across population groups and addresses usability for those with disabilities or language barriers.
 - ▷ Develop a good-practice approach to the evaluation, design and reporting for DHT and equity.
- ▶ There are a range of national standards and guidelines that emphasize the need to consider equity when developing and implementing digital technologies into health-care systems’ policy and practice. For example, the National Institute for Health and Clinical Excellence in the United Kingdom has produced an Evidence Standards Framework for Digital Health Technologies that outlines 21 standards across the design, value, performance and deployment of such technologies (93). Equity is one of the standards, with a requirement that, if the DHT claims to address health or care inequality, it should show evidence of “contributing to challenging health inequalities in the United Kingdom health and social care system, or improving access to care among hard-to-reach populations; and promoting equality, eliminating unlawful discrimination and fostering good relations between people with protected characteristics”. These characteristics are set out in the United Kingdom Government Equalities Act 2010 (103). The standards extend this to include “actions taken in the design of the DHT to mitigate against algorithmic bias that could lead to unequal impacts between different groups of service users or people”.
 - ▷ Collate examples of approaches health and care systems are taking to address equity in the development and introduction of DHT in order to facilitate health system and policy learning in digital equity.

Table 2. Directives and standards focused on digital technology in health and care systems

Country or region	Organization (year)	Publication	Equality consideration
Global	WHO (2012)	National eHealth Strategy Toolkit (90)	Equity and accessibility of care included as a strategic goal and challenges to address
	WHO (2016)	Monitoring and Evaluating Digital Health Interventions: A Practical Guide to Conducting Research and Assessment (91)	Equity as a dimension of quality, one of the four health-system level indicators in the digital health metric
	WHO (2019)	Recommendations on Digital Interventions for Health System Strengthening: WHO Guideline (92)	Client to provider telemedicine – awareness of inequalities, targeted client communication (Recommendation 6), highlighted that measures should be taken to address inequities in access to mobile devices so that further inequity is not perpetuated in accessing health information and services, including mechanisms to ensure individuals who do not have access to mobile devices can still receive appropriate services
United Kingdom	National Institute for Clinical Excellence (2022)	Evidence Standards Framework for Digital Health Technologies (last updated August 2022) (93)	Equity considered in standard 4: consider health and care inequalities and bias mitigation (evidence to address, mitigate health inequalities); standard 10: describes the intended purpose and target population (evidence on consideration of access (connectivity/hardware), digital literacy)
EU	European Parliament and Council (2016)	Directive 2016/2102 on the accessibility of the websites and mobile applications of public sector bodies (94)	An EU directive on accessibility of public sector websites (all disciplines not limited to health); includes a requirement to ensure that access for people with disabilities is on an equal basis
United States	Agency for Healthcare Research and Quality (2021)	Creating a digital healthcare equity framework with an accompanying guide for its use (95)	Underway, expected completion September 2023

Country or region	Organization (year)	Publication	Equality consideration
Digital inclusion			
England (United Kingdom)	NHS Digital (2022)	Digital inclusion for health and social care (96)	Guidelines for local health and care organizations to help them to take practical steps to increase access to digital services for all in their communities; includes design principles for digital inclusion
	NHS Digital (2022)	Digital Service Manual (97)	Guidelines to support the National Health Service to design and build its digital services, considering standards, design, style guide, accessibility, including a focus on inclusivity
	Digital Inclusion Toolkit (2022)	Digital inclusion advice for councils, by councils (98)	A collaborative resource for local councils and other organizations tackling digital exclusion
	Department of Health and Social Care (2022)	A Plan for Digital Health and Social Care (99)	Government White Paper setting out approach to digital health care
Wales (United Kingdom)	Welsh Government	Digital Communities Wales (100)	Digital inclusion community programme providing resources, tools and support for organizations working with digitally excluded people, including a focus on digital to support health and well-being; part of the Welsh Government's strategy for digital inclusion
Sweden	Swedish Post and Telecom Authority (2022)	Digital Coach (101)	Digital Coach is a new initiative to support citizens to use digital services, including digital health services
Sweden	Swedish Post and Telecom Authority (2022)	Supporting health professionals (102)	A guide for health professionals to support others



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Annex 1. Search strategy

This scoping review uses the methodology outlined by Arksey and O'Malley (18) with the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews) checklist guiding the reporting (19).¹

The Applied Social Sciences Index and Abstracts (ASSIA), Medline, Psychological Information Database (PschINFO; American Psychological Association) and Scopus were searched for reviews and meta-analyses published between 2016 and May 2022. Table A1.1 shows a sample search strategy. Supplementary searches were carried out for grey literature in the Health Management Information Consortium and the Turning Research into Practice databases and relevant websites, reviewing electronic contents of key journals and citation tracking included literature in Google Scholar. Once data had been extracted and thematically mapped, a further search was made for primary research conducted in the WHO European Region countries from 2018 to May 2022 to help to fill gaps in areas where no secondary research was identified.

Table A1.1. A sample search strategy for reviews (ProQuest Dialog of Psychological Information Database)

Set	Searched for	Results ^a
S1	(SU.EXACT.EXPLODE("Electronic Health Services"))	14 931
S2	(SU.EXACT("Information and Communication Technology" OR "Computer Mediated Communication"))	16 950
S3	(ti,ab("health IT" OR "health information technology" OR "health information technologies" OR ehealth OR eHealth OR "electronic health" OR mhealth OR m-health OR "mobile health"))	8 400
S4	(ti,ab("digital health" OR telehealth OR telecare OR telemedicine OR teleHealth OR tele-care OR tele-medicine))	4 740
S5	(ti,ab((medical or clinical or health or healthcare or nurs*) N/3 informatics))	499
S6	(ti,ab(health N/1 (app OR apps OR application*)))	1 532
S7	S6 OR S5 OR S4 OR S3 OR S2 OR S1	39 481
S8	(SU.EXACT ("Text Messaging" OR "Computer Mediated Communication" OR "Mobile Applications") OR SU.EXACT.EXPLODE("Mobile Devices"))	10 158
S9	(ti,ab(cell* N/1 (phone* or telephone* or technolog* or device*)) OR ti,ab(mobile* N/1 (phone* or telephone* or technolog* or device*)))	10 604
S10	(ti,ab(digital N/1 (technolog* or device*)))	4 130
S11	(ti,ab(smartphone* or smart-phone* or ipad* or i-pad*))	7 522
S12	(ti,ab(tablet N/1 (device* or computer*)))	810
S13	(ti,ab(electronic mail* OR email* OR e-mail))	10 893
S14	(ti,ab((text* OR voice OR electronic OR instant) N/1 messag*) OR ti,ab((text* OR voice OR electronic OR instant) N/1 remind*))	3 964

¹Reference numbers refer to the main reference list.

Table A1.1 (contd)

Set	Searched for	Results^a
S15	(ti,ab(texting or texted))	1 092
S16	(ti,ab(sms N/1 (service* or messag*)) OR ti,ab(mobile N/1 (app OR apps OR application*)))	3 537
S17	S16 OR S15 OR S14 OR S13 OR S12 OR S11 OR S10 OR S9 OR S8	37 385
S18	(ti,ab(Health OR healthcare OR "health care"))	666 635
S19	S18 AND S17	8 787
S20	S19 OR S7	45 011
S21	(SU.EXACT("Healthcare Disparities" OR "Health Equity"))	3 700
S22	(MJSUB.EXACT("Rural Health") AND ti,ab(equity or inequit* or equality or inequalit* or disparit*))	66
S23	(ti,ab((health) N/2 (equity or inequit* or equality or inequalit* or disparit*)) OR ti,ab((healthcare) N/2 (equity or inequit* or equality or inequalit* or disparit*)) OR ti,ab("health care" N/2 (equity or inequit* or equality or inequalit* or disparit*)))	15 483
S24	(ti,ab("medically underserved area" OR "physician shortage area" OR "underserved patients"))	135
S25	S24 OR S23 OR S22 OR S21	17 784
S26	(SU.EXACT.EXPLODE("Socioeconomic Factors") OR SU.EXACT("Gender Equality"))	123 141
S27	(SU.EXACT("Social Equity" OR "Equity" OR "Racial Disparities" OR "social deprivation"))	5 177
S28	(SU.EXACT("Immigration" OR "Racial and Ethnic Groups" OR "Refugees" OR "Older Adulthood") AND ti,ab(equity or inequit* or equality or inequalit* or disparit*))	3 525
S29	(ti,ab(social N/1 determinant*))	4 555
S30	(ti,ab(socioeconomic N/1 (determinant* OR factor*)) OR ti,ab(socio-economic N/1 (determinant* OR factor*)))	4 157
S31	(ti,ab(rural N/1 communit*))	6 259
S32	ti,ab((vulnerable OR underserved OR "low income" OR rural OR sensitive OR disadvantaged) N/1 population*)	11 774
S33	S32 OR S31 OR S30 OR S29 OR S28 OR S27 OR S26	151 175
S34	S33 AND S18	51 362
S35	(SU.EXACT("Meta Analysis" OR "systematic review"))	60 762
S36	(ti,ab(review N/2 (systematic or rapid or scoping or mapping)))	47 129
S37	ti,ab(meta-analysis OR metaanalysis OR meta-analyses OR metaanalyses)	42 097
S38	S37 OR S36 OR S35	84 088
S39	S34 OR S25	62 712
S40	(S39 AND S38 AND S20) and (pd(2016-2022))	52

^aDuplicates are removed from the search and from the result count.

Screening

Screening by title and abstract and subsequent full-text review of relevant literature was undertaken by three reviewers (TA, DB and KW) with each review screened by one person and checked by a second at title/abstract and full-text stages using the inclusion/exclusion criteria outlined in Table A1.2. Prior to screening and full-text review, researchers followed a calibration process to ensure agreement. A second reviewer resolved any uncertainty throughout the initial screening and full-text review process.

Table A1.2. Summary of review inclusion and exclusion criteria

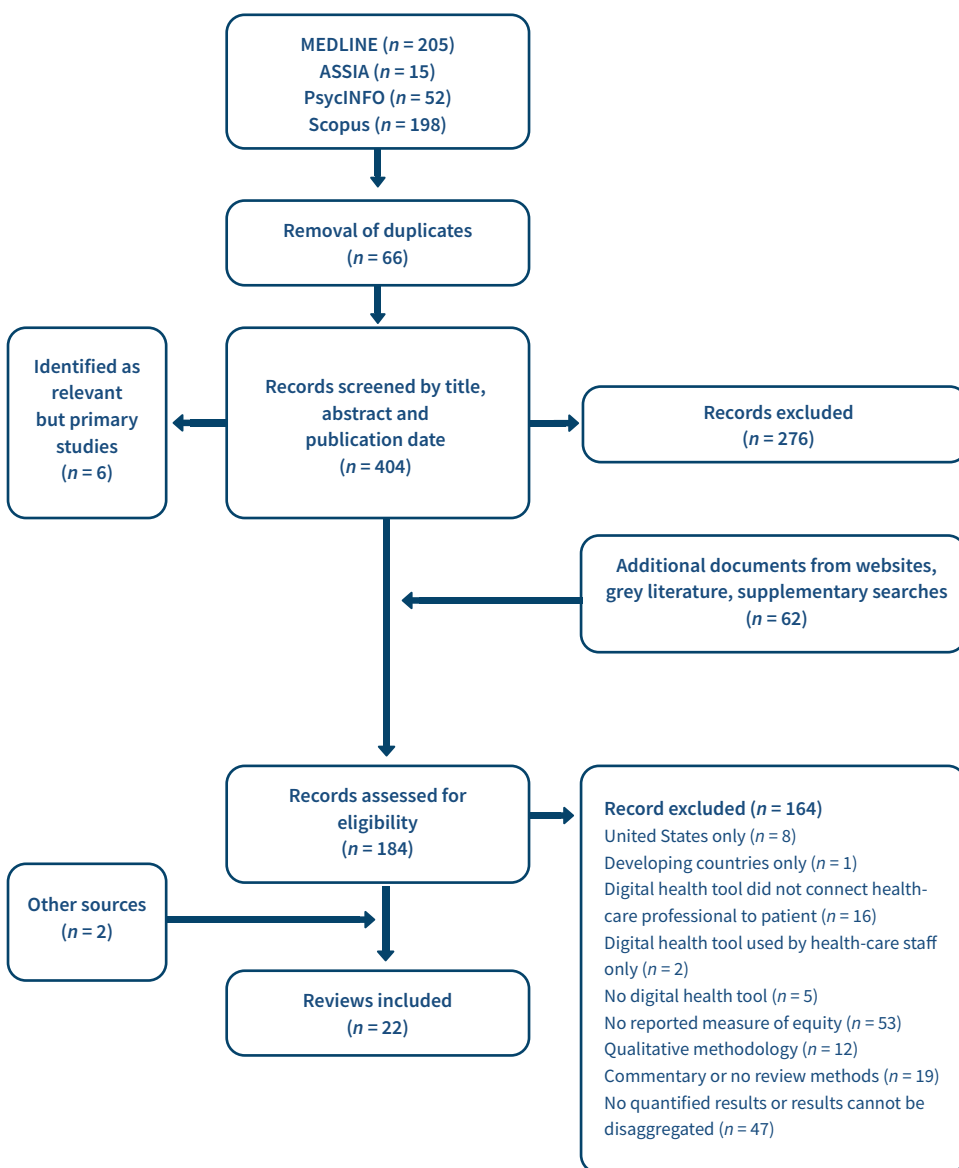
	Included	Excluded
Population	▶ Any	–
Concept	<ul style="list-style-type: none"> ▶ Digital health specific ▶ Technology connects an individual to health professionals ▶ Addresses equity through access to, use of or engagement with DHT within groups of interest 	<ul style="list-style-type: none"> ▶ Technology that connects peers to peers or health professionals to health professionals (e.g. a laboratory providing blood test result to a doctor) ▶ If the topic is general wellness rather than health (e.g. wellness apps)
Context	▶ Specific to Member States of the WHO European Region or global in interpretation	▶ Specific to a country that is not part of the WHO European Region (e.g. reviews specific to the United States)
Type of evidence	▶ Quantitative or mixed methods; systematic, scoping, rapid or mapping reviews; meta-analyses reporting clear quantitative results	<ul style="list-style-type: none"> ▶ Qualitative reviews ▶ Mixed-method reviews where quantitative outcomes could not be disaggregated
Dates	▶ Reviews published from 2016 onwards	▶ Published before 2016
Language	▶ All languages	–

Data extraction and analysis

Data were extracted by one reviewer and checked by a second. The following information was captured: (i) author and publication date; (ii) participant characteristics; (iii) interventions and exposures; (iv) included study features; (v) equity outcomes; and (vi) solutions, limitations and evidence gaps.

Fig. A1.1 outlines the PRISMA flow diagram for the identification of the final set of documents.

Fig. A1.1. PRISMA flow diagram



Note: Assia: Applied Social Sciences Index and Abstracts; PsycINFO: Psychological Information Database.

Summary of results linked to the PROGRESS PLUS elements

The results were thematically mapped against the PROGRESS PLUS framework to capture data on equity of access, use and engagement with DHT. Care was taken to capture any intersectional information reported. Religion was included in the race/ethnicity/culture/language element of the PROGRESS PLUS framework. A potential direction of effect was considered to exist where $\geq 75\%$ of the reviews discussing an equity domain noted evidence of inequity pointing in the same direction. Table A1.3 summarizes the results linked to the PROGRESS PLUS elements in relation to access, use and engagement.

Table A1.3. Number of reviews reporting significant differences in inequity based on PROGRESS PLUS element versus the total number of reviews that investigated this inequity indicator in relation to access to, use of and engagement with DHT

PROGRESS PLUS element	Evidence related to inequity	Linkage to ^a		
		Access	Use	Engagement
Place of residence	Evidence of inequity	3/3 ^b	5/5	-
Race/ethnicity/culture and religion ^c	Evidence of inequity	2/2	6/8	3/6
	Evidence of no inequity	-	1/8	1/6
	Conflicting evidence	-	1/8	2/6
Occupation	Evidence of inequity	-	1/2	-
	Evidence of no inequity	-	1/2	-
	Conflicting evidence	-	-	1/1
Gender/sex	Evidence of inequity	-	5/8 ^d	1/2
	Evidence of no inequity	-	1/8	-
	Conflicting evidence	-	2/8	1/2
Education	Evidence of inequity	-	4/5	3/3 ^e
	Evidence of no inequity	-	-	-
	Conflicting evidence	-	1/5	-
Socioeconomic status	Evidence of inequity	1/1	4/5	-
	Evidence of no inequity	-	-	1/2
	Conflicting evidence	-	1/5	1/2
Social capital ^d	Evidence of inequity	-	1/1	-
	Evidence of no inequity	-	-	-
	Conflicting evidence	2/2	-	-
Plus: age	Evidence of inequity	-	8/12	4/5 ^e
	Evidence of no inequity	-	2/12	-
	Conflicting evidence	-	-	1/5
Plus: disability or complex needs	Evidence of inequity	3/3	1/3	-
	Evidence of no inequity	-	-	-
	Conflicting evidence	-	2/3	-
Plus: marginalized groups such as homeless or substance misuse	Evidence of inequity	-	1/1 ^b	1/1 ^b

^aNo evidence found indicated by -; a potential direction of effect was considered to exist when ≥75% of the reviews discussing the domain noted consistent evidence of inequity.

^bSome evidence indicated that provision of digital health care increased an individual's ability to access health care.

^cFor the purpose of this review religion was included in the race/ethnicity/culture domain.

^dEvidence from two primary studies.

^ePotential direction of effect could not be determined, as the evidence indicated conflicting directions of effect.



Annex 2. Characteristics of included reviews

Please note that in the following table the reference numbers refer to the main Reference list.

Table A2.1. Characteristics of the included reviews

Review	Inclusion criteria for review				Features of included studies		
	Population	Digital tool	Setting/ context	Date limit	No. of studies	Countries	Study design
Reviews of primary studies							
Antonio et al., 2019 (22)	General population	Tethered patient portals	Not stated	No date–2018	65	United States (<i>n</i> = 51) WHO/Europe (<i>n</i> = 6) Netherlands (<i>n</i> = 4) United Kingdom (<i>n</i> = 2) New Zealand (<i>n</i> = 1) Australia (<i>n</i> = 2) Other developed (<i>n</i> = 3) Not applicable (<i>n</i> = 5)	Quantitative (<i>n</i> = 24) Qualitative (<i>n</i> = 17) Mixed methods (<i>n</i> = 15) Grey literature (<i>n</i> = 9)
Bedi et al., 2021 (36)	Children undergoing cleft palate treatment	Telehealth	Not stated	1995–2020	8	United States (<i>n</i> = 2) Mexico and United States (<i>n</i> = 2) WHO/Europe (<i>n</i> = 1) Scotland (United Kingdom) (<i>n</i> = 1) LMIC (<i>n</i> = 5) India (<i>n</i> = 3) Ecuador (<i>n</i> = 1) Brazil (<i>n</i> = 1)	Quantitative (<i>n</i> = 8) Case-series (<i>n</i> = 3) Case-control (<i>n</i> = 3) Case report (<i>n</i> = 1) Cohort study (<i>n</i> = 1)

Table A2.1 (contd)

Review	Inclusion criteria for review				Features of included studies		
	Population	Digital tool	Setting/ context	Date limit	No. of studies	Countries	Study design
Reviews of primary studies							
Behesti et al., 2022 (29)	Not stated	Telehealth	Primary care	2000–2018	43	United States (<i>n</i> = 15) WHO/Europe (<i>n</i> = 24) United Kingdom (<i>n</i> = 12) Netherlands (<i>n</i> = 3) Poland (<i>n</i> = 2) Belgium (<i>n</i> = 1) Greece (<i>n</i> = 1) Germany (<i>n</i> = 1) Ireland (<i>n</i> = 1) Italy (<i>n</i> = 1) Spain (<i>n</i> = 1) Sweden (<i>n</i> = 1) Other developed (<i>n</i> = 1) China (<i>n</i> = 1) LMIC (<i>n</i> = 3) Bahrain (<i>n</i> = 1) Brazil (<i>n</i> = 1) Zambia (<i>n</i> = 1)	Quantitative (<i>n</i> = 40) RCT (<i>n</i> = 14) Observational (<i>n</i> = 17) Cross-sectional (<i>n</i> = 3) Longitudinal survey (<i>n</i> = 1) Descriptive (<i>n</i> = 2) Retrospective (<i>n</i> = 1) Prospective (<i>n</i> = 1) Controlled trial (<i>n</i> = 1) Qualitative (<i>n</i> = 1) Mixed methods (<i>n</i> = 1) Not mentioned (<i>n</i> = 1)
Carini et al., 2021 (24)	Not stated	Not stated	Digital patient portals	2013–2019	47	United States (<i>n</i> = 33) WHO/Europe (<i>n</i> = 10) Netherlands (<i>n</i> = 3) Finland (<i>n</i> = 2) United Kingdom (<i>n</i> = 2) France (<i>n</i> = 1) Israel (<i>n</i> = 1) Sweden (<i>n</i> = 1) Canada (<i>n</i> = 3) Australia (<i>n</i> = 1) Other developed (<i>n</i> = 4)	Quantitative (<i>n</i> = 39) ^a Descriptive (<i>n</i> = 17) Observational (<i>n</i> = 14) Interventional (<i>n</i> = 5) RCT (<i>n</i> = 3) Qualitative (<i>n</i> = 7) Mixed methods (<i>n</i> = 2)

Table A2.1 (contd)

Review	Inclusion criteria for review				Features of included studies		
	Population	Digital tool	Setting/ context	Date limit	No. of studies	Countries	Study design
Reviews of primary studies							
Chambers et al., 2019 (32)	General population	Online digital service for addressing symptoms, providing health advice and directing to appropriate services; excluded treatment services (e.g. cognitive behavioural therapy)	Health seeking for an urgent health problem	No date–2018	27 (29 papers)	United States (<i>n</i> = 9) WHO/Europe (<i>n</i> = 12) United Kingdom (<i>n</i> = 9) Netherlands (<i>n</i> = 2) Norway (<i>n</i> = 1) Not applicable (<i>n</i> = 1) Not reported (<i>n</i> = 5)	Quantitative (<i>n</i> = 21) Uncontrolled observational (<i>n</i> = 12) Simulation (<i>n</i> = 4) RCT (<i>n</i> = 2) Experimental audit (<i>n</i> = 1) Physician vs symptom checker (<i>n</i> = 1) Other (<i>n</i> = 1) Qualitative (<i>n</i> = 1) Not reported (<i>n</i> = 5)
Cho et al., 2021 (25)	Patients ≥18 years who are diagnosed with cancer; includes family members	Electronic symptom self-reporting system/ tool	Reporting outside of the clinic/hospital setting	2010–2020	33		Quantitative (<i>n</i> = 25) Quasi-experimental (<i>n</i> = 17) Experimental (<i>n</i> = 7) Case-control (<i>n</i> = 1) Qualitative (<i>n</i> = 1) Mixed methods (<i>n</i> = 7)
Haridy et al., 2021 (39)	Patients with chronic viral hepatitis	Telemedicine, electronic medical records, mobile applications (m-health), web-based or email intervention, social media or novel devices	Settings in which screening, diagnosis or treatment is provided	No date–2020	80	Reported as: North America (<i>n</i> = 56) Europe (<i>n</i> = 10) Australasia (<i>n</i> = 7) Asia (<i>n</i> = 7)	Quantitative studies Observational (<i>n</i> = 10) Quasi-experimental pre-post (<i>n</i> = 21) RCT (<i>n</i> = 3) Cluster randomized (<i>n</i> = 2) Retrospective cohort (<i>n</i> = 11) Prospective cohort (<i>n</i> = 2) Group randomized (<i>n</i> = 2)

Table A2.1 (contd)

Review	Inclusion criteria for review				Features of included studies		
	Population	Digital tool	Setting/ context	Date limit	No. of studies	Countries	Study design
Reviews of primary studies							
Heaslip et al., 2021 (23)	Homeless population within underlying health conditions	Mobile phone technology	Homeless accessing any health or warfare services	2015–2017	17	United States (<i>n</i> = 13) WHO/Europe (<i>n</i> = 2) Italy (<i>n</i> = 1) United Kingdom (<i>n</i> = 1) Canada (<i>n</i> = 1) Other developed (<i>n</i> = 1)	Quantitative (<i>n</i> = 5) Qualitative (<i>n</i> = 10) Mixed methods (<i>n</i> = 2)
Hirvonen et al., 2020 (26)	Older adults (50–70 years; majority of study participants had to fall into this age range)	eHealth (e.g. online personal health records, tele-health services and m-health)	Not stated	2010–not stated	32	United States (<i>n</i> = 15) WHO/Europe (<i>n</i> = 10) Netherlands (<i>n</i> = 3) United Kingdom (<i>n</i> = 3) Spain (<i>n</i> = 2) France (<i>n</i> = 1) Germany (<i>n</i> = 1) Australia (<i>n</i> = 2) New Zealand (<i>n</i> = 1) Canada (<i>n</i> = 1) Other developed (<i>n</i> = 6) Taiwan (China) (<i>n</i> = 2) LMIC (<i>n</i> = 1) Malaysia (<i>n</i> = 1)	Quantitative (<i>n</i> = 10) Questionnaire (<i>n</i> = 8) Non-randomized (<i>n</i> = 1) RCT (<i>n</i> = 1) Qualitative (<i>n</i> = 14) Mixed methods (<i>n</i> = 8)
Kapadia et al., 2022 (38)	Includes at least one ethnic minority group who are health service users	Digital health application and online digital information	Online national health services for primary, secondary and tertiary care	2011–2021	12	WHO/Europe (<i>n</i> = 12) United Kingdom (<i>n</i> = 4); England (<i>n</i> = 2); Scotland (<i>n</i> = 10); specific localities in England (Enfield, Hampshire, Leicester and south London) (<i>n</i> = 5)	Quantitative (<i>n</i> = 10) Cross-sectional (<i>n</i> = 9) RCT (<i>n</i> = 1) Qualitative (<i>n</i> = 1) Mixed methods (<i>n</i> = 1)

Table A2.1 (contd)

Review	Inclusion criteria for review				Features of included studies		
	Population	Digital tool	Setting/ context	Date limit	No. of studies	Countries	Study design
Reviews of primary studies							
Kruse and Heinemann, 2022 (22)	Patients	Telemedicine in all aspects of care	Put in place during COVID-19	2020–2021	46	United States (<i>n</i> = 16) WHO/Europe (<i>n</i> = 12) Belgium and Iceland (<i>n</i> = 2) Spain (<i>n</i> = 2) Sweden (<i>n</i> = 1) Czechia (<i>n</i> = 1) Netherlands and Spain (<i>n</i> = 1) Finland (<i>n</i> = 1) Netherlands, Spain and Taiwan (China) (<i>n</i> = 1) United Kingdom (<i>n</i> = 1) France (<i>n</i> = 1) Netherlands (<i>n</i> = 1) Australia (<i>n</i> = 5) Canada (<i>n</i> = 2) Other developed (<i>n</i> = 12) Korea (Republic of) (<i>n</i> = 1) China (<i>n</i> = 2) Japan (<i>n</i> = 1) Taiwan (China) (<i>n</i> = 1) LMIC (<i>n</i> = 6) Brazil (<i>n</i> = 2) Israel (<i>n</i> = 1) India, Uganda and Zimbabwe (<i>n</i> = 1) Iran (Islamic Republic of) (<i>n</i> = 1) Peru (<i>n</i> = 1)	Quantitative RCT (<i>n</i> = 18) Cross-sectional (<i>n</i> = 5) Prospective (<i>n</i> = 3) Clinical trial (<i>n</i> = 2) Post-trial (<i>n</i> = 2) Open label intervention (<i>n</i> = 1) Cohort (<i>n</i> = 1) Non-experimental (<i>n</i> = 1) Qualitative (<i>n</i> = 9) Mixed methods (<i>n</i> = 3)

Table A2.1 (contd)

Review	Inclusion criteria for review				Features of included studies		
	Population	Digital tool	Setting/ context	Date limit	No. of studies	Countries	Study design
Reviews of primary studies							
Litchfield et al., 2021 (9)	Any individuals using digital technology in relation to their health and well-being	Health care in the developed world in the early stages of the COVID-19 pandemic	Not stated	2020–2021	9	United States (<i>n</i> = 6) WHO/Europe (<i>n</i> = 3) United Kingdom (<i>n</i> = 1) Italy (<i>n</i> = 2)	Quantitative (<i>n</i> = 8) Cohort (<i>n</i> = 6) Cross-sectional (<i>n</i> = 2) Mixed methods (<i>n</i> = 1)
Meirte et al., 2020 (31)		ePROM questionnaires in a digital form (i.e. mobile phone app, tablet, computer)	Clinical setting	No date–2017	32	United States (<i>n</i> = 11) WHO/Europe (<i>n</i> = 17) Netherlands (<i>n</i> = 5) United Kingdom (<i>n</i> = 3) Italy (<i>n</i> = 2) Austria (<i>n</i> = 1) Denmark (<i>n</i> = 1) France (<i>n</i> = 1) Germany (<i>n</i> = 1) Norway (<i>n</i> = 1) Spain (<i>n</i> = 1) Switzerland (<i>n</i> = 1) Canada (<i>n</i> = 2) Other developed (<i>n</i> = 3) China (<i>n</i> = 1) Unknown (<i>n</i> = 1)	Quantitative (<i>n</i> = 32) Observational studies (<i>n</i> = 14) Experimental studies (<i>n</i> = 18)
Pang et al., 2022 (28)	Older adults with cancer (> 65 years; average sample in article had to be over 65 years)	Any technology use to aid the delivery of health care	Health-care setting	No date–2020	19	United States (<i>n</i> = 7) WHO/Europe (<i>n</i> = 11) United Kingdom (<i>n</i> = 7) Germany (<i>n</i> = 2) Denmark (<i>n</i> = 1) Netherlands (<i>n</i> = 1) Canada (<i>n</i> = 1) Other developed (<i>n</i> = 1)	Quantitative (<i>n</i> = 15) Cross-sectional (<i>n</i> = 10) Non-randomized (<i>n</i> = 2) Pre- and post-test (<i>n</i> = 1) RCT (<i>n</i> = 2) Qualitative (<i>n</i> = 4)

Table A2.1 (contd)

Review	Inclusion criteria for review				Features of included studies		
	Population	Digital tool	Setting/ context	Date limit	No. of studies	Countries	Study design
Reviews of primary studies							
Parker et al., 2021 (35)	Different socioeconomic or disadvantaged groups	Remote general practitioner consultations	Primary care, general practitioner consultation	No date–2020	13	United States (<i>n</i> = 4) WHO/Europe (<i>n</i> = 8) Denmark (<i>n</i> = 2) United Kingdom (<i>n</i> = 2) Italy (<i>n</i> = 1) Netherlands (<i>n</i> = 1) Spain (<i>n</i> = 1) Sweden (<i>n</i> = 1) Canada (<i>n</i> = 1) Other developed (<i>n</i> = 1)	Quantitative Retrospective longitudinal studies (<i>n</i> = 8) Cross-sectional surveys (<i>n</i> = 3) Interrupted time series (<i>n</i> = 1) Mixed methods (<i>n</i> = 1)
Reiners et al., 2019 (34)	Presence of a chronic disease	e-health technology for chronic disease	Not stated	2008–2018	22	United States (<i>n</i> = 7) WHO/Europe (<i>n</i> = 8) England (United Kingdom) (<i>n</i> = 2) Germany (<i>n</i> = 2) Netherlands (<i>n</i> = 1) Poland (<i>n</i> = 1) Spain (<i>n</i> = 1) Sweden (<i>n</i> = 1) Canada (<i>n</i> = 1) Australia (<i>n</i> = 2) Other developed (<i>n</i> = 4) Korea (Republic of) (<i>n</i> = 1) LMIC (<i>n</i> = 3) Bolivia (<i>n</i> = 1) Malaysia (<i>n</i> = 1) India (<i>n</i> = 1)	Quantitative (<i>n</i> = 20) Non-randomized (<i>n</i> = 11) Descriptive (<i>n</i> = 7) RCT (<i>n</i> = 2) Qualitative (<i>n</i> = 1) Mixed method (<i>n</i> = 1)

Table A2.1 (contd)

Review	Inclusion criteria for review				Features of included studies		
	Population	Digital tool	Setting/ context	Date limit	No. of studies	Countries	Study design
Reviews of primary studies							
Truong et al., 2022 (21)	Racial/ethnic minorities of any ages including their care and health-care providers	Health-care settings	Telehealth consultation for clinical assessment, diagnosis and management	2005–2020	28	United States (<i>n</i> = 23) WHO/Europe (<i>n</i> = 3) Denmark (<i>n</i> = 1) Denmark and Sweden (<i>n</i> = 1) United Kingdom (<i>n</i> = 1) Australia (<i>n</i> = 1) Other developed (<i>n</i> = 1) LMIC (<i>n</i> = 1) Cambodia, Korea (Republic of), Uzbekistan and Vietnam (<i>n</i> = 1)	Quantitative (<i>n</i> = 19) RCT (<i>n</i> = 11) Cohort (<i>n</i> = 1) Quasi-experimental (<i>n</i> = 2) Cross-sectional (<i>n</i> = 4) Case series (<i>n</i> = 1) Qualitative (<i>n</i> = 3) Mixed methods (<i>n</i> = 6)
Verma et al., 2021 (37)	Older adults (≥ 65 years) living with cancer or a cancer survivor and their care givers	Digital health (e.g. technologies with Internet such as smartphones, wearables)	Not stated	2000–2021	11	United States (<i>n</i> = 2) WHO/Europe (<i>n</i> = 3) Denmark (<i>n</i> = 2) Germany (<i>n</i> = 1) Canada (<i>n</i> = 3) Australia (<i>n</i> = 2) Other developed (<i>n</i> = 5) LMIC (<i>n</i> = 1) Iran (Islamic Republic of) (<i>n</i> = 1)	Quantitative (<i>n</i> = 10) Cross-sectional (<i>n</i> = 10) Qualitative (<i>n</i> = 1)

Table A2.1 (contd)

Review	Inclusion criteria for review				Features of included studies		
	Population	Digital tool	Setting/ context	Date limit	No. of studies	Countries	Study design
Reviews of reviews							
Woodcock, 2022 (33)	Not stated	Automatic patient self-scheduling	Booking outpatients' appointments	No limits	30	United States (<i>n</i> = 10) WHO/Europe (<i>n</i> = 5) England (United Kingdom) (<i>n</i> = 4) 7 countries within WHO/Europe (<i>n</i> = 1) Other developed (<i>n</i> = 10) Australia (<i>n</i> = 3) Canada (<i>n</i> = 1) Taiwan (China) (<i>n</i> = 3) China (<i>n</i> = 3) LMIC (<i>n</i> = 4) Iran (Islamic Republic of) (<i>n</i> = 3) Philippines (<i>n</i> = 1) Other (review) (<i>n</i> = 1)	Quantitative (<i>n</i> = 26) Cross-sectional (<i>n</i> = 20) Case study (<i>n</i> = 3) Case-control (<i>n</i> = 2) Descriptive (<i>n</i> = 1) Mixed methods (<i>n</i> = 2) Other (<i>n</i> = 2) Systematic review (<i>n</i> = 1) Commentary (<i>n</i> = 1)
Yao et al., 2022 (27)	General population	Any digital health intervention	Not stated	1990–2020	41	United States (<i>n</i> = 19) WHO/Europe (<i>n</i> = 15) United Kingdom (<i>n</i> = 8) Norway (<i>n</i> = 3) Italy (<i>n</i> = 2) Netherlands (<i>n</i> = 1) Switzerland (<i>n</i> = 1) Canada (<i>n</i> = 2) Australia (<i>n</i> = 1) Other developed (<i>n</i> = 4) Korea (Republic of) (<i>n</i> = 1) LMIC (<i>n</i> = 3) Bangladesh (<i>n</i> = 1) Indonesia (<i>n</i> = 1) Israel (<i>n</i> = 1)	Literature reviews (<i>n</i> = 6) Quantitative (<i>n</i> = 17) Qualitative (<i>n</i> = 15) Mixed methods (<i>n</i> = 3)

Table A2.1 (contd)

Review	Inclusion criteria for review				Features of included studies		
	Population	Digital tool	Setting/ context	Date limit	No. of studies	Countries	Study design
Reviews of reviews							
Antonio et al., 2020 (40)	Patients regardless of demographic and disease characteristic Health providers, consumers, educators, policy-makers, researchers, and the public	Patient portal, patient web portal, tethered personal health record	Clinical setting in any country except LMICs	1990–2019	14 reviews	Not stated	N/A
Barnett et al., 2021 (41)	Diagnosed mental health condition or receiving mental health care; includes staff and family members of people receiving mental health care	Any spoken or written communication (Internet or telephone) between a mental health professional and the patient, family member, service user, carer or other health professional	Not stated	2010–2020	19 reviews	Not stated	N/A

Notes: LMIC: low- and middle-income country; N/A: not applicable; RCT: randomized control trial; WHO/Europe: WHO European Region.

^aThe total number of study designs was 48 despite only including 47 studies because one study counted as both an observational study and a descriptive study.



THE WHO REGIONAL OFFICE FOR EUROPE

The World Health Organization (WHO) is a specialized agency of the United Nations created in 1948 with the primary responsibility for international health matters and public health. The WHO Regional Office for Europe is one of six regional offices throughout the world, each with its own programme geared to the particular health conditions of the countries it serves.

MEMBER STATES

Albania

Andorra

Armenia

Austria

Azerbaijan

Belarus

Belgium

Bosnia and Herzegovina

Bulgaria

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Cyprus

Czechia

Denmark

Estonia

Finland

France

Georgia

Germany

Greece

Hungary

Iceland

Ireland

Israel

Italy

Kazakhstan

Kyrgyzstan

Latvia

Lithuania

Luxembourg

Malta

Monaco

Montenegro

Netherlands

North Macedonia

Norway

Poland

Portugal

Republic of Moldova

Romania

Russian Federation

San Marino

Serbia

Slovakia

Slovenia

Spain

Sweden

Switzerland

Tajikistan

Türkiye

Turkmenistan

Ukraine

United Kingdom

Uzbekistan

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World Health Organization

Regional Office for Europe

UN City, Marmorvej 51,

DK-2100, Copenhagen Ø, Denmark

Tel.: +4545337000; Fax: +4545337001

Email: eurocontact@who.int

Web site: www.who.int/europe

