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Do community-based digital health inclusion programmes contribute to tackling health inequalities in disadvantaged population groups?: a qualitative study of experiences of a city-wide programme in the North of England

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Abstract

Background Advances in digital healthcare and health information provide benefits to the public. However, lack of digital skills together with access, confidence, trust and motivation issues present seemingly insurmountable barriers for many. Such digital health exclusion exacerbates existing health inequalities experienced by older people, people with less income, less education or who don't have English as a first language. This study examines the role of a city-wide digital inclusion programme in the North of England, which works with Voluntary Sector Community Organisations (VCSOs) to provide digital support to disadvantaged communities (Digital Health Hubs). The aim was to explore if and how Digital Health Hubs contribute to tackling health inequalities, with a specific focus on impacts on service-users and how these impacts are produced.

Methods We used qualitative semi-structured interviews to explore the experiences of service-users receiving digital support, and perspectives of staff working for organisations coordinating or providing digital support ($n=30$).

Results Inductive thematic analysis was used to identify four major themes and mapped to 'Consolidated Framework for Implementation Research' constructs. These were: programme components, recipient-centred support, impacts on service-users and system-level barriers to digital health services. Findings suggest moderators of implementation are provision of community spaces, social activities and devices and Wi-fi, and recipient-centred support through community understanding, personalised regular support and trusting relationships. Impacts on service-users include improved social and emotional resilience and basic digital skills. Health system-level barriers to digital health services, such as inconsistency in service provision, were also identified.

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Conclusions Themes highlight the importance of recipient-centred support by Voluntary and Community Sector Organisations (VCSOs) which centres the unique needs of specific communities. Our data provide policymakers with a model for implementation that could be replicated and scaled-up. Our data add to the public health, primary care and digital health research by proposing an initial programme theory for how Digital Health Hubs may reduce health inequalities, and recommendations for evaluation which consider short-, medium- and long-term outcomes, and contextual factors which are likely to be crucial to Digital Health Hubs' effectiveness.

Keywords Digital health, Health inequalities, Public health, Primary care, Health systems, Health policy, Community servicess

Background

Digital services are essential for many activities of daily living including applying for jobs, searching for housing, maintaining social relationships and accessing welfare benefits and healthcare [1]. Despite 96% of the population of the United Kingdom (UK) being online, 8.5 million adults lack basic digital skills [2]. Digital exclusion occurs as a result of not being able to make the most of technology [3] and encompasses a number of contributing factors including access (e.g. devices and data), skills and confidence, motivation and trust [4].

Digital literacy and internet connectivity have been called the "super social determinants of health" because they address all other social determinants of health (SDOH), for example employment and housing, each of which influences an individual's health [5]. Digital exclusion has been highlighted as a global public health priority and the World Health Organisation (WHO) recognises the need to mitigate digital exclusion in its recommendations on digital interventions for health systems strengthening [6].

Groups who face a higher risk of digital health exclusion include people over the age of 75, people living in socioeconomic disadvantage, disabled people and people with life-impacting conditions, and people with less English language skills [7]. These groups already suffer poorer health outcomes, and so if not addressed, digital exclusion poses the risk of worsening pre-existing health inequalities and widening the 'digital divide' (the gap between those who are excluded and those who are able benefit from technology) [3, 4, 8].

Digital inclusion is an approach to overcoming barriers to using technology [9]. In the UK, funding has been provided to Voluntary and Community Sector Organisations (VCSOs) and public sector organisations to develop initiatives that support digitally excluded citizens [10, 11]. Initiatives include 'Digital Health Hubs' delivered by Good Things Foundation as a strand of the NHS 'Widening Digital Participation Programme'. Digital Health Hubs (DHHs) have been described as "dedicated community locations with trusted people on hand to guide socially and digitally excluded people to improve their online skills and access relevant information and tools (both online and in their local area) to improve their health and wellbeing" [12, 13]. The programme sits alongside other initiatives such as social prescribing (helping people to improve their health and wellbeing by connecting them to community services [14]) and within a wider policy drive to improve the alignment between the voluntary sector and public health priorities [13]. The number of DHHs has grown in recent years, but the VCSOs providing support tend to operate at a hyper-local level with small numbers of people and are highly 'complex' due to the nature of digital exclusion, multiple programme components, and the variation in contexts within which they are implemented [15]. Such degrees of complexity make evaluation extremely challenging, and, apart from the Good Things Foundation evaluation [13], there is a lack of robust evidence for how communities at risk of health inequalities experience digital health technologies [16, 17], how DHHs support these communities to reduce inequalities, and where the DHHs might need to be enhanced to optimise their impact (14).

Our approach to the research was informed by theory-based evaluation science [18–20] and the Medical Research Council (MRC) guidance for developing and evaluating complex interventions [15], which recommend going beyond asking whether an intervention works and making explicit the underpinning programme 'theory' for producing positive change [15]. Developing a programme theory allows better understanding of the causal relationships between interventions and their outcomes, and the interaction between interventions and their context [15]. Programme theory facilitates a shared understanding of how an intervention works with diverse stakeholders and provides a framework for evaluation [15, 21]. A review of the use of theory in the evaluation of public health interventions highlights several examples of programme theory being used to inform the development of outcome indicators, the overall evaluation design and data analysis [22].

Given our interest in developing programme theory, the aims of our research were:

1. To explore impacts of DHHs on service users and how DHHs produce their impacts (or why they don't) with a particular focus on people living in socioeconomic deprivation.

2. To determine how DHHs interact with the context in which they are implemented, and potential moderators of implementation success which could help inform planning of future digital inequity policy.
1. To identify areas of focus for future evaluation.

Methods

Study design

We used semi-structured qualitative interviews with service-users and staff of DHHs to explore multiple stakeholder perspectives. The study was conducted by a multidisciplinary team with varied backgrounds and experience including primary care, digital health, public health, social science, health psychology and people with lived experience.

Study setting

The research team partnered with 100% Digital Leeds [23] to conduct the research. 100% Digital Leeds is led by the digital inclusion team in the Integrated Digital Service at Leeds City Council and Leeds Health and Care Partnership NHS West Yorkshire Integrated Care Board [23]. The 100% Digital Leeds team strengthen partnerships between local healthcare providers, public and third sector organisations to coordinate a city-wide digital health inclusion programme [23] (known as 'Digital Health Hubs', DHHs).

Study participants and recruitment

There are 26 DHHs in Leeds. With the help of 100% Digital Leeds staff, we recruited ten DHHs in south and east Leeds, two of the highest scoring areas in Leeds for deprivation [24, 25]. LA and EC contacted DHH staff by email and telephone with study information and worked with them to purposively sample staff and service-users to take part in interviews. We aimed to recruit a diverse sample from groups at high risk of digital exclusion, and iteratively reflected on the demographics of our sample. To increase our sample of younger and more ethnically diverse participants we included two community organisations specifically supporting Black and Asian communities in south and east Leeds. Service users were eligible to be interviewed if they were adults (over the age of 18) who self-identified as having experienced digital health exclusion (lack of skills, confidence, trust or motivation to use the internet to access healthcare and health information) and were receiving support from a DHH. They also needed to have adequate capacity to read and understand the participant information sheet and consent form (translated into the first language of the participant, if necessary, by the staff and volunteers of the DHH). Staff were eligible if they were employed by a VCSO delivering a DHH, or an organisation directly interacting with the DHH. Potential participants were provided with an information sheet and were encouraged to get in touch with the researchers if they wished to take part or if they had any questions. Data were iteratively reviewed as they were collected, and recruitment continued until saturation was reached.

Data collection

After taking written informed consent, in-person semi-structured interviews with service-users were conducted by LA, and online semi-structured interviews with staff were conducted using MS Teams by LA and EC. As professional status can influence data in qualitative research [26], LA conducted all service-user interviews and introduced herself as a researcher from UCL with no involvement in service provision or medical background. LA has experience of working for a VCSO and built rapport with participants prior to the interviews by attending sessions at the DHHs. This encouraged participants to speak freely about their health and their experiences with the DHHs. We chose semi-structured interviews so we could explore personal experiences of staff and service-users relevant to our research questions in more depth. Interviews took place between July 2023 and March 2024. Interview guides (see supplementary files) were developed and piloted with our Patient and Public Involvement (PPI) representatives, IS and MS. Service-user interviews explored health and digital capability, reasons for attending the DHHs, experiences of the DHHs including what they had found helpful and why, and barriers and facilitators of engagement and access (to digital health technology and to inclusion support). We focused on access to digital health technologies in primary care, for example by interacting with GP practices and self-management apps and websites for long-term conditions. All interviews were conducted in English, and all non-White British participants were able to express themselves sufficiently in English and did not take up the offer of being interviewed with a VCSO staff member who spoke their first language. Staff were asked about their professional roles and experience supporting people with digital inclusion, and their views and experiences of how the DHHs do or don't address individual service-user needs. Interviews ranged in length from 20 to 49 min and were audio-recorded and professionally transcribed verbatim. Study participants were provided with a voucher as a thank you for their time.

Data analysis

Data analysis took place concurrently with data collection and inductive thematic analysis was used to analyse the transcripts [27]. Firstly, codes were identified and labelled independently by three researchers- LA, EC (postgraduate Research Assistants) and SP (postdoctoral academic General Practitionere). Secondly,

Table 1 Service recipient demographics ($n=18$)

Category	*n* (%)
Gender	
Male	10 (56)
Female	8 (44)
Average age (range)	69 years (50–89)
Ethnicity	
White British	12 (67)
Pakistani	3 (17)
Bangladeshi	1 (6)
Indian	1 (6)
Caribbean	1 (6)
Education	
No formal qualifications	6 (33)
Level 1 (one to four GCSE passes)	2 (12)
Level 2 (five or more GCSE passes)	5 (28)
Level 3 (two or more A Levels or equivalent)	2 (12)
Level 4 or above (Bachelor's or post-graduate qualifications)	0 (0)
Apprenticeship	2 (12)
Unknown	1 (6)
Employment status	
Employed	2 (12)
Unemployed	1 (6)
Retired	13 (72)
Not working due to disability or ill health	2 (12)
Diagnosed with long-term health condition	
Yes	13 (72)
No	5 (28)

Table 2 Staff characteristics ($n=12$)

Category	*n* (%)
Stakeholder group	
VCSO	6 (50)
Local Authority	3 (25)
NHS	3 (25)

codes were discussed and refined by LA, EC and SP collaboratively. To enhance the reliability and validity of the analysis a sample of transcripts was then sent to DN (postgraduate academic General Practitioner), MS and IS (PPI representatives) for additional coding and suggestions for grouping of themes. SP acted as primary analyst refined themes and sub-themes before sharing with all co-authors, receiving feedback and making further refinements. Participant validation of themes and subthemes was also conducted by LA and EC during a participatory workshop with participants attending one of the DHHs. This approach meant that multiple perspectives were considered and contributed to the validity of our findings.

To provide a structured, comprehensive and theoretically-grounded approach to implementation and evaluation planning [28], themes were mapped to the 'Consolidated Framework for Implementation Research' (CFIR) constructs [29]. CFIR is one of the most commonly used determinant frameworks to assess factors that influence implementation success [30] and provided an evidence-based framework for organising our themes into the domains which can be used to inform implementation planning: (i) core components (essential and indispensable elements of the intervention); (ii) adaptable periphery (adaptable elements, structures, and systems related to the intervention and organization into which it is being implemented); and (iii) inner setting (characteristics of organisations, networks and the climate that directly interact with the intervention) [29, 31–34]. The outer setting (external environments and context which constrain or facilitate organizations to carry out the intervention e.g. external policies and incentives) was not included in order to focus on the interaction between service-users and VCSOs.

Results

Participant demographics

Interviews were conducted with 18 service recipients and 12 staff ($n=30$ in total). The mean age of service recipients was 69 years old. 10/18 of service recipients were male,12/18 were White British, 13/18 had no qualifications above GCSE (General Certificate of Secondary Education in the UK) level, and 16/18 were not in employment. 13/18 were diagnosed with a long-term health condition. Demographic characteristics of service recipients are summarised in Table 1.

Staff represented the NHS (in non-clinical roles), VCSOs and the local authority (see Table 2), and either had roles supporting the VCSOs implementing the DHHs or directly providing digital support to serviceusers. Some service-users were referred to DHHs via an established pathway from GP practices and others attended the DHHs as one of a range of services provided by the VCSOs implementing the DHHs, such as coffee mornings and community lunches.

Summary of findings

Findings are organised according to study aims as follows:

1. To explore impacts of DHHs on service users and how DHHs produce their impacts (or why they don't) with a particular focus on people living in socioeconomic deprivation.

Four major themes, and several sub-themes, were identified as addressing the first study aim by the research team. These were: programme components, recipientcentred support, impacts on service-users and system-level barriers to digital health services. These are summarised in Table 3. Service-user impacts are also

Table 3 Summary of analytic themes and sub-themes

Analytical themes	Sub-themes	CFIR construct (domain)
Programme components (Core Intervention Components)	Community spaces	Intervention Design (Intervention Characteristics), Structural Characteristics (Inner Setting)
	Social activities	Intervention Design (Intervention Characteristics)
	Device & Wifi provision	Intervention Design (Intervention Characteristics), Structural Characteristics (Inner Setting)
Recipient-centred support delivered by VCSOs (Adaptable Periphery)	Community understanding	Intervention Adaptability (Intervention), Culture (Inner Setting)
	Personalised regular support	Intervention Adaptability (Intervention), Culture (Inner Setting)
	Trusting relationships	Intervention Adaptability (Intervention), Culture (Inner Setting)
Impacts on service users	Improved social and emotional outcomes (confidence and agency, social connection and improved mental health)	
	Basic digital skills	
System barriers to digital health services	Inconsistent online service provision by GP Practices	

represented through a proposed programme theory in Fig. 1.

2. To determine how DHHs interact with the context in which they are implemented, and potential moderators of implementation success which could help inform planning of future digital inequity policy.

Programme components and recipient-centred support were identified as potential moderators of implementation success and are mapped to CFIR domains and constructs in Table 3.

3. To identify areas of focus for future evaluation.

Testing of the initial programme theory and outcome measures are identified as areas of focus for future research and are discussed following a more detailed description of analytical themes and sub-themes with participant quotes.

Figure 1 illustrates the impacts on service-users and proposed programme theory for reducing health inequalities.

Analytic themes and sub-themes

Community spaces

Participants described the setting of the Digital Health Hubs needing to be familiar spaces where service-users had attended activities before, where they feel comfortable and where they know other people. VCSOs were described as better able to provide this than NHS or academic organisations.

"They (the VCSO) were doing various things that must have interested me. There was a Tuesday morning coffee morning, everybody piled in and you just chat. So, I went in for that and then the IT thing started and then Covid

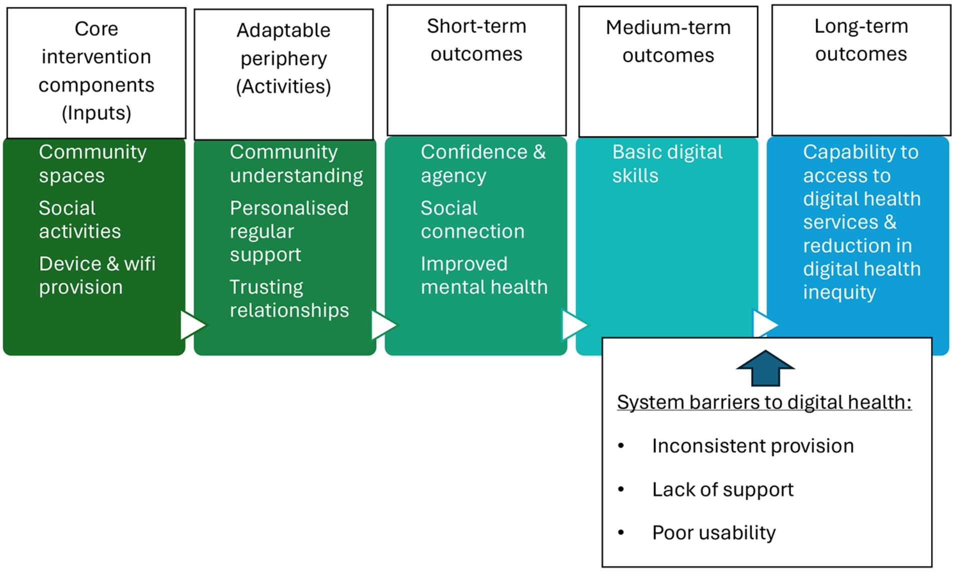

Fig. 1 Proposed programme theory

came and so on. And, I have been involved ever since." P24, 89 yo White British male service-user.

Social activities

Service recipients described being part of groups which engaged in digital support as one of many social activities, including lunch clubs and bingo. This increased engagement with the digital support and built rapport within the group.

"This group does so much more than just The Breakfast Club (Breakfast & Browsing digital support). We have the lunch club and then we have Bingo Bash and we have trips. There's always something going on. There's always like a celebration." P26, 62yo White British female service-user.

Devices and Wifi

Recognizing that access to Wifi and devices was a key barrier to access, staff and volunteers described lending or gifting devices and Wifi access in public spaces. They emphasised that skills training was provided alongside the equipment in digital support sessions so that service-recipients could build their skills and confidence first.

"We've got free public Wi-Fi and some devices for the Digital Health Hub which we've been able to gift. All our members at Breakfast Club have all got a device with 24 months of data. And they do five hours of learning for that." P18, Outreach and Digital Engagement Officer.

Community understanding

Staff supporting VCSOs described how important it is for the delivery of the DHHs to be led by local organisations who understand the needs and experiences of their communities and use this understanding to guide service development.

"I think there needs to be more of a kind of an asset-based approach where we are putting the voice of the community at the heart and ensuring that the community is able to steer the ship and take control of some of this work." P01, Third Sector Health & Care Development Officer.

Personalised regular support

Participants described making digital support more effective by asking service recipients about their personal needs, concerns and fears regarding digital devices and services, reflecting on people's use of devices for different purposes.

"Ask people, don't tell them what they want. Ask them what it is they need this device for because it will be very different to what perhaps a younger person wants it for. They might never surf the internet for anything in their life. They might just want it for two things and that'll be all they ever use it for." P30, Social Prescribing Link Worker.

Persistent and regular support was also highlighted as being an important aspect of the programme by service recipients and staff. This allows service-users to return for support for ongoing issues arising from utilising digital health services and to be able to practise over time. This professional describes how the VCSO-delivered model of offering digital support in community settings where people are attending other activities contrasts with GP practices which might not offer digital support due to assumptions about patients not using online services.

"But certainly we know that some of our GP practices would never even ask them to use digital, they would have already have thought, "Well no, they're not going to." So I think that's a really great one that shows that kind of model of just quiet persistence I suppose, in terms of committing to something and being quite relaxed about it and about the take-up." P02, Staff, Leeds Care Partnership.

Trusting relationships

Participants emphasised the importance of the relationships between VCSOs and service recipients, particularly (and in keeping with the findings on community spaces) the roles of trust and familiarity which are built from VCSOs offering a number of vital services including those tackling social isolation and the cost-of-living crisis.

" He (Digital Inclusion Worker) is always there. You can ask him whatever you want, as many times as you like. But he doesn't talk down to you. He's very respectful. And he's understanding, as well; he can joke with you, you know what I mean? And it makes it easier. You don't go home thinking, oh my god." P20, 77yo White British Female service-user.

Confidence and agency

Participants listed several social and emotional impacts of the programme for service recipients, in addition to digital skills building. This included building confidence and a sense of agency in being able to use digital services. This Digital Inclusion Worker described how one service recipient was able to book his own hospital appointment rather than having to rely on family members for help, and the sense of pride this gave him.

"One of the guys in one of my lessons came in one week and said, "I got a link from the hospital and normally I'd have waited for the kids to come. Because I felt more confident now, I clicked on the link. I did it myself," and he was so proud that he hadn't had to wait for his kids to come round and do it for him. It's so empowering to feel that confidence building, that you can do it yourself." P15, Digital Inclusion Worker.

Service recipients also described an increase in confidence which impacted positively on their health and wellbeing.

"It's benefitting us not with just learning, we're getting our confidence and then of course (when) you get your confidence, your health improves as well." P10, 65yo White British Female service-user.

Social connections

Social connection was also highlighted as a positive impact. Service recipients described the digital support and other activities offered by VCSOs as providing opportunities to avoid isolation, meet other people and form friendships, which was described as particularly important for older people.

"The doctor said I think it would do you good to join some activities, you know? The best thing I ever did was to come; it helped me out. I'm out every day and you see other people, don't you? Have a chat, that's what I missed. Because I can talk to people, you know what I mean?" P12, 79yo White British Female service-user.

Improved mental health

Service recipients also talked about the emotional impacts of attending the digital support groups and how this improved their mood, and reduced stress and anxiety.

"I just enjoy coming, just looking forward to coming. Because it gets me out and keeps my mind occupied. That's why I come as well; it takes me away from thinking things that you do when you've got depression." P14, 67yo White British Female service-user.

Reduced barriers to digital services

Participants described several barriers to using the internet in general (and digital health services in particular, which is discussed below) These included lack of self-efficacy in learning digital skills at an older age, language barriers, frustration or low confidence due to previous difficulties using devices, fear or mistrust due to scammers, lack of familiarity with Artificial Intelligence (AI), and not being able to afford devices or Wifi. However, the core components and adaptable periphery of the programme successfully addressed these barriers through familiarity, access to devices and Wifi, regular personalised support, social engagement and trusted relationships.

"It is frustrating for them. I mean, like yesterday doing the NHS app. But I do think they do genuinely want to learn, and they want to be able to do it even if it is frustrating. Because you know, once you get used to it – I feel like they come now for digital, whereas at the beginning they came for breakfast, if that makes sense." P18, Outreach and Digital Engagement Officer.

Basic digital skills

In terms of digital knowledge and skills specifically, participants described that service recipients gained several basic digital skills, from very basic skills like typing to more complex tasks like using WhatsApp and bus schedule apps.

"I am getting more savvy through what I've been doing here. Without that help I wouldn"t have been able to do lots of things. Like I've got WhatsApp now, and people do text me things. I can do various other things, as well, which I couldn't do before." P19, Male White British service recipient, age unknown.

This Digital Inclusion Officer shared an example of a service recipient who learnt how to use full stops when typing on their device, and how even these basic skills can make a big difference to people.

"One guy (service-user) said to me, "The best thing I've learned this week is how to do a full stop – no, how to do the space bar." He didn't know the space bar. And it's always the smallest thing that makes a massive difference to the people that we teach, that they want to learn." P15, Digital Inclusion Officer.

System-level barriers to digital health services

The findings regarding digital health services suggest that the pathway to digital health inclusion is complex. Amongst service recipients some found digital health services useful, particularly being able to access their medical records and medication via the NHS app.

"I've got an NHS app to access my GP surgery. It's got all my health information on there. I know exactly what I'm taking. I know when I've got to take it. I know roughly what's being said in my consultations because it's all listed and documented on there." P25, 54 year old White British Female service recipient.

Other service recipients listed a number of barriers to using digital health services, including the inconsistency of the online services provided by their GP practices.

"I have got the NHS app. You could order your prescriptions there on it and they also had a big, long ladder with all the doctors and all the dates and you could book your appointments on it. Now, I have just gone back to them thinking, "Oh good, I will go back to this", and they [GP Practice] have stopped doing that bit." P22, 66 year old Pakistani Male service recipient.

Additional barriers described by staff include lack of information and support about how to use online services such as diabetes or weight self-management apps, both from NHS professionals and due to the usability of the apps themselves. Staff described how this perpetuated anxiety about online services, which can be particularly difficult for people with pre-existing mental health problems.

"You have a lot of learners coming in wanting to get help with their digital health needs, such as "How do I get on this weight management thing that my GP's referred me to, but no clear instructions on how to do it?". You find them going back to their GP surgery, hoping to have someone like a receptionist basically sit with them and go through that process. So that creates more angst and resistance for learners to be like, "You know what? I'd actually rather just ring up," or "I'd just rather all of this to not be online." P16, Digital Inclusion Officer.

Discussion

We have proposed an initial programme theory which brings together potential service-user impacts of Digital Health Hubs (DHHs) (improved social and emotional outcomes and improved basic digital skills) and potential moderating factors (community spaces, social activities and devices and Wi-Fi, and community understanding, personalised regular support, and trusting relationships) (see Fig. 1). This is consistent with previous research suggesting that reducing physical barriers to digital health technologies and providing educational support via trusting relationships is necessary [35–37], particularly for people with less education, people living in socioeconomic deprivation, and for older people. These groups may be reluctant to accept support due to due to fears about burdening others and feeling helpless [38, 39].

Our findings are consistent with previous research suggesting that the social capital resulting from connecting with others when trying to access digital technology can be a "positive adaptive mechanism" facilitating healthy behaviours [36, 37, 40]. Previous research also supports our findings that personalising training to the participant's lifestyle and perceived needs, developing an amicable relationship with volunteers, and pacing teaching and repeating sessions help improve participants digital skills [41]. Unlike our study, the research also found that a tiered curriculum and giving participants notes or recordings with instructions as an aide-memoire from volunteers also helped [41].

Our finding that the pathway from digital access and capability to digital health inclusion is complex is supported by existing literature which suggests that regardless of digital access, use of digital health services may be limited by contextual factors, and lack of accessibility of interventions and health professional facilitation [16, 42].

We have drawn on the behaviour change and digital inequality literature to suggest a possible evaluation framework with indicators and measurement approaches for the outcomes we identified. Our programme theory therefore adds to the research in the fields of public health, digital health and primary care by not only providing a suggested pathway of action for how DHHs reduce digital health inequity, but also an outcomes framework which could be tested and refined through an iterative process of evaluation (see Table 4).

Table 4 Suggested outcomes and indicators for future evaluation of DHHs

Potential outcome (change)	Suggested indicator (what will be measured)	Suggested measurement approach
Confidence and agency	General Self-Efficacy Scale [43] Health Confidence Score [44] Patient Enablement Instrument [45]	Self-report questionnaires Validated psychometric scale
Social connection	Social Connectedness Scale [46] Social network size [46]	Likert scale Asking participants to make a social network list in qualitative interviews or focus groups [47]
Improved mental health	Patient Health Questionnaire (PHQ-9) Generalised Anxiety Disorder 7-item scale (GAD-7) [48]	Self-report questionnaires
Basic digital skills	Digital Inclusion Scale; Media Literacy Survey [49]	Surveys
Capability to access to digital health services	Digital Health Care Literacy Scale [50] Numbers engaging with NHS digital services, including appointment booking, patients records and self-management apps and website	Validated 3-item assessment scale Routinely collected electronic usage data from the NHS and self-management app and website providers
Reduction in digital health inequity	Demographic data about digital health service usage	Population-level surveys

Recommendations for testing our initial programme theory include using mixed methods to gather diverse evidence (including workshops, document review and observations) to test and refine the theory repeatedly. A quasi-experimental design could be appropriate in order to establish causal links by comparing outcomes between intervention and control groups [19, 22]. A randomised controlled trial (RCT) could also provide strong causal evidence, but due to DHHs being complex interventions, challenges would include standardising intervention protocols across sites, controlling for contextual factors, and isolating causal effects of the intervention (digital inclusion programmes) from their context (including support and encouragement from VCSOs staff) [15].

We identified three themes for system-level barriers to digital health equity, including inconsistent provision of online services by GP Practices, lack of information and support from GP Practices, and poor usability of self-management apps. This is consistent with evidence that the development of digital health technologies has been driven by healthcare provider's needs rather than the needs of service-users from populations most at risk of health inequalities [16].

We have therefore developed novel guidance for healthcare providers on how to work with VCSOs and the public to support people at risk of digital exclusion. These are listed in our recommendations for practice, policy and research below.

Recommendations for practice, policy and research

Based on our findings, the following recommendations may help inform the implementation and evaluation of DHHs and health policy on addressing digital health inequity:

1. A DHH implementation model consisting of familiar community spaces with provision of social activities and access to devices and Wi-fi is replicable and has the potential to be scaled up nationally.
2. Our proposed programme theory suggests service-user impacts are seen in the short-, medium- and long-term, that would be amenable to evaluation through an iterative approach. Mixed methods could be used to capture the range of outcomes (see Table 4). Evaluation should consider contextual factors including staff time and resource encouraging engagement from service-users, and this should be included in a cost-effectiveness analysis.
3. In terms of policy addressing digital health equity, digital health services should be offered alongside non-digital services by health systems, and there should be more consistency in service provision between organisations serving a particular geographical area.
4. More of the 'front-line' digital health services such as patient portals (including the NHS app) should be designed and delivered with equity as a priority. Equity measures for technology developers include involvement of service-users most vulnerable to health inequalities in design, with tailoring of accessibility features to the needs of these individuals, and digital skills support embedded into interventions or facilitated by professionals. Healthcare providers could improve support to people at risk of digital exclusion by assessing digital capability prior to referring people to digital services and developing and supporting peer support networks for people who are digitally excluded. Healthcare providers could work more closely with VCSOs providing digital inclusion programmes by co-producing referral pathways, accessing joint funding for digital transformation, and involving VCSOs in training sessions on digital services being offered to service-users.

Limitations

We purposively sampled participants from ten DHHs and relied on service-users volunteering to take part. We may therefore have missed the views of service-users who did not come forward. However, data saturation was reached through interviewing service-users who did identify as digitally excluded and who engaged with the research. Participants provided insights to their experiences of digital exclusion, including if and how support from DHHs improved their digital skills, and barriers to accessing digital health services, which allowed the thematic analysis to address the study aims. The thematic analysis is unlikely to have been impacted by the absence of service-users who may be so excluded that they do not self-identify as having experienced digital self exclusion. Our participants are predominantly older white British people with less income and education, with less representation from other groups at risk of digital exclusion such as people with less English language skills or with disabilities. Our staff interviews were conducted predominantly with staff from the VCSO sector, with less representation from the NHS, particularly GP Practices which service-users access for primary care. Staff demographic information was not collected or recorded, but we recognise that staff age, educational and socioeconomic background may have affected their interactions with service-users and should have been included. Our study focuses on south and east Leeds and our data represent the experiences specific to this area. However, based on our findings we have also developed an initial programme theory for how DHHs might produce their impacts. We suggest the initial programme theory can be generalized to other regions through a process of iterative evaluation. We have also provided recommendations for such evaluation.

Conclusions

In conclusion, our research suggests Digital Health Hubs do contribute to addressing health inequalities in disadvantaged communities. Crucially, they do this not just by providing digital access and skills but improving social and emotional resilience through person-centred support delivered by trusted VCSOs which centres the unique needs of specific communities. DHHs provide a model for community-based digital inclusion support that could be replicated and scaled up nationally. We have proposed an initial programme theory which provides a framework for a more rigorous large-scale evaluation of the effectiveness and cost-effectiveness of DHHs. We have also developed recommendations for policy and technology developers addressing digital health inequity, and novel guidance for healthcare providers to work more effectively with VCSOs providing digital inclusion programmes.

Abbreviations

DHH	Digital Health Hub
VCSO	Voluntary or Community Sector Organisation
CFIR	Consolidated Framework for Implementation Research
NHS	National Health Service
RCT	Randomised Controlled Trial

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-025-21418-y.

Supplementary Material 1

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Author contributions

SP and KB conceived the initial idea for the research. FS, DN, IS and MS made significant contributions to the design of the research. LA and EC collected the data. SP secured funding for the study, developed the research protocol, and led the data analysis and preparation of the manuscript. All authors contributed to the data analysis and have reviewed the manuscript and approved the original and revised submissions.

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Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request. The data are not publicly available due to their containing information that could compromise the anonymity of research participants.

Declarations

Ethics approval and consent to participate

This study was ethically approved by the UCL Research Ethics Committee (ID no 6761/004). The research was performed in accordance with UCL research ethics guidelines and regulations. Written informed consent was obtained from all individual participants included in the study.

Consent for publication

Participants provided consent for anonymised data to be used for publication.

Competing interests

The authors declare no competing interests.

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