VA Virtual Care Consortium of Research (VC CORE)
State of the Art (SOTA) Conference

Pre-Conference Readings: Engagement Workgroup

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Evidence and Findings Brief

Thank you for participating in the VA Virtual Care (VC) SOTA. Your pre-conference assignment is to review this evidence brief and assigned readings focused on engagement with VC technologies. As you read the brief, we ask that you record your thoughts on the Key Questions below to help facilitate and enrich our in-person discussions. We also encourage you to compose additional discussion questions for the SOTA Conference.

During the SOTA, your workgroup facilitator(s) will lead the group through discussions toward the goal of reaching consensus on what is known (current evidence base) and what needs to be known (knowledge gaps) in key domains, thus allowing us to make and prioritize recommendations for future research related to VC. Following our discussions, workgroup leads will create a PowerPoint summarizing the discussion, agreed upon priorities, and recommendations, which will be presented to all SOTA participants on day two of the conference.
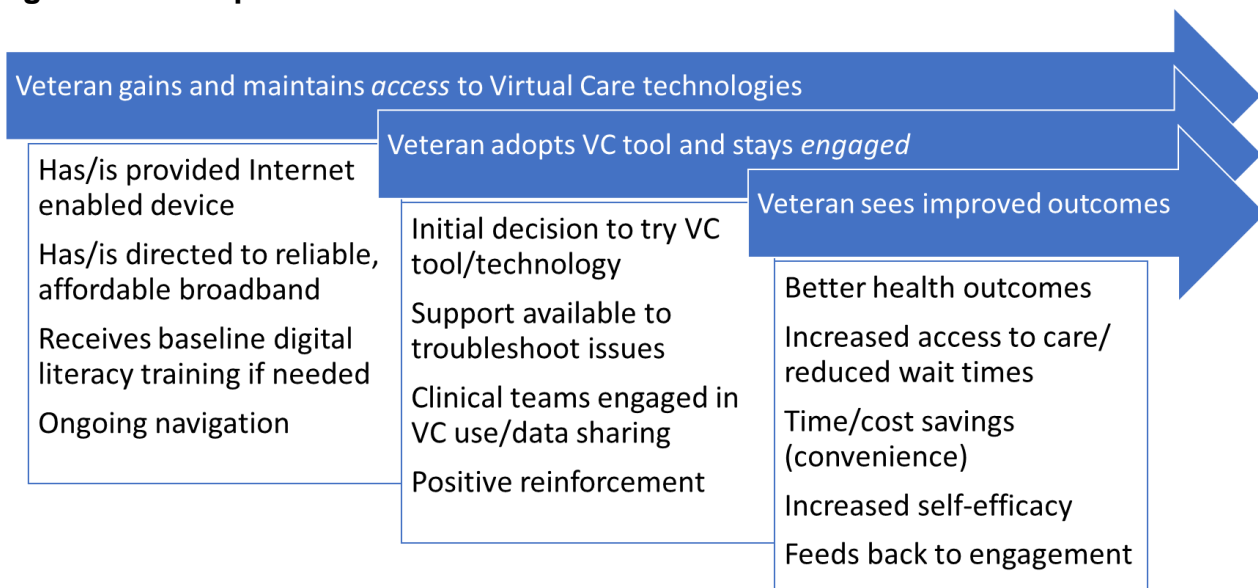
Overview of VA VC SOTA

The VA VC SOTA will focus on three areas, *access*, *engagement*, and *outcomes.* Figure 1 presents a conceptual framework for the SOTA, and illustrates the relationship between these three areas.

The overarching goal of the SOTA is to inform policy and clinical operations and generate a research agenda focused on opportunities to:
1. Address VC access disparities
2. Enhance Veteran engagement with VC
3. Define and improve outcomes influenced by VC

Figure 1. Conceptual Framework for VA VC SOTA

Veteran gains and maintains *access* to Virtual Care technologies

Has/is provided Internet enabled device

Has/is directed to reliable, affordable broadband

Receives baseline digital literacy training if needed

Ongoing navigation

Veteran adopts VC tool and stays *engaged*

Initial decision to try VC tool/technology

Support available to troubleshoot issues

Clinical teams engaged in VC use/data sharing

Positive reinforcement

Veteran sees improved outcomes

Better health outcomes

Increased access to care/ reduced wait times

Time/cost savings (convenience)
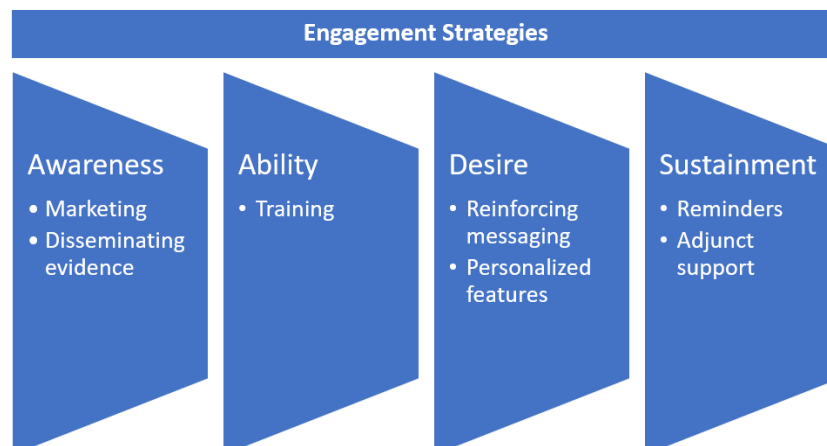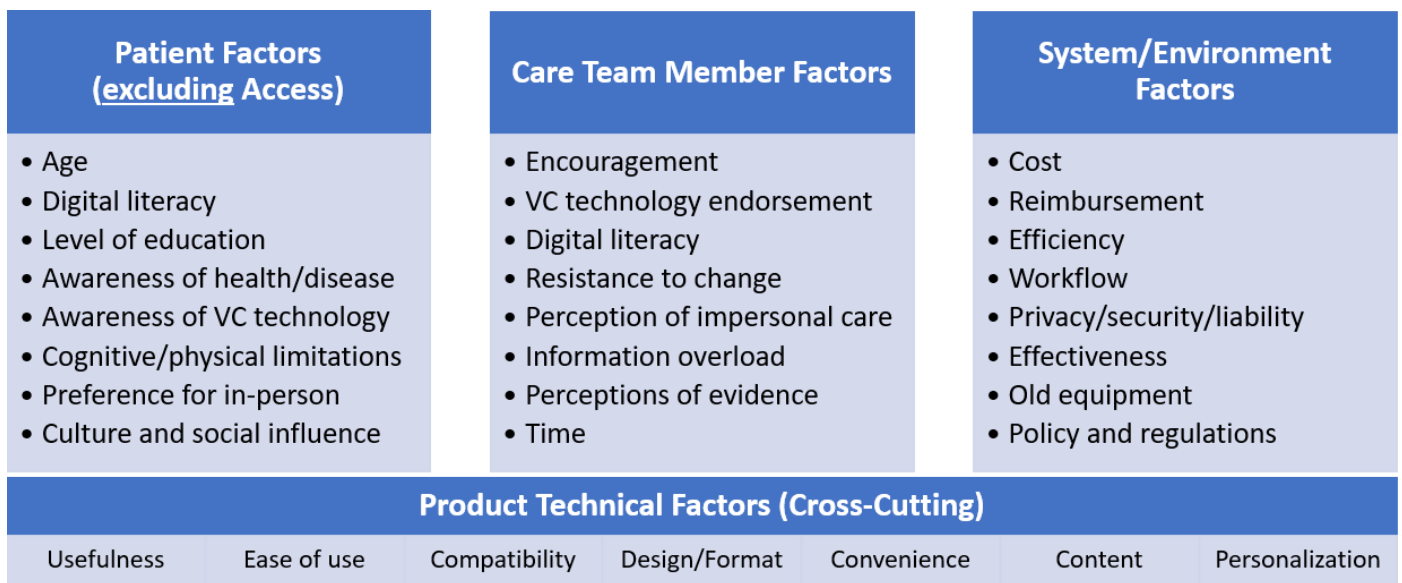
Increased self-efficacy

Feeds back to engagement

Key Questions and Frameworks for the Engagement Workgroup

The VC SOTA *Engagement* Workgroup will focus on the following key questions:

1. Based on the existing evidence about factors that influence engagement with VC among Veterans, what additional research is needed to understand such factors?
   a) **How should VA prioritize research related to these factors to maximize impact?**

2. Based on the existing evidence, what strategies at the Veteran, clinical team, and/or system-levels show the most promise in supporting Veteran engagement with VC?
   a) **How should VA prioritize research related to these strategies to maximize impact (e.g. research that will inform strategy design, testing, and policy)?**

3. What additional research beyond factors and strategies is needed to enhance Veteran engagement with VC?

As shown below, our SOTA engagement discussions will consider factors at the patient, care team, and broader system and environmental levels that can impact Veteran engagement with VC technologies, cross-cutting factors that are associated with VC technologies themselves, and examples of promising strategies that could support Veteran engagement with VC.

Patient Factors (excluding Access)	Care Team Member Factors	System/Environment Factors
• Age	• Encouragement	• Cost
• Digital literacy	• VC technology endorsement	• Reimbursement
• Level of education	• Digital literacy	• Efficiency
• Awareness of health/disease	• Resistance to change	• Workflow
• Awareness of VC technology	• Perception of impersonal care	• Privacy/security/liability
• Cognitive/physical limitations	• Information overload	• Effectiveness
• Preference for in-person	• Perceptions of evidence	• Old equipment
• Culture and social influence	• Time	• Policy and regulations

Product Technical Factors (Cross-Cutting)

Usefulness	Ease of use	Compatibility	Design/Format	Convenience	Content	Personalization

Engagement Strategies

Awareness
• Marketing
• Disseminating evidence

Ability
• Training

Desire
• Reinforcing messaging
• Personalized features

Sustainment
• Reminders
• Adjunct support

To inform our discussions, the Engagement Planning Workgroup conducted a rapid review of the published literature focused on factors that influence Veteran engagement with VC technologies, relevant frameworks, strategies that could promote engagement, and related interventions. Given its related focus, we also reviewed select literature from the field of implementation science regarding the adoption and use of VC technologies. We prioritized studies conducted within the VA health care system, but also examined evidence from outside VA that can inform the care of Veterans. The articles and ideas included in this document are not meant to be exhaustive, but rather, aim to provide a shared foundation for discussion. Below, we summarize some key themes and findings from this literature search.

Background/Context

What do we mean by "engagement" with VC technologies?

Although there is evidence for the effectiveness of using specific VC technologies in specific care contexts (e.g., using specific digital and mobile health (mHealth) apps for mental health conditions), it is often the case that individuals use these technologies less than intended, or have waning use over time. In implementation science terms, we might say that in such cases, the VC technology didn't "stick" or that use was not sustained.

Variations in uptake and sustained use of VC technologies can have direct implications for realizing their intended benefits for the individual, their relationships with clinical team members, and the broader healthcare system. From such a perspective, "engagement" resides somewhere between digital access, our first SOTA working group, and outcomes, our third SOTA working group. Said differently, without digital access, one cannot engage with a VC technology; however, without adequate engagement, one cannot realize desired outcomes from the technology. As noted above, the charge to this group is to think about research related to user engagement with VC technologies.

To ensure we are starting from the same foundation, our group first needs a shared understanding of the term "engagement" for our work together. In the existing literature, user engagement with specific VC technologies has been described in different ways. For example:

- *User engagement refers to a user's uptake and sustained interactions with a digital intervention, which includes interest in adopting an intervention…initial uptake …and continued use of an intervention*[1] (Borghouts et al, 2021)

- *The term 'engagement' refers to a user's involvement and interaction with a [digital] intervention* [2,3] (Arnold et al., 2021; Baltierra et al., 2016)

For our purposes in this workgroup, we will characterize "user engagement" as a Veteran's uptake and sustained used of specific VC technologies. Because another SOTA workgroup is focusing on access, this workgroup will concentrate more on a Veteran's decision to use and continue to use (rather than ability to use) VC technologies.

Further, it is also important that we recognize that what constitutes engagement varies across different VC technologies. While a self-help app may be intended for active use over a minimum six-month period, other apps intended to be used in conjunction with a clinical encounter may only be used in tandem with a treatment. An automated texting protocol may deliver a mix of motivational messages requiring only passive reading and occasional responses to assessment questions, while remote patient monitoring requires daily answers to questions and submission of daily vital signs for chronic disease monitoring. In these ways, engagement is a dynamic term and ties to specific technologies and use cases.

Section 1. Utilization of VC Modalities in VA

The purpose of this section is to broadly describe utilization of VA VC technologies across platforms. While these data show rapid growth in VC use for some technologies, engagement with VC still varies across technologies and subsets of the Veteran population.

1. **Shifts toward Synchronous Telehealth Use within the VA**
   In a national assessment of VC expansion in VA during the COVID-19 pandemic, Ferguson *et al.* showed large shifts in video-based, telephone, and in-person weekly encounters[4] (see Figure 1).
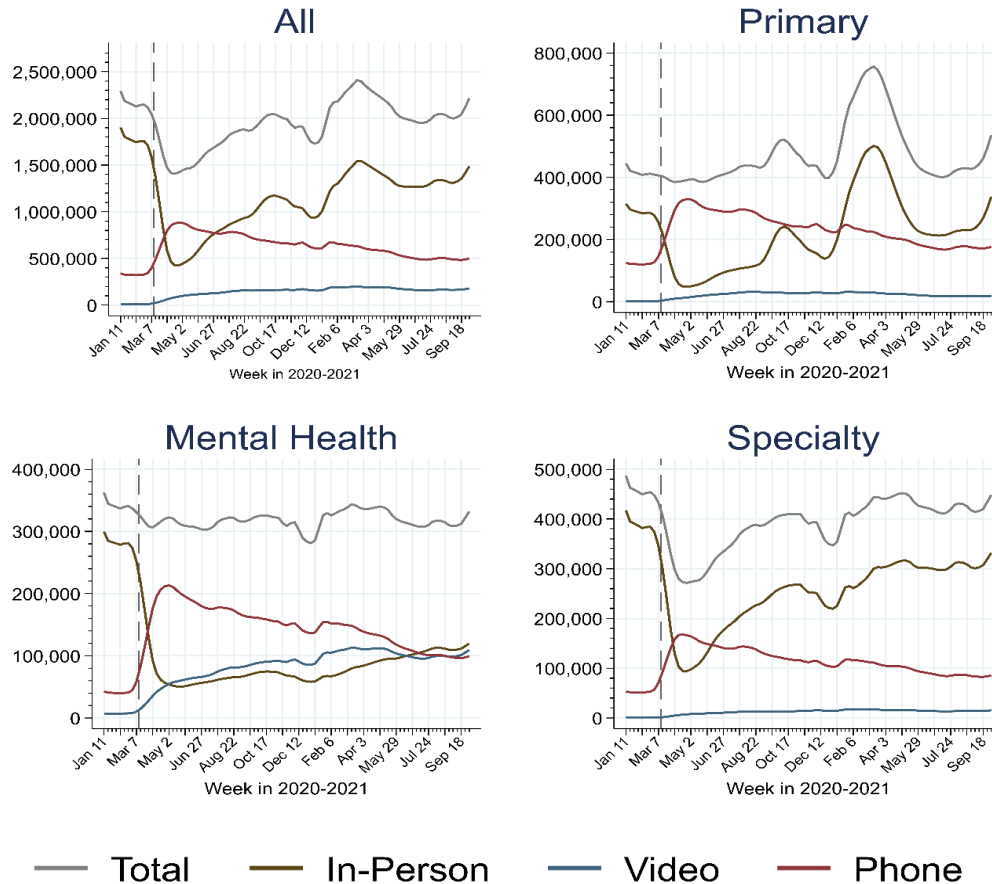
Figure 1: Encounters at the Veterans Health Administration (VA) between January 4, 2020 and October 2, 2021 by care delivery method and care type. The dashed line represents March 11, 2020: World Health Organization declares COVID-19 a pandemic. While all of primary care, mental health, and specialty care initially shifted toward telephone and video visits, mental health had the largest increase in video care and most sustained use of telephone and video.

   a. In FY21, approximately 1.9M unique Veterans completed over 9.5M VVC encounters. For comparison, VA has a population of approximately 6.5M patients.[5]
   b. In January 2022, nearly 474k patients completed a total of 829k VVC encounters.[5]
   c. Connolly *et al.,* 2021 found a stark difference in video visit use based on discipline, with psychologists having considerably higher video experience compared to psychiatrists, other medical providers (e.g., MDs and NPs), and other clinicians (e.g., social workers).[6]

2. **MyHealtheVet (MHV) Utilization Year over Year (YoY) and Cumulatively[7]**
   a. In January 2022, 1.51M unique MHV registrants (includes Veterans, healthcare teams, caregivers, and other beneficiaries) logged into MHV. Of these:
      - 671k Veterans and beneficiaries requested 2.71M prescription refills (+30% YoY and the most ever in one month).
      - 577k viewed appointments (+6% YoY) and received 3.5M email reminders.
      - 486k exchanged 2.8M secure messages with healthcare teams (+2% YoY).
      - 220k downloaded 600k files in Blue Button (the function of MHV that allows users to view and download information from their VA health record).

b. Cumulatively, MHV is the most used VC platform:
- 6.1M accounts created since November 2004; 3.6M authenticated Veterans
- 206M prescription refills requested since August 2005
- 150M secure messages initiated since June 2008

3. **VA Web and Mobile App Utilization**
   a. VA Connected Apps (as of April 2022) – These apps connect to VA's network, so additional data security (e.g., secure login) is required to ensure protection meets federal standards. Data from connected apps can be seen by VA clinical team members. Utilization metrics for VA 'Connected' apps are also available on Power BI dashboards.

App (Web, iOS, & Android)	Cumulative Unique Users
VA Video Connect	2,271,589
Virtual Care Manager	139,379
Annie	46,417
VA Sync My Health Data	22,605
Mental Health Checkup	16,875
Patient Viewer	5,170
VA Pain Coach	3,333
Image Viewing Solution	2,493
My VA Images	1,467
VA Health Chat	838

   b. VA Self-Contained Apps (more than 5 million total downloads) – These apps can be downloaded by anyone from Apple's App Store (iOS) or Google Play (Android), do not require any sign-in process and do not connect to the VA network. VA health care staff cannot see data in self-contained apps unless transmitted specifically by Veterans.

App (iOS & Android)	Downloads
Mindfulness Coach	1,001,087
CBT-i Coach	840,113
PTSD Coach	630,257
PFA Mobile	425,454
ACT Coach	302,936
PE Coach	288,115
AIMS	281,744
CPT Coach	267,401
COVID Coach	225,837
PTSD Family Coach	212,718
VetChange	189,990
Stay Quit Coach	189,614
STAIR Coach	175,409
Insomnia Coach	96,895
Couples Coach	70,503
Beyond MST	34,417

4. **Home Telehealth/Remote Patient Monitoring (RPM)[5] –** programs that apply care and case management principles to coordinate care using health informatics, disease management and technologies such as in-home and mobile monitoring, messaging and/or video technologies.
   a. In FY21, approximately 150k Veterans used some form of RPM

Section 2. Factors that Influence Implementation of and Engagement with VC in VA

The purpose of this section is to summarize prominent factors impacting Veteran engagement with VC that have been documented in previous VA studies. Note that while the overall focus of the engagement workgroup is *Veteran* engagement with VC, we have also included some evidence regarding factors that influence VC use among VA clinical teams. Many VC modalities support some interaction between Veterans and their VA clinical teams, and clinician endorsement has been shown to be an influential factor in adoption of VC among Veterans and across VC platforms.[8-11] For these reasons, we anticipate that clinical team member engagement with VC will be a critical aspect of our group discussions. Of note, the engagement barriers listed in section 2 below report system-level barriers (IT, staffing) and provider-level barriers, and then focuses on more Veteran-level barriers.

1. **Research on Veteran and Provider Attitudes Toward the Use of Mobile Health Technology**
   a. In a study with interviews of 77 older Veterans, Gould and colleagues (2019)[12] found that:
      i. 65% of Veterans were found to prefer some form of technology (as opposed to printed materials), such as an app, website, or DVD, for self-management support
      ii. 29% indicated that an app was the first preference for delivery modality, and 35% preferred printed materials for self-management
   b. In a study of VA provider perceptions of mobile health, Miller et al (2019) found[13]:
      i. 91% of providers know how to find mobile apps and download them to a smartphone
      ii. 82% agreed "using apps helps to address my patients' needs"
      iii. 81% "know other providers who have found value in using mobile apps"
      iv. 80% have "recommended using mobile apps to colleagues"
      v. 87% agreed "using apps makes it easier to provide educational materials"
   c. Customer feedback on VA 'Connected' apps are regularly pulled from many sources by VA's Office of Connected Care (OCC), consolidated, then provided to the product teams for prioritization of updates
   d. Customer feedback for VA 'self-contained' apps are collected and consolidated by the team that develops those apps (mobilementalhealth@va.gov)

2. **Engagement Barriers at the System, Provider, and Patient Level**
   a. **IT Barriers**
      i. Usability/User interface issues
         1. Number of steps required for connection, authentication, and/or enrollment with a VC modality, including but not limited to virtual visits, automated texting, and the online patient portal[14,15,16]
         2. Inflexibility for using different types of VC modalities, including video-capable platforms (VVC)[14]
         3. Frequent logoffs, time required to log onto alternative systems (e.g., secure messaging through VA's online portal)[17]
         4. Taken together, all of these points underscore that the usability of specific VC technologies can be a significant barrier
      ii. Functionality
         1. Inability to communicate with specific VA providers or care team members (as opposed to a Veteran's larger care team)[14]
         2. Limited integration with VA's EHR [17]
         3. Access for individuals other than the Veteran, including families and caregivers to messages[14]

   b. **Operational Barriers**
      i. Staff shortages and new workflows can result in VA clinical staff taking on multiple new roles which can be overwhelming[14]

  ii. Limited clarity on staff roles and responsibilities can also present challenges in incorporating VC platforms into clinical processes[15]

  iii. VA providers have cited structural and contextual barriers to mobile health adoption including not having time to discuss and assist with apps in care[13]

  iv. VA providers have reported lack of resources for training Veterans and technical support for Veterans

  v. Leadership support and clinic readiness can influence adoption and use over time[18]

  vi. If there is not clarity and convergence, national policies related to VC can also be a barrier

c. **Digital Literacy and Training**

  i. Clinical team members have described limited awareness of VC resources and not knowing how to integrate apps into clinical practice[13]

  ii. There is a perceived lack of sufficient training among providers regarding VC modalities and needs for additional training[12,13]

  iii. Limited awareness of VC resources among Veterans has also been noted in multiple studies[11,12]

  iv. Lower computer proficiency among Veterans is associated with preferences for using different VC modalities (e.g., preferring DVDs over web and mobile apps)[12,19]

  v. Insufficient knowledge of technical lexicon, menu symbols, limited comfort with technologies, and frustration with ongoing maintenance have been documented challenges for Veterans[12]

  vi. Veterans face difficulties with passwords and log-ins.[16]

  vii. VA clinical team members may assess Veteran suitability for VC modalities based on the Veteran's technology experience rather than potential benefits[18]

d. **Older Age**

  i. Older age is associated with lower VC use among both Veterans[4,20] and clinical team members[6]

  ii. Veterans over the age of 45 may be less likely to use certain VC modalities (e.g., video)[6]

  iii. Older Veterans have been shown to be at higher risk of drop-out from VC programs (e.g., home telehealth)[21]

  iv. Technology adoption among older Veterans may also relate to expectations of in-person social contact, suggesting that VC may be more appealing as a supplement, not substitute, for in-person care.[22]

  v. Studies suggest older Veterans would benefit from simplified application designs and digital literacy training to increase comfort, confidence, and willingness to use.[23]

  vi. The experience of homelessness is associated with more rapid physiological aging, suggesting age-related barriers may be more pronounced in this population.[22]

  vii. Similarly, VA providers over the age of 50 have been shown to be significantly less likely to use certain VC modalities (e.g., video)[6]

e. **Racial Disparities and Racism**

  i. Studies have shown that Black Veterans are less likely to use select VC technologies (e.g., VA's My Health*e*Vet patient portal).[20,22]

  ii. Implicit bias on the part of healthcare workers and structural racism in the healthcare system may contribute to observable disparities.[22]

  iii. Cultural tailoring of recruitment materials and outreach approaches can generate more interest in VC among specific racial and/or ethnic groups[22,24]

f. **Substance Use**

    i. Substance Use Disorder (SUD) has been associated with reduced likelihood of use for some VC modalities (e.g., video visits)[22]

    ii. Although there is some evidence that Veterans with SUD may prefer VC options like video to in-person visits, studies also indicate that Veterans actively using substances can have difficulty keeping video appointments, concentrating during visits, and express lower interest in interacting with healthcare providers via video[22]

g. **Effects of Health and Functional Status**

    i. Veterans with more chronic conditions have been found to be more likely to receive VC during the ongoing COVID-19 pandemic[4]

    ii. Other analyses have shown that Veterans with higher Care Assessment Need (CAN) scores and more functional impairment may be at higher risk of drop-out from VC (e.g., home telehealth) [21]

    iii. Functional limitations such as impaired vision or hearing, or large fingers can act as barriers to engagement.[12]

    iv. Symptom severity may result in lower use of some VC modalities (e.g., specific VA apps like the Concussion Coach)[25]

3. **Evidence for Specific Clinical Specialties**

  a. **Mental Health**

    i. Clinician concerns, logistical obstacles, and technology itself have been identified as part of systematic reviews as prominent factors influencing use of select VC modalities (e.g., video telehealth)[26]

    ii. Specific diagnoses and service utilization has been shown to predict odds of VC use (e.g., use of the patient portal; use of video or phone versus in-person visits)[27]

    iii. Studies have also shown that limited proof of efficacy (71.8%), concerns about data privacy (59.1%), and not knowing where to find relevant apps (51.0%) are frequent concerns among Veterans when it comes to using VC modalities (e.g., apps) for mental illness needs[8]

  b. **Primary Care**

    i. During the rapid mobilization of virtual primary care services in response to COVID-19, key barriers included workforce training, Veteran education, and insufficient technology infrastructure[28]

    ii. Experiences during the COVID-19 pandemic have underscored the important role that established scheduling practices can play in the use of VC modalities (e.g., video)[14]

  c. **Specialty Care**

    i. Reach of VC training was more limited in specialty care clinicians compared to Primary and Mental Health care[29] leading up to the COVID-19 Pandemic [29]

    ii. Existing clinical workflows, including those related to scheduling, can result in perceived barriers to VC adoption (e.g., scheduling clerks not closely integrated into cardiology clinics result in a sense among cardiologists that scheduling is a barrier to telehealth adoption)[14]

    iii. In a survey among VA providers, subspecialty providers reported greater inabilities to conduct a required physical exam or ability to assess physical health status than primary care providers[6]

Section 3. Examples of Operational Initiatives To Increase VC Adoption and Engagement in VA

The purpose of this section is to briefly summarize select operational efforts within VA intended to support the initial adoption and use of VC technologies. As noted in each of the numbered sections, these efforts have targeted different VA stakeholders.

1. **Office of Connected Care (OCC) Strategies to Facilitate VC Expansion During COVID-19**
   a. **Training and support for the VA workforce**[29]
      i. Tactical areas that were critical to the VA's success include:
         1. Frontline clinicians directed to complete trainings
         2. Policy restrictions relaxed
         3. National helpdesk staffing was increased
         4. Local sites that dedicated highest numbers of staff to VC expansion were the most successful at onboarding Veterans
      ii. Increased access to training and materials
         1. Launched Connected Care Academy, a 'one-stop shop' for all VC training and 24/7 access to materials for VA healthcare staff and academic and other federal organizations that we partner with
         2. Launched the Office of Connected Care's Promotional Toolkit Directory (internal sharepoint directory of promotional materials)
      iii. Raise VA healthcare staff digital literacy
         1. Developed an 8-part 'VA Virtual Care Best Practices' TMS series
         2. Created clinical support tools, including Office of Connected Care Outreach Toolkit, for both Veterans and VA staff, available to the public
      iv. Standardization of practice
         1. VA now has a nationwide directive to incorporate a test call standard operating procedure into VVC workflow to ensure veterans are prepared for their VVC visit

   b. **Expanding the technology infrastructure**
      i. VA Clinical Resource Hubs provide a network of solutions that combine in-person care and telehealth support to underserved VA medical facilities. This allows rural Veterans to get the care they need, when they need it, regardless of location.
      ii. Launched new VA Virtual Health Resource Centers (VHRC) modeled after the original at the St. Cloud, MN VA to support Veterans, healthcare staff, and family members/caregivers on the use of VC tools and programs.
         1. In FY21 delivered over 5,000 consultations/visits
         2. In FY21 delivered a total of 383 training and marketing events to a total of 17,567 attendees (Veterans and VA staff) to increase awareness, knowledge, and skills in VC use (VHRC Power BI Data Dashboard)
         3. The development of additional VHRCs at VA facilities in FY22 has been included as part of National Director Performance Goals.
      iii. Launched the VHRC Implementation Consult Service (ICS) providing facilities the implementation roadmap, materials, and guidance needed to launch a VHRC
         1. As of February 2022, a total of 20 facilities/programs had requested consultation regarding building a VHRC; 4 facilities/programs began the VHRC ICS cohort process.
            a. VHRC ICS Leaf Request site
            b. VHRC Implementation Consult Service Team: VHAVHRC@va.gov
         2. Results and lessons learned when implementing VHRCs[30]:
            a. VHRC staff knowledge and skills of VC increased
            b. Staff and facility readiness to adopt VC increased
            c. Use of implementation best practices increased

        d. VC utilization increased among Veterans and clinical team members

        e. The establishment of VHRCs may increase efficiencies in delivery of VC training and consultation to staff and Veterans, which may increase capacity and decrease barriers to adoption.

  c. Providing consistent, multi-modal messaging to diverse stakeholders

      i. A multi-modal communications plan was deployed to describe VA's virtual tools

      ii. Detailed instructions about accessing live helpdesk support and other messages especially aimed at new VC users were disseminated

2. **National Center for PTSD's Tech into Care Initiative**

  a. The National Center for PTSD (NCPTSD) created *Tech into Care* as an initiative to help anyone learn how to integrate technology into care for Veterans. The Program is focused primarily on the suite of <u>mobile mental health apps</u> created by NCPTSD.

      i. The apps provide self-help, education and support for PTSD and related issues. Health care professionals can use treatment companion apps with Veterans to keep them engaged between sessions. Most are available for iOS and Android devices.

      ii. Resources developed to support engagement with these apps include ongoing lecture series, app demonstration videos for both patients and clinicians, Continuing Education courses, and downloadable PDF guides and roadmaps, as well as other materials addressing, for example, privacy concerns and clinical information.

      iii. For Veterans who prefer to use a computer or who do not have a mobile device, NCPTSD has a variety of online courses.

      iv. The Practice-Based Implementation (PBI) Network hosts monthly interactive Tech into Care Community of Practice calls open to any VA staff.

Section 4. Examples of Implementation Strategies to Increase VC Adoption and Engagement in VA Research and QI Projects

The purpose of this section is to briefly summarize a few strategies that have been developed and tested as part of VA research or evaluation projects to increase adoption and continued use of select VC technologies. As with the content of this entire brief, Section 4 is not comprehensive and many members of the VA research community are pursuing work related to strategy development and testing for different VA stakeholders and contexts of care. It will be extremely helpful to talk about this body of work together in our group.

1. **Supported Adoption Program** – to encourage secure messaging (SM) use[16]

  a. Goals of this project included to (1) conduct a multisite, randomized, encouragement design trial to test the effectiveness of a supported adoption program (SAP) designed to increase patient engagement with the secure messaging feature of VA's online patient portal; and (2) evaluate the impact of the SAP and Veteran-level SM adoption.

  b. The SAP was comprised of multiple components, including 2 snail mailings sent to Veterans, 2 secure messages sent to Veterans from their VA primary care team's secure messaging account, and 1 telephone-based motivational interview with Veterans. The SAP components were developed to address key constructs of behavioral and motivational theories and reflected input from VA My HealtheVet Coordinators who regularly work with Veterans to facilitate patient portal access and SM use

  c. Compared to those Veterans who did not receive the SAP, those who received the SAP had significantly higher rates of SM adoption and SM use persisted a year after the encouragement ended. The adoption rate among SAP recipients was 24% at 21 months; 10% above the control group (usual care). Most adopters (70.3%) sent their first message without a motivational interview.

d. Veterans who received the SAP also noted higher perceived provider autonomy support and less telephone use to communicate with their VA provider compared to Veterans who did not receive the SAP.
e. Most common reported Veteran barriers to SM adoption include self-efficacy (not comfortable using computer), no perceived need, and difficulties with portal password and log-in.

2. **Augmented Implementation Facilitation** – E.g. for automated Texting System (aTS)[18]
   a. This project included a hybrid type 2 effectiveness implementation trial comparing two approaches for supporting implementation of an automated texting protocol via VA's Annie system (aTS) to support Veterans with Hepatitis C medication management
      i. Usual Implementation Clinics received the start-up experience that VA designed for all new clinics instituting the aTS: a live virtual demonstration and access to a resource website that included promotional materials and training guides. Usual Implementation clinics could receive troubleshooting assistance from the external facilitators (EFs) by phone or email, but only if and when they reached out to them.
      ii. In addition to the start-up experience above, Augmented Implementation clinics received an implementation toolkit, support for local champion development, and proactive outreach by the primary EF. The toolkit contained sections on evidence of texting in health care, suggestions for gaining leadership and clinic support, use of champions, tips and tools on how to use the aTS, and promotional materials to encourage clinic and patient participation. Proactive outreach from the EF included one in-person visit early in implementation efforts and check-ins with clinic champions throughout implementation.
   b. aTS reach and use was modest with 197 Veterans approached, 71 (36%) enrolled, 50 (25%) authenticated, and 32 (16%) using the aTS
   c. Providers found aTS appropriate with high potential for scale-up, but reported difficulties w/ startup, Veteran selection and recruitment, and clinic workflow integration
   d. Veterans generally found the aTS easy to use and helpful, but low perceived need for self-management support contributed to high declination to use the protocol.
   e. In augmented implementation facilitation clinics, more Veterans actively used the aTS HCV protocol compared with Veterans at usual implementation clinics
   f. Veterans who texted reported lower distress about failing HCV treatment & better adherence to HCV medication; sustained virologic response did not differ by group
   g. Facilitated implementation increased aTS engagement, but no between-group difference for clinical effectiveness outcomes

3. **Personalized Implementation of Video Telehealth (PIVOT)[31]**
   a. PIVOT is an implementation strategy used to increase adoption of video telehealth to home (VTH) across a large, urban VHA medical center (Houston VAMC)
   b. In PIVOT, a group of external facilitators (EFs) travels to an implementation site and undertakes several steps:
      i. Meet with health-system leadership and key stakeholders (e.g., information technology, MH leadership, site telehealth lead) to discuss nationally established, system-wide implementation goals; present evidence for VTH; and consult about where to initiate implementation efforts.
      ii. Identify on-site Internal Facilitators (IFs), often community or specialty clinic supervisors, with knowledge of the local system, influence, and existing relationships with providers. IFs are trained in VTH delivery and empowered to become a local VTH expert with support from EFs.
      iii. Identify Clinical Champion providers with help from IFs across clinics and disciplines (e.g., psychiatry, psychology, social work, masters-level counselors) to maximize

uptake. Ideally, one Clinical Champion is identified in each satellite community or specialty MH clinic where VTH implementation will occur.

    iv. Train Clinical Champions in VTH delivery, then mentor and empower them to provide support and guidance to ensure consistent, positive VTH messaging.

    v. provide support, resources (i.e. note templates, emergency guidance), and troubleshooting to help IFs create and sustain a VTH program.

    vi. Throughout the implementation process, EFs review and compile multilevel (federal, state, local, organizational) best practices, ethical guidelines, laws, and mandates concerning VTH delivery, technology, and compensation.

    vii. In preparation for sustainability, IFs are encouraged to take an active role in expanding and sustaining the innovation, with guidance from EFs on how to access information directly and to communicate with site leadership about relevant changes.

c. During its implementation from FY13 to FY18, the increase in the number of patients receiving VTH and VTH visits was 6.3 and 6.5 times (respectively) greater for Houston relative to median national improvement.

d. PIVOT-R, an adaptation for rural sites has also proven successful relative to the national median. Growth in number of Veterans treated by telehealth from FY18 to FY19 was 2.85 times greater than the national annual average of growth at VHA facilities.[32]

Section 5: Evidence from Systematic Reviews on Engagement with VC Outside VA

1. **Engagement with e-health in Older Adults[33]:** Systematic reviews have explored the benefits of e-health for older adults, finding clinically significant improvements in health behaviors (increased physical activity and healthy eating) as well as psychological and health outcomes (memory and blood pressure). A scoping review of barriers and facilitators to e-health engagement in this population found the following most frequently cited:

    a. **Barriers:** lack of self-efficacy, knowledge, support, functionality, and information provision about the benefits of e-health

    b. **Facilitators:** active engagement of the target end users in the design and delivery of e-health programs, overcoming concerns about privacy, support for enhancing self-efficacy in the use of technology, and integration of e-health programs across health services to accommodate the multimorbidity that older adults typically face

    c. **Gaps:** Research on constructs of habit, hedonic motivation, price value, and social influence, inclusion of older adults in design process

    d. **Findings** from this review suggested that older adults are more likely to use e-health services that are cognizant of their physical and functional needs, provide appropriate education and training to engage with e-health, address previous negative experiences of, and misconceptions about, digital health technologies; and employ strategies to enhance the perceived trustworthiness and credibility of e-health.

Table: Overview of findings from Barriers and facilitators to the use of e-health by older adults

Factor	Category	Barrier [# of studies]	Facilitator (# of studies)
Individual	Intrinsic	Aging limitations: reduction of hearing, sight, memory, fine motor control [5]. Perceived self-efficacy [4]. Lacking confidence in e-health [1]. Fear and dislike of technology [1]. No interest in learning [2].	Desire to learn [5]. Motivation to make a lifestyle change [2]. Altruism: wanting to contribute to scientific progress [3].
	Extrinsic	Lack of experience/skills with e-health [2] or technology [3]. Lack of knowledge of e-health [2].	Belief that e-health services are of benefit [4]. Convenience of e-health [1].

		Previous negative experience [1]. Unmet expectations [1]. Lack of need to change [4]. Fear traditional services may perish [1]. Disbelief in efficacy of e-health [3] Lack of external accountability [2]. Inability to incorporate into routine [1]. Required effort [2]. Cultural limitations: language barriers and e-health detracting from time with family [1].	Ability to incorporate into current routine [3]. Previous experience and skills [4]. Previous experience with e-health and required skills [4]. Positive experience with technology generally [1]. Opportunity to learn new information [1].
Tech	Functional	Small screen and text [1]. Small icons, lack of color contrast [1]. Complex functionality [1]. Poor functionality [3].	Ease of use such as audio feedback, and large and clear visual display [4].
	Content	Lack of alerts [1]. Alert fatigue: reminders/emails/texts [1]. Condescending/impersonal communication [1]. Overwhelming and difficult to understand content [2]. Too much content on one page [1]	Personalized content [4]. Use of reminders/alerts [3]. Use of images [1].
Relational	Tech Support	No training/support to learn [2]. No one to help troubleshoot issues [1]. Reliance on family for guidance, and lack of family's patience and understanding while learning [1].	Training/support to learn [5]. Dedicated coach for training and continued support [1]. Peer-to-peer platform to share experiences [1]. Option for family/carer to support [1].
	Social Support	Lack of social interaction [2]. Absence of interpersonal communication [1]. Communication through technology considered an 'inauthentic experience' [1].	Socially inclusive and community-based information [1].
Organizational	Privacy	Health information concerns [3].	
	Trust	Unknown accuracy of information [3]. Knowing who are communicating with [1]. Concern in management of emergencies [1]. Concern over Western Medicine's prioritization of medication [1].	Recommendation from physician [2]. Content designed by experts in field [1]. Access to specialists in platform [1]. Authenticity: platform with clear credentials [1].
	Data sharing	Lack of communication between health platforms [1].	Sharing of health information between health care providers [3].

Table 1: Individual = persons' individual attributes including physicality, cognition, experience, skills, and knowledge; Technological = the use of the technology, including device functionality, content, and availability; relational = person-to-person engagement and support; Environmental = location context and characteristics; Organizational = structure, capabilities, and development of the service

2. **Patient Engagement with Digital Mental Health Interventions (DMHIs)** [1]– Defined as using digital formats such as smartphone apps, internet websites, wearable devices, virtual reality, or video games aimed primarily at a mental health target such as psychological well-being, anxiety, depression, stress, or mood. A systematic review classified barriers and facilitators of engagement with DMHIs into user, program, and technology/environment related constructs. The table below summarizes the findings of this review.

| Category	Construct	Summary of findings
User Related	Demographic variables (sociodemographic factors, such as age, gender, and education)	Overall, women were more likely to engage with DMHIs than men
	Personal traits (factors related to personality traits, such as neuroticism and extraversion)	Neuroticism, agreeableness, openness, and resistance to change were associated with higher engagement, whereas extraversion was associated with lower engagement
	Mental health status (factors related to the current mental health status of the user, such as the type and severity of symptoms)	Severity of mental health symptoms increased the interest in DMHIs, but symptoms related to depression, mood, and fatigue were a barrier to actual engagement
	Beliefs (with regard to technology, mental health, and mental health services)	Positive beliefs about mental health help-seeking and technology-facilitated engagement
	Mental health and technology experience and skills (previous experience with technology, mental health technology and services, and skills related to digital, mental health, or digital health literacy)	Digital health literacy and positive experiences with mental health services and technology were facilitators to engagement
	Integration into life (the extent to which the user is able to find time and space to use the intervention and make it part of their routine)	Engagement was facilitated if people were able to integrate DMHI use into their daily lives
Program Related	Type of content (content and features offered by the intervention)	Engagement was facilitated if content was credible and if activities offered by the DMHI were of an appropriate length
	Perceived fit (factors related to how appropriate to the user's culture and values, and adaptable to the user's needs an intervention is; vs a one-size-fits-all solution)	Engagement was facilitated if information offered by a DMHI was customizable and relevant to the user
	Level of guidance (on how, when, how often to use the intervention, for example, through notifications or a coach)	Guided interventions, either through a human therapist or automated reminders to use a DMHI, had higher engagement than unguided interventions
	Social connectedness (the extent to which the intervention connects or isolates the user with or from others)	Being able to connect with other people through a DMHI facilitated engagement
	Impact of intervention on the user (such as an improvement or exacerbation of mental health symptoms [as measured by a validated survey scale])	DMHI engagement was facilitated if participants experienced a positive impact as a result of using a DMHI, such as the improvement of symptoms
Technology and Environment related	Technology-related factors such as the resources and costs required to use the intervention, usability, and technical issues experienced by the user)	Technical issues were a common barrier to engagement
	Privacy and confidentiality (factors related to data security, storage, confidentiality, and privacy of the digital intervention)	Engagement was facilitated if participants had a sense that the digital platform was private and anonymous, and they could safely disclose information
	Social influence (factors from the users' social environment, such as perceptions held by their peers, family, and health care provider, that influence their intention to use an intervention)	Participants were more likely to use DMHIs if people close to them, such as family and friends, thought they should use DMHIs

	Implementation (such as the availability of user training, the phase of the user's mental health care–seeking process during which the intervention is introduced or accessed, and characteristics of the health care organization supporting the DMHI)	DMHI engagement was facilitated if people were trained on how to use it

3. **Patient-Generated Health Data/Remote Measurement Technology[34]** – Defined as any mobile technology that enables monitoring of a person's health status through a remote interface, with the data then either transmitted to a health care provider for review or to be used as a means of education for the user themselves. A systematic review organized the barriers and facilitators most frequently noted as shown below.

   a. **Barriers:** Technical malfunctions were most widely reported (11 studies), including:
      i. Not receiving notifications or receiving them at the wrong time
      ii. Disappearance or freezing of the app, losing power or restarting without warning
      iii. Difficulties connecting remote (wearable and/or smart technology) devices with apps
      iv. Studies reported that this led to participant withdrawal, data loss, or significantly fewer data entries (e.g. by 35%)
   b. **Facilitators:** 4 studies demonstrated a positive and motivating effect of feedback.
      i. Buchem et al reported that 50% of participants felt motivated by virtual rewards such as badges (i.e. an indicator of accomplishment OR skill that can be earned)
      ii. Dale et al reported that 67% liked receiving motivational texts from the RMT system
      iii. Some participants reported a benefit associated with learning about their real-time activity [32] and talking about app data with a study coordinator
      iv. Further incentives that were suggested to increase motivation to engage included social sharing and comparison, or gaming features, including monetary rewards
      v. Another aspect reported to be "enjoyable" in 1 study was receiving the training instructions, which was seen to be an important contributor to increased engagement

Gaps: future research should focus on the entire engagement process and quantify the impact of specific variables on engagement in terms of observable changes in usage statistics in *rigorous experimental design*.
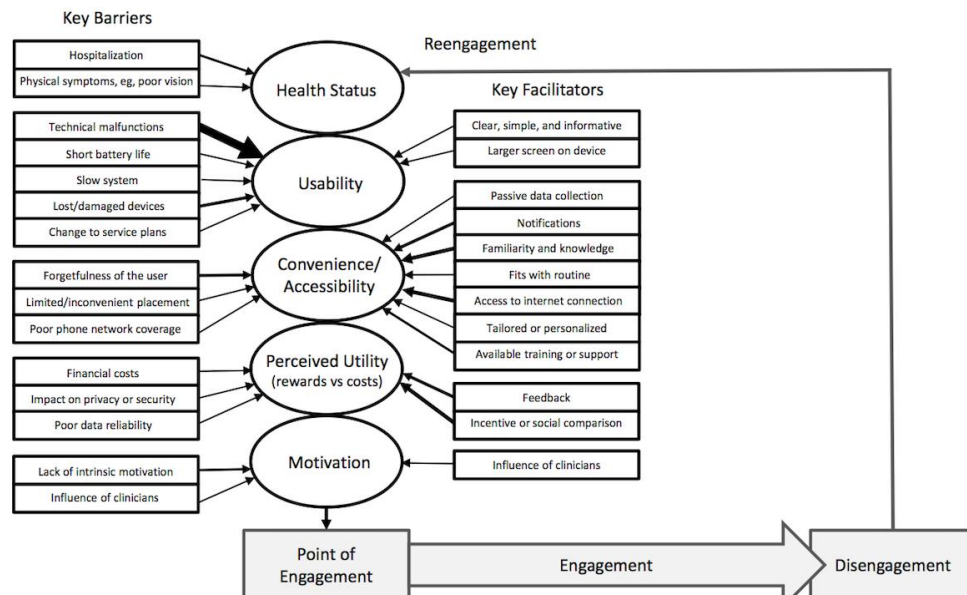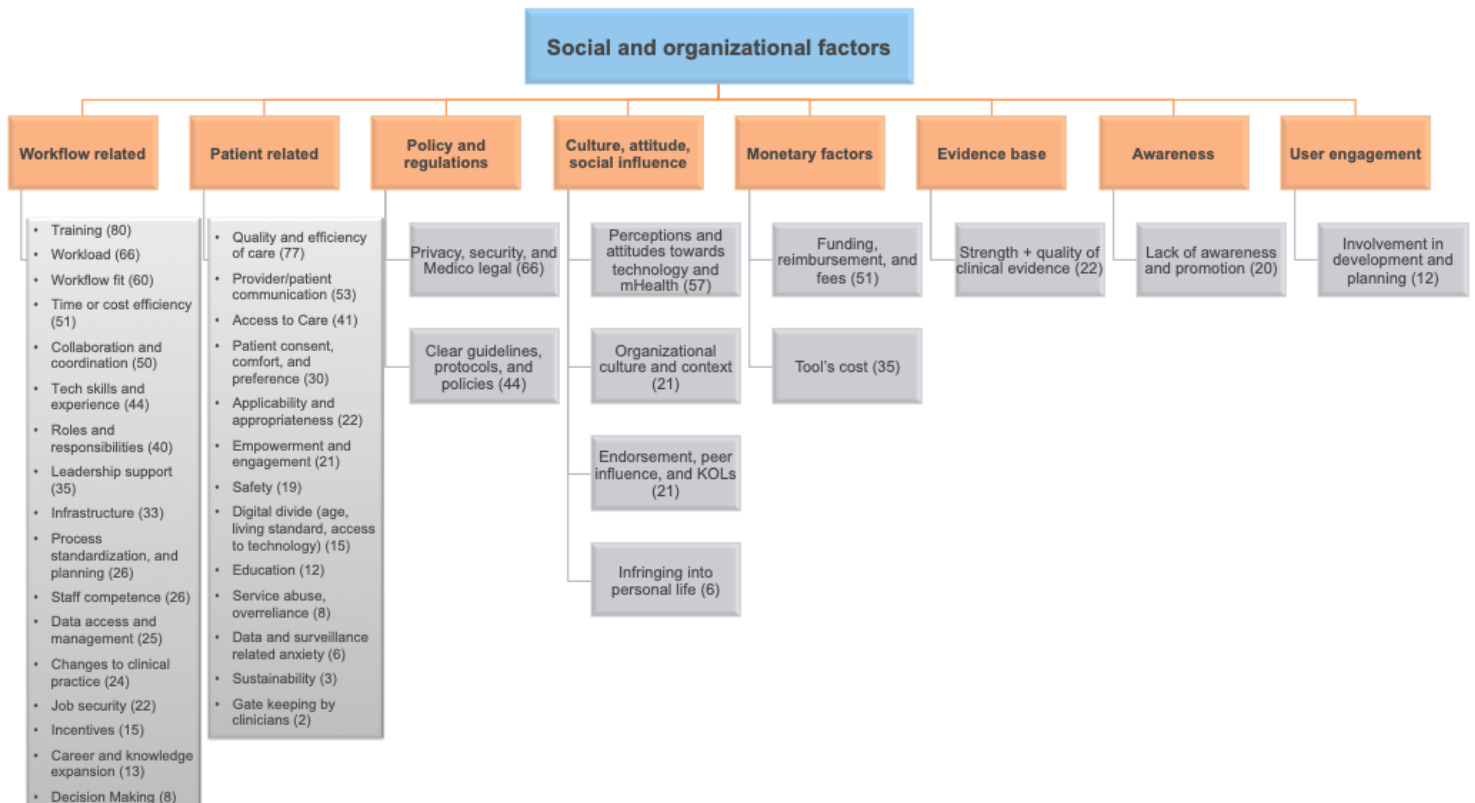

4. **Clinician Engagement with Mobile Health (mHealth)** [35]**:** Defined by WHO as "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, Personal Digital Assistants (PDAs), and other wireless devices."

a. A systematic review identified various technical factors impacting clinicians' adoption of mHealth, summarized with their respective frequencies as shown below.

Technical factors

Technical issues	Usefulness	Ease of Use	Compatibility	Design	Convenience	Content	Personalization
Technical difficulties (38)	Benefit, performance expectancy, and added value (64)	Effort expectancy, usability (55)	Interoperability (31)	Layout, interface, culturally appropriate design (11)	Mobility and flexibility (17)	Trustworthiness and quality (15)	Customization and adaptability (7)
Technical support (27)			EHR integration (20)	Patient centered design (7)			
Reliability (21)			Competition with existing programs (1)				
Connectivity (17)							

b. Social and organizational factors impacting clinicians' adoption of mHealth were manifestly more numerous than technical factors. These factors are summarized with their respective frequencies below.

Social and organizational factors

Workflow related	Patient related	Policy and regulations	Culture, attitude, social influence	Monetary factors	Evidence base	Awareness	User engagement
• Training (80) • Workload (66) • Workflow fit (60) • Time or cost efficiency (51) • Collaboration and coordination (50) • Tech skills and experience (44) • Roles and responsibilities (40) • Leadership support (35) • Infrastructure (33) • Process standardization, and planning (26) • Staff competence (26) • Data access and management (25) • Changes to clinical practice (24) • Job security (22) • Incentives (15) • Career and knowledge expansion (13) • Decision Making (8)	• Quality and efficiency of care (77) • Provider/patient communication (53) • Access to Care (41) • Patient consent, comfort, and preference (30) • Applicability and appropriateness (22) • Empowerment and engagement (21) • Safety (19) • Digital divide (age, living standard, access to technology) (15) • Education (12) • Service abuse, overreliance (8) • Data and surveillance related anxiety (6) • Sustainability (3) • Gate keeping by clinicians (2)	Privacy, security, and Medico legal (66) Clear guidelines, protocols, and policies (44)	Perceptions and attitudes towards technology and mHealth (57) Organizational culture and context (21) Endorsement, peer influence, and KOLs (21) Infringing into personal life (6)	Funding, reimbursement, and fees (51) Tool's cost (35)	Strength + quality of clinical evidence (22)	Lack of awareness and promotion (20)	Involvement in development and planning (12)

c. The review findings indicate important areas that must be targeted in future work to promote and foster clinicians' successful adoption of mHealth tools.

POLICY

For **policy** makers

- Legislate regulations that simplify and facilitate **reimbursement**, and **data privacy and management**
- Incorporate mHealth in **health insurance** schemes
- Develop new **remote care protocols**
- Support the inclusion of mHealth-related skills in **medical education**
- Fund more research that contributes to a solid **evidence base**
- Harmonize to reach **interoperability**

DEVELOPMENT

For **mHealth** providers

- **Involve clinicians** in the design, planning, and implementation
- Facilitate **user feedback**
- Provide reliable **training material** about the tools' features, benefits, and workflow integration scenarios
- Ensure continuous **technical support**
- Deliver **usefulness** and **ease of use**
- Work on solving **interoperability** and **EMR integration** issues
- Engage with **reliable clinical associations and opinion leaders** to endorse the tool and create trust

IMPLEMENTATION

For **clinical** decision makers

- Support a **cultural shift** that promotes the benefits of technology and innovation
- Facilitate mHealth **training programs**
- Integrate mHealth in **the workflow**
- Create **new roles** that support the implementation
- Encourage the creation of **multidisciplinary teams** combining digital and clinical expertise
- **Redefine the current roles** to reflect the new skills needed for a successful implementation

5. **Implementation Strategies used in eHealth** [36]
   a. The goal of this systematic review was to summarize evidence from existing studies regarding implementation strategies used when implementing eHealth interventions for patients with chronic illnesses living at home, implementation outcomes, and the relationship between implementation strategies, implementation outcomes and degree of implementation success
   b. A variety of electronic databases were searched and studies were included that described implementation strategies used to support the integration of eHealth interventions, and those strategies were categorized according to the Expert Recommendations for Implementing Change (ERIC) compilation of implementation strategies.
   c. Implementation success was determined according to author reporting of implementation in the studies themselves. The review found that the following implementation strategies were directly related to implementation success in several studies:
      - Management support and engagement, internal and external facilitation, training, audit and feedback
   d. The authors identified no clear relationship between the number of implementation strategies used and implementation success across the studies
   e. The tables below summarize the studies included in this review and the components of their respective implementation strategies.

Overview of included studies

First author	Patient groups	eHealth	Setting	Implementation framework	Implementation stage	Study design	Data collection
Bailey	COPD[a]	Clinical monitoring	Sheltered housing	N/A[b]	Middle[c]	Case study (QUAL[d])	Self-report assessment, observation, focus groups, interviews, workshops
Boonstra	Long-term illnesses	Video consultation	Homecare	Structurationism	Middle	Single case study (MIXED)	Interviews, workshops, written reports, policy plans, meeting minutes, observations, quantitative data on system use
Fortney	Depression	ICBT[e], *Beating the Blues*, video consultation	Primary care safety net clinics	RE-AIM[g]	Early[h]	Quality improvement methods (QUAL)	Qualitative needs assessments
Hadjistavropoulos	Anxiety, depression	ICBT, *Wellbeing Course*	Community mental health clinics	CFIR[i]	Late[j]	Process evaluation (QUANT[k])	Online survey
Hendy	Long-term illnesses	Clinical monitoring, *WSD[l]*	Primary care trusts	NPT[m]	Late	Comparative, longitudinal, qualitative, ethnographic case study (QUAL)	Interviews, meeting observations, document review
Hendy	Long-term illnesses	Clinical monitoring, *WSD*	Health and social care organizations	N/A	Late	Longitudinal, ethnographic case studies (QUAL)	Observations, document review, informal discussions, interviews
Horton	COPD	Clinical monitoring	Homecare	N/A	Middle	Case study (QUAL)	Focus groups, field notes, meeting minutes
Lindsay	PTSD[n], anxiety, depression, insomnia, chronic pain, SUD[o]	Video consultation, *Video to Home*	VA[p] Medical Center	PARIHS[q], RE-AIM	Late	Mixed-method program evaluation (MIXED)	Interviews, quantitative data on system use
Taylor	COPD, chronic HF[r]	Clinical monitoring	Community health care	PDSA[s]	Middle	Case studies and action research methodologies (QUAL)	Workshop observations, focus groups, document review, field notes
Terpstra	Chronic pain	ICBT, *Master Your Pain*	Mental health care institutions	TDF[t], TAM[u]	Early	Descriptive design (QUANT)	Evaluation questionnaire
Wells	Chronic illness	Online PHR[v]	Health delivery organizations	N/A	Late	Grounded theory inductive approach (MIXED)	Interviews, Web-based survey
Wilhelmsen	Depression	ICBT, *Mood-GYM*	General practice	NPT	Late	Qualitative study (QUAL)	Telephone interviews

[a]COPD: chronic obstructive pulmonary disease; [b]N/A: not applicable; [c]Middle: 4-12 months postimplementation startup; [d]QUAL: qualitative; [e]ICBT: internet-delivered cognitive behavioral therapy; [f]EBP: evidence-based practice; [g]RE-AIM: reach, effectiveness, adoption, implementation, maintenance framework; [h]Early: 0-3 months postimplementation startup; [i]CFIR: consolidated framework for implementation research; [j]Late: >12 months postimplementation startup; [k]QUANT: quantitative; [l]WSD: Whole Systems Demonstrator; [m]NPT: normalization process theory; [n]PTSD: posttraumatic stress disorder; [o]SUD: substance use disorder; [p]VA: Veterans Affairs; [q]PARIHS: promoting action on research implementation in health services; [r]HF: heart failure; [s]PDSA: plan, do, study, act; [t]TDF: theoretical domains framework; [u]TAM: technology acceptance model; [v]PHR: patient health record; [w]GP: general practitioner.

Categories of implementation strategies used in the included studies

Studies	Engage consumers	Use evaluative and iterative strategies	Change infrastructure	Adapt and tailor to the context	Develop stakeholder interrelationships	Use financial strategies	Support clinicians	Provide interactive assistance	Train and educate stakeholders	Total categories reported	Overarching implementation strategy (authors' description)
Bailey	x		x						x	3	Training
Boonstra	x	x	x	x	x	x	x			7	Not reported
Fortney	x	x	x	x	x			x	x	7	External facilitation/mixed
Hadjistavropoulos	x	x			x	x	x	x	x	7	External facilitation
Hendy		x	x		x		x		x	5	Not reported
Hendy			x		x	x		x		4	Managerial strategies
Horton			x						x	2	Not reported
Lindsay		x	x	x	x			x	x	6	External facilitation
Taylor	x	x	x	x	x	x	x		x	8	Action research
Terpstra									x	1	Training
Wells	x	x		x	x	x	x		x	7	Mixed
Wilhelmsen									x	1	Training
Total	6	7	8	5	8	5	5	4	10		

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Original Paper

Adoption of Mobile Apps for Depression and Anxiety: Cross-Sectional Survey Study on Patient Interest and Barriers to Engagement

Jessica Lipschitz[1,2], PhD; Christopher J Miller[2,3], PhD; Timothy P Hogan[4,5], PhD; Katherine E Burdick[1,2], PhD; Rachel Lippin-Foster[3], BA; Steven R Simon[3,6,7], MD; James Burgess[3], PhD

[1]Department of Psychiatry, Brigham and Women's Hospital, Boston, MA, United States

[2]Department of Psychiatry, Harvard Medical School, Boston, MA, United States

[3]Center for Healthcare Organization and Implementation Research, VA Boston Healthcare System, Boston, MA, United States

[4]Center for Healthcare Organization and Implementation Research, Edith Nourse Rogers Memorial Veterans Hospital, Bedford, MA, United States

[5]Division of Health Informatics and Implementation Science, Department of Quantitative Health Sciences, University of Massachusetts Medical School, Worcester, MA, United States

[6]Geriatrics and Extended Care Service, Veterans Affairs Boston Healthcare System, Boston, MA, United States

[7]Harvard Medical School, Boston, MA, United States

Corresponding Author:
Jessica Lipschitz, PhD
Department of Psychiatry
Brigham and Women's Hospital
221 Longwood Ave
Boston, MA, 02115
United States
Phone: 1 617 732 6548
Email: jlipschitz@bwh.harvard.edu

Abstract

Background: Emerging research suggests that mobile apps can be used to effectively treat common mental illnesses like depression and anxiety. Despite promising efficacy results and ease of access to these interventions, adoption of mobile health (mHealth; mobile device–delivered) interventions for mental illness has been limited. More insight into patients' perspectives on mHealth interventions is required to create effective implementation strategies and to adapt existing interventions to facilitate higher rates of adoption.

Objective: The aim of this study was to examine, from the patient perspective, current use and factors that may impact the use of mHealth interventions for mental illness.

Methods: This was a cross-sectional survey study of veterans who had attended an appointment at a single Veterans Health Administration facility in early 2016 that was associated with one of the following mental health concerns: unipolar depression, any anxiety disorder, or posttraumatic stress disorder. We used the Veteran Affairs Corporate Data Warehouse to create subsets of eligible participants demographically stratified by gender (male or female) and minority status (white or nonwhite). From each subset, 100 participants were selected at random and mailed a paper survey with items addressing the demographics, overall health, mental health, technology ownership or use, interest in mobile app interventions for mental illness, reasons for use or nonuse, and interest in specific features of mobile apps for mental illness.

Results: Of the 400 potential participants, 149 (37.3%, 149/400) completed and returned a survey. Most participants (79.9%, 119/149) reported that they owned a smart device and that they use apps in general (71.1%, 106/149). Most participants (73.1%, 87/149) reported interest in using an app for mental illness, but only 10.7% (16/149) had done so. Paired samples *t* tests indicated that ratings of interest in using an app recommended by a clinician were significantly greater than general interest ratings and even greater when the recommending clinician was a specialty mental health provider. The most frequent concerns related to using an app for mental illness were lacking proof of efficacy (71.8%, 107/149), concerns about data privacy (59.1%, 88/149), and not knowing where to find such an app (51.0%, 76/149). Participants expressed interest in a number of app features with particularly high-interest ratings for context-sensitive apps (85.2%, 127/149), and apps focused on the following areas: increasing

exercise (75.8%, 113/149), improving sleep (73.2%, 109/149), changing negative thinking (70.5%, 105/149), and increasing involvement in activities (67.1%, 100/149).

Conclusions: Most respondents had access to devices to use mobile apps for mental illness, already used apps for other purposes, and were interested in mobile apps for mental illness. Key factors that may improve adoption include provider endorsement, greater publicity of efficacious apps, and clear messaging about efficacy and privacy of information. Finally, multifaceted apps that address a range of concerns, from sleep to negative thought patterns, may be best received.

Introduction

The majority of the US population owns smartphones (77% in 2016) [1], and the number of mobile apps for health has grown exponentially over the past decade. A study by the IMS Institute for Healthcare Informatics [2] found that the number of health and wellness apps available to consumers has more than doubled between 2013 and 2015 (from 43,000 to over 90,000). Although the content and quality of these apps vary widely, the potential public health impact of such tools is enormous. Research suggests that mobile health (mHealth) interventions can have a positive influence on a wide range of health conditions [3,4] and, while not a substitute for in-person treatment, these tools offer a treatment option that does not have as many access barriers as in-office treatment (eg, no transportation is required) and may allow for reduced cost of care (since marginal cost is negligible).

In mental illness—where stigma and self-reliance beliefs are additional barriers to treatment seeking and engagement [5]—mobile health (mHealth) offers even greater potential. Common mental health disorders such as depression and anxiety impact nearly a third of the US population, and most of those who need treatment do not receive it [6,7]. The sheer number of people affected makes providing adequate treatment in traditional clinical settings prohibitive in terms of availability of trained providers. Studies indicate that mHealth interventions can improve functioning and symptoms in those with depression and/or anxiety [8-11] and also that technology offers some advantages over in-person treatments. Specifically, mHealth interventions offer 24/7 support because mobile devices are often kept with users throughout the day. In addition, patients may be more likely to report severe symptoms on technology platforms than in person [12], and patients value the autonomy and empowerment that can be offered by such platforms [13].

Unfortunately, adoption of mHealth interventions for common mental illnesses such as depression and anxiety remains low. To date, mHealth is neither a routine part of mental health care offerings in the United States nor has any mHealth platform for mental illness been widely adopted by consumers in the United States. These patterns are particularly noteworthy in systems such as the Veterans Health Administration (VHA), which has invested substantially in building and evaluating several free behavioral health apps specifically designed for mental health concerns of veterans. Several theoretical models explaining technology adoption and continued use have been put forth in the literature [14-16]. Existing models have some conflicting

and some overlapping components and have been found to explain as little as 17% and as much as 53% of the variance in adoption [15]. Newer unified models may explain more of the variance in adoption and use, but much of this literature has traditionally focused largely on adoption of technology in the workplace, a considerably different context than the treatment of mental illness. This multifaceted theoretical canvas underscores the complexity of understanding adoption and the potential importance of studying specific types of technology within the intended use population. At present, it is unclear what are the best approaches for encouraging patient adoption of mHealth interventions.

Research on patient adoption of technology in treatment of mental illness suggests that interest outpaces adoption. Specifically, studies of patients with depression, anxiety, and posttraumatic stress disorder (PTSD) suggest that interest varies widely based on the type of technology in question, but most patients are interested in using some kinds of technology in treatment [17,18]. With regard to mHealth specifically, Erbes et al [19] found that over half of a sample of patients with PTSD expressed interest in mHealth programs for PTSD, but less than 10% were currently using these platforms to help manage their symptoms.

Given high interest and low adoption, there is a need to build a stronger understanding of the factors that may affect adoption at the system level. Research on other patient-facing technologies suggests that how such technologies are integrated into the health care system may impact patient adoption. For example, findings from studies focused on adoption of one Web portal indicate that provider endorsement can improve rates of adoption [20]. It remains to be determined whether this is the case for mHealth interventions.

There is also a need to build a stronger understanding of factors that may affect adoption at the patient level. A large national survey of health app use in the general population indicated that lack of interest, cost, and concern about data privacy were key barriers to adoption [21]. These findings have been reinforced in other studies focused on mental health apps. Specifically, a study focused on mHealth interventions for depression found that cost, concerns about privacy, concerns over intervention efficacy, and misfit of intervention features to needs (ie, personalization) were key barriers to adoption of depression apps [22]. Another study focused on health and mental health apps found that efficacy and privacy are key barriers to adoption as well as not knowing where to find an app or knowing which

app to download [23]. However, these studies were conducted using only partially clinical samples, that is, presence of clinically significant symptoms (on self-report or via medical record diagnosis) was either not an eligibility criterion or not assessed.

Stronger understanding of patient perspectives on mHealth interventions in relevant clinical samples is required to support the development of targeted implementation strategies and platform modifications that will ultimately promote adoption. The aim of this study was to characterize mHealth interest, concerns, and preferences in a sample of patients with an active diagnosis of depression, anxiety, and/or PTSD. Specifically, we sought to (1) identify patients' degree of interest in mHealth interventions for mental health, (2) identify whether provider endorsement would impact degree of interest, (3) determine reasons for nonuse of mHealth interventions for mental health, and (4) identify what mHealth content or features are of most interest to patients.

Methods

Recruitment

We used the Veterans Affairs (VA) Corporate Data Warehouse (CDW) to identify individuals meeting eligibility criteria and to extract contact and diagnostic information for those individuals. Eligibility criteria were as follows: (1) US military veteran enrolled in care at the VA Boston Healthcare System; (2) receiving VA primary care, as indicated by having at least one encounter in the local primary care clinic between January 1, 2016, and July 1, 2016; (3) aged 18 years or older; and (4) attended a VA medical appointment between January 1, 2016, and July 1, 2016, in which an anxiety disorder (including obsessive-compulsive disorder), unipolar depressive disorder, or PTSD was documented as a condition treated in the appointment. Codes based on the 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) were used to determine visits associated with unipolar depression (F32-F34) and anxiety and PTSD (F40-F43). The decision to include patients with any or all of these diagnoses in the sample was based on high comorbidity rates between these diagnoses and the similarity of pharmacological and psychotherapeutic treatments for these disorders [24-29].

A total of 2840 veterans in the CDW met the above criteria. Within this sample, we divided records into 4 strata (white men, nonwhite men, white women, and nonwhite women) and randomly sampled 100 records from each stratum to achieve a gender- and minority-balanced set of potential participants. These randomly selected 400 individuals were actively recruited for participation via mailed surveys and accompanying study information. Although electronic medical record diagnostic codes were used to define our CDW search parameters and establish a set of eligible participants, these codes were not extracted for use in our dataset. This decision was made to protect patients' privacy, especially those patients who chose not to participate. The only information extracted from patient's charts was name and mailing address.

We used a modified Dillman method for recruitment [30]. The 400 veterans identified as potential participants were sent a series of 3 mailings, each including a letter inviting the veteran to participate, a study fact sheet, the survey, a postage-marked opt-out postcard, and a postage-marked return envelope. In addition, the first mailing contained a $10 Patron coupon for use at the local VA facility cafeteria and general store. The study invitation letter informed veterans that they may keep this coupon regardless of their decision to participate in this research. Participants who returned either the survey or opt-out postcard were not included in successive mailings.

All recruitment and study procedures were approved by the VA Boston Healthcare System's institutional review board.

Survey

Survey items were a combination of validated measures and newly developed questions based on the literature on technology use and adoption [31-33]. As there was no precedent for items evaluating concerns related to mental health app use and/or interest after clinician endorsement, these items were developed based on existing literature and field tested among a diverse team of colleagues with expertise in survey development. Items on mental health app features of interest to participants were selected based on a review of the literature on common elements of depression and anxiety apps [34,35].

The final survey consisted of 38 questions focused on 6 domains: (1) sociodemographic characteristics; (2) physical and mental health symptoms assessed using the SF-1 (first item of the 36-item Short Form Health Survey) for overall health [31,36], the Patient Health Questionnaire-8 (PHQ-8) for depression symptom severity [32,37], and Generalized Anxiety Disorder-7 (GAD-7) for anxiety symptom severity [33,38,39]; (3) technology ownership and use; (4) interest in apps for mental illness; (5) reasons for not using apps for mental illness; and (6) interest in specific mental illness app features (see Multimedia Appendix 1 for a list of items in each domain).

Data Analysis

We aggregated descriptive data on the following: demographic and health characteristics, devices owned, current technology use, and ratings on interest in mHealth interventions.

We used paired sample *t* tests to evaluate the degree to which provider endorsement impacted participants' level of interest in use of mHealth interventions for mental illness. Specifically, *t* tests compared participants' general interest ratings with those provided when asked how interested they would be in using a mobile app for mental illness if their primary care provider (PCP) recommended it. A similar comparison was conducted between general interest ratings and those provided when asked how interested they would be in using a mobile app for mental illness if their mental health provider recommended the app. Finally, we used *t* tests to compare interest ratings associated with PCP recommendation with those associated with mental health provider recommendation.

We also compiled aggregate descriptive data on the following: reasons endorsed for using or not using mobile apps for mental health and interest in specific app features and content.

Results

Participants

A total of 149 surveys were returned (response rate of 37.3%, 149/400). The resulting sample was fairly balanced on demographic characteristics (see Table 1). For clarity and because no item or scale had missing data for more than 8.1% (12/149) of respondents, all results are reported as percentages of the full sample.

The mean PHQ-8 score was 11.25 (SD 6.62), and the majority of the sample (65.8%, 98/149) reported symptoms that met the PHQ-8 cutoff score of 8, indicating clinically significant depressive symptoms [40]. The mean GAD-7 score was 9.65 (SD 6.02), and more than half of the sample (56.4%, 84/149) reported symptoms that met the GAD-7 cutoff score of 8 for clinically significant anxiety symptoms [33,39]. Self-reported mental health conditions were collected and are detailed in Table 1.

Technology Ownership and Use

The majority of the participants reported owning a smartphone (75.8%, 113/149) and a smaller portion reported owning a tablet (45.6%, 68/149). Together, a total of 119 participants (79.9%, 119/149) reported owning a smart device that could be used to run a mental health app. Table 2 displays participant answers with regard to current app and smart device technology use.

Interest in Apps for Mental Illness

When asked how interested they would be in using an app for mental illness, 73.1% (87/149) reported some level of interest. Specifically, 12.8% (19/149) indicated that they would be completely interested, 22.1% (33/149) indicated that they would be very interested, 22.8% (34/149) indicated that they would be moderately interested, and 15.4% (23/149) indicated that they would be a little interested. When the sample was limited to only those who owned a smart device, the percentage of individuals with some level of interest in using an app for mental illness was slightly higher (77.3%, 92/149).

In addition, when asked about interest in apps that could deliver context-sensitive feedback (ie, utilizing passive sensors to respond to physical or behavioral changes), the majority of the sample (84.0%, 125/149) reported some interest. Specifically, 28.9% (43/149) reported that they would be completely interested, 26.2% (39/149) reported that they would be very interested, 16.1% (24/149) reported that they would be moderately interested, and 12.8% (19/149) reported that they

would be a little interested. When the sample was limited to only those who owned a smart device, the percentage of individuals interested in an app that delivered context-sensitive feedback was only slightly higher (86.6%, 103/149).

Relationship Between Interest in Apps for Mental Illness and Provider Endorsement

Paired sample *t* tests were used to determine whether provider endorsement would impact interest levels. Starting with an alpha=.05 as the critical P value, the Bonferroni corrected P value for 3 t tests was .017. Participants rated global interest independent of provider endorsement (mean 2.81 [SD 1.38]) significantly lower than interest in the context of PCP endorsement (mean 3.13 [SD 1.38], t_{147}=−5.65, P<.001, d=0.23). Similarly, participants rated global interest independent of provider endorsement (mean 2.81 [SD 1.38]) significantly lower than interest in the context of mental health provider endorsement (mean 3.30 [SD 1.36], t_{145}=−4.05, P<.001, d=0.36). Finally, participants rated interest in the context of PCP endorsement (mean 3.13 [SD 1.38]) significantly lower than interest in the context of mental health provider endorsement (mean 3.30 [SD 1.36], t_{145}=−3.37, P<.001, d=0.12). When the sample was limited to only those who owned smart devices (n=119), these comparisons remained significant at the P<.001 level in the same directions.

Reasons for Not Using Apps for Mental Illness

Table 3 displays the frequency with which participants endorsed specific reasons for not using mental health apps. The most commonly endorsed reasons were not having proof that the app would work, concerns about privacy, and not knowing where to find such an app. These were the most commonly endorsed reasons both when the full sample was considered and when the sample was limited to only those participants who owned smart devices.

Interest in Specific Mental Illness App Features

Table 4 displays the frequency with which participants endorsed interest in features of mental health apps. The features with the highest interest ratings related to increasing exercise, getting better sleep, cognitive restructuring (changing negative or self-critical thinking), and behavioral activation (getting involved in more activities). These features were the most frequently endorsed both when the full sample was considered and when the sample was limited to only those participants who owned smart devices.

Table 1. Demographic characteristics of the sample (N=149).

Characteristics	Statistics
Age (years), mean (SD)	57.5 (13.9)
Gender, n (%)	
Male	77 (51.7)
Female	67 (45.0)
Not reported	5 (3.4)
Race or ethnicity, n (%)	
Caucasian or white	67 (45.0)
African American or black	44 (29.5)
Other	11 (7.4)
Hispanic or Latino	9 (6.0)
Not reported	7 (4.7)
Asian	6 (4.0)
American Indian, Alaskan Native	4 (2.7)
Pacific Islander	1 (0.7)
Education, n (%)	
Middle school (7th-8th)	1 (0.7)
High school (9th-12th)	24 (16.1)
Some college or vocational school	41 (27.5)
Associates degree (2-year college)	16 (10.7)
Bachelor's degree (4-year college or university)	36 (24.2)
Graduate degree	27 (18.1)
Not reported	4 (2.7)
English as first language, n (%)	134 (89.9)
Marital status, n (%)	
Divorced or separated	49 (32.9)
Married	46 (30.9)
Single, never married	39 (26.2)
Widowed	11 (7.4)
Not reported	4 (2.7)
Annual household income, n (%)	
Less than US $20,000	36 (24.2)
US $20,000 to US $34,999	21 (14.1)
US $35,000 to US $49,999	35 (23.5)
US $50,000 to US $74,999	20 (13.4)
US $75,000 to US $99,999	15 (10.1)
US $100,000 to US $149,999	8 (5.4)
US $150,000 or more	2 (1.3)
Not reported	12 (8.1)
Self-reported health rating, n (%)	
Excellent	3 (2.0)
Very good	21 (14.1)
Good	56 (37.6)

Characteristics	Statistics
Fair	51 (34.2)
Poor	11 (7.4)
Not reported	6 (4.0)
Self-reported behavioral health conditions, n (%)	
Depression	107 (71.8)
Stress	97 (65.1)
Anxiety	96 (64.4)
Difficulty sleeping	93 (62.4)
Posttraumatic stress disorder	91 (61.1)
Chronic pain	88 (59.1)
Overweight	76 (51.0)
Smoking	32 (21.5)
Diabetes	26 (17.4)
Substance use disorder (not alcohol)	15 (10.1)
Alcohol use disorder	14 (9.4)

Table 2. Technology use characteristics of sample (N=149).

Type of technology use	Frequency endorsed, n (%)
Smartphone or tablet functions	
Texting	118 (79.2)
Taking pictures or camera	116 (77.9)
Apps	106 (71.1)
Searching the internet	104 (69.8)
Checking the weather forecast	103 (69.1)
Email	101 (67.8)
Driving or walking directions	95 (63.8)
Social media	83 (55.7)
Use of apps for other health-related goals	
Daily steps	42 (28.2)
Tracking calories	34 (22.8)
Mindfulness exercises	31 (20.8)
Weight management	30 (20.1)
Sleep	28 (18.8)
Mental illness	16 (10.7)

Table 3. Factors impacting use of mental health apps.

Reason	Smart device owners (n=119), n (%)	Full sample (N=149), n (%)
I might use an app for these problems if I saw proof that it worked.	92 (77.3)	107 (71.8)
I am concerned about protecting my privacy with having my information in an app like this.	73 (61.3)	88 (59.1)
I don't know how to find an app that would help.	61 (51.3)	76 (51.0)
I don't think an app can help me to get better.	44 (37.0)	55 (36.9)
I am already in treatment for stress, depression, anxiety or PTSD[a] and don't see the need for an app.	43 (36.1)	52 (34.9)
It would be embarrassing to have an app like this on my phone.	31 (26.1)	39 (26.2)
I don't use apps at all.	13 (10.9)	29 (19.5)
I tried an app like this before and did not like it because it was not personalized enough.	13 (10.9)	14 (9.4)
I don't think I have a problem with stress, depression, anxiety or PTSD.	12 (10.1)	21 (14.1)
I tried an app like this before and it did not help.	11 (9.2)	11 (7.4)
I tried an app like this before and did not like it because it was difficult to use.	10 (8.4)	12 (8.1)

[a]PTSD: posttraumatic stress disorder.

Table 4. Interest in specific features of mental health apps.

Item wording (intervention label)	Smart device owners (n=119), n (%)	Full sample (N=149), n (%)
Increase your physical activity or exercise (physical activity)	95 (79.8)	113 (75.8)
Help you learn to get better sleep (Cognitive Behavioral Therapy for Insomnia)	87 (73.1)	109 (73.2)
Learn how to change negative/self-critical thinking (cognitive restructuring)	86 (72.3)	105 (70.5)
Get involved in more activities (behavioral activation)	86 (72.3)	100 (67.1)
Track mood/stress/anxiety/PTSD[a] symptoms (progress monitoring)	80 (67.2)	95 (63.8)
Speak with a health coach when your symptoms are bad. (professional support)	79 (66.4)	98 (65.8)
Learn more about your mental health condition. (psychoeducation)	77 (64.7)	92 (61.7)
Help improve your social skills (social skills training)	75 (63.0)	92 (61.7)
Remind you to take your medications. (medication adherence)	73 (61.3)	91 (61.1)
Connect with a community of people with similar mental health problems (social support)	61 (51.3)	72 (48.3)

[a]PTSD: posttraumatic stress disorder.

Discussion

Principal Findings

Results from this study indicate that access and interest in mobile apps for mental illness outpace actual use. Specifically, we found that access to devices and use of apps, in general, was high: nearly 80% of our sample reported owning smart devices, and of those with smart devices, nearly 90% reported that they use apps. Interest in using mobile apps for mental illness was also high: over 70% of the sample indicated that they have some level of interest. Despite owning the requisite devices, having active and relevant diagnoses (as indicated by PHQ-8 and GAD-7 scores), and expressing interest, use of mobile apps for mental illness was low: only 1 in 10 participants used apps for mental illness. These findings could be interpreted as indicating that most participants wanted to use mHealth interventions for mental illness and had the device and technology knowledge to do so.

Findings also provide some guidance into factors that may impact adoption. First, the highest-rated reasons for not using apps for mental health were related to not having proof of efficacy, concerns about whether these apps could keep mental health information adequately private, and not knowing where to find such an app. These findings suggest that public dissemination of information on efficacy of apps for mental illness (eg, in doctors' offices or on public transportation) could improve adoption. Moreover, informing users how information within the app is protected (eg, in the introductory screens of the app) may increase adoption. Concerns related to efficacy and privacy are supported by earlier studies [21,22,41], but until recently [23], lack of information on where to find evidence-based apps has not been clearly articulated as a barrier to adoption. With regard to barriers to adoption, it is important to specifically note that this study did not evaluate cost as a barrier to adoption for 2 reasons. First, within VA, cost concerns of medical care are different than outside VA. Second, VA has

developed a number of mobile apps for mental illness that are freely available to the public and relevant for the veterans recruited in this study.

Provider endorsement also appears to be a promising avenue for increasing adoption of mHealth for mental illness. Participants provided significantly higher interest ratings in the context of provider endorsement than when asked more generally about interest in using such apps. These findings are consistent with existing literature on the impact of provider endorsement in patient adoption of other patient-facing technologies (eg, patient portals that offer messaging and other features) [20]. These findings go beyond the existing literature, however, by showing that the type of provider endorsing the intervention may matter because interest ratings were greater in the context of mental health provider endorsement than PCP endorsement. Provider recommendation is not currently the norm; recent research suggests that individuals are more likely to hear about mental health apps through social media, Web searches, or friends than through medical providers [23]. Findings from our study underscore that providers could potentially play a key role in increasing adoption. Findings also raise questions about who among providers should be endorsing mHealth interventions to maximize the chances of adoption.

Although this study did not seek to directly test existing models of technology adoption, some interesting parallels between these findings and existing models were observed. Specifically, the Unified Theory of Acceptance and Use of Technology [15] indicates that 2 key determinants of technology adoption and use are performance expectancy (a user's beliefs on whether the technology will be helpful) and social influence (how strongly an individual believes that important others think he or she should use the technology). Findings that both proof of efficacy and provider endorsement would encourage use are consistent with these 2 theoretical constructs. Considering the results from this research in relation to such constructs is particularly important to understanding how evolving theories of technology adoption can best be applied in different contexts, including patient adoption of technology and its integration into mental health treatment.

Findings also provide insight into what features and content of apps patients with depression, anxiety, and/or PTSD may find most useful. Over 70% of participants with smart devices reported interest in using apps that facilitate core functions of cognitive behavioral therapy such as cognitive restructuring and behavioral activation. Over 73% of participants with smart devices reported interest in features that would promote wellness in areas of behavioral health such as sleep difficulties and inactivity. These findings suggest that this population may be best served by individual apps or suites of apps that target depression and anxiety from multiple angles [10].

In addition, interest in context-sensing mobile app interventions was high; 85% of participants indicated some level of interest in this type of intervention. This finding contrasts with other research where participants endorsed skepticism and concern over context sensing [41]. Interest in context-sensing mobile app interventions may indicate an interest in personalization. Along these lines, Table 3 shows that the majority of those who

reported having used an app for mental health also endorsed that they did not like it because it was not sufficiently personalized. This finding should be interpreted with caution because we do not know which apps these participants used, and it is difficult to draw conclusions based on such a small subsample (only 10.7% of the full sample had used apps for mental illness). However, other research corroborates that patient reports of insufficient personalization is a perceived barrier to using mobile treatment apps for depression [22].

It was also worth noting that although participants endorsed interest in apps that offered the option of speaking to a health coach, 5 other features were endorsed more frequently than this feature. There has been a lot of emphasis on the integration of health coaching into app platforms both as a way to enhance engagement and as a way to produce higher levels of change [42,43]. On the other side of this debate, some research indicates that integrating health coaching does not necessarily ensure engagement in technology-based interventions for depression as users can simply ignore calls from coaches [44]. Findings from this study contribute to this debate and indicate that health coaching capabilities may not be essential for user interest and/or engagement.

Strengths and Limitations

Key strengths of this study include engagement of a racially diverse, clinical sample and proactive recruitment methods. By mailing paper surveys to patients identified as eligible, we expect to have captured data from individuals who may not have responded to more passive recruitment approaches (eg, flyers in waiting rooms). However, our proactively mailed survey methodology also introduces some bias as it is also possible that those who were less interested in use of technology were less likely to respond to the survey. Nevertheless, it is our expectation that the clinical nature of our sample was appropriate for our research questions and that our recruitment method introduced less bias than studies recruiting online or via social media, which essentially make technology proficiency a condition for entry into the study.

The sample in this study consisted entirely of veterans receiving services at a single VA hospital in a metropolitan area in the northeastern United States. Generalizability of findings to nonveteran samples and samples collected in other geographical areas should be tested in future studies. In addition, given the scope and funding level of this study, the presence of diagnoses required for eligibility was based on patients' medical records and not verified by study staff independently through a structured clinical interview.

Finally, this study evaluated stated preferences and interests. A close-ended question format was used for this survey; however, the downside of survey items formatted in this manner is that they can produce less nuanced data when answer options do not fully capture patients' thoughts. Additional research that includes more nuanced data collection such as a mixed-methods study with qualitative interviews will be an important next step. Moreover, moving forward, it will be necessary to evaluate whether these self-reported findings hold up behaviorally. That is, future research will need to assess whether implementation strategies and platforms consistent with observed preferences

and interests are associated with positive impact on adoption and engagement.

Conclusions and Future Directions

Mobile apps are a new and promising adjunctive, and possibly even stand-alone, treatment option for patients with depression and anxiety disorders. They are technologies that can reach patients beyond the confines of traditional brick-and-mortar clinic visits and engage them directly, in the context of their daily lives. For these reasons, mobile apps are also a unique treatment option to implement, one that requires a thorough understanding of patient perspectives and preferences if effective implementation strategies are to be designed. As reinforced in this study, smart devices are ubiquitous and patients are interested in using this technology. Findings from this study offer several key takeaway points. First, in this sample of individuals with clinically significant mood and/or anxiety symptoms, most were interested in using mobile apps as part of treatment, but few were doing so. Second, participant interest ratings suggest that provider endorsement may positively influence adoption of these technologies. Third, integration of wearables and passive data to direct interventional content, interventions to improve self-care around sleep and inactivity,

and common cognitive-behavioral therapy interventions such as cognitive restructuring and behavioral activation were all perceived as valuable by patients. Finally, messaging around these technologies should increase awareness of mobile apps available for this population, relay what is known around efficacy, and address privacy concerns. One way to disseminate these messages could be through patients' providers, but this would require that providers have easy access to up-to-date information on which apps are efficacious and safe.

Evaluating the generalizability of these findings in a nonveteran sample and determining whether preferences observed here translate to actual behaviors will be critical moving forward. It will also be important to evaluate whether patient interest and concerns are different across various demographic subgroups (eg, gender, race, age, and education) to determine how best to create systems that meet the needs of all segments of the population. Adjusting messaging and implementation strategies in ways that reflect these findings and evaluating patient adoption and engagement are essential next steps. In addition, evaluating whether preferences endorsed translate to preferential use of specific app features in real-world settings could direct attention of app developers toward the features that patients most value.

Conflicts of Interest

None declared.

Multimedia Appendix 1

Survey questions.

[PDF File (Adobe PDF File), 84KB-Multimedia Appendix 1]

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Abbreviations

CDW: Corporate Data Warehouse
GAD-7: Generalized Anxiety Disorder-7
mHealth: mobile health
PTSD: posttraumatic stress disorder
PCP: primary care provider
PHQ-8: Patient Health Questionnaire-8
VA: Veteran Affairs
VHA: Veterans Health Administration

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Barriers and facilitators to the use of e-health by older adults: a scoping review

Jessica Wilson[1*], Milena Heinsch[1], David Betts[2], Debbie Booth[3] and Frances Kay-Lambkin[1]

Abstract

Background: Limited attention has been paid to how and why older adults choose to engage with technology-facilitated health care (e-health), and the factors that impact on this. This scoping review sought to address this gap.

Methods: Databases were searched for papers reporting on the use of e-health services by older adults, defined as being aged 60 years or older, with specific reference to barriers and facilitators to e-health use.

Result: 14 papers were included and synthesised into five thematic categories and related subthemes. Results are discussed with reference to the Unified Theory of Acceptance and Use of Technology2. The most prevalent barriers to e-health engagement were a lack of self-efficacy, knowledge, support, functionality, and information provision about the benefits of e-health for older adults. Key facilitators were active engagement of the target end users in the design and delivery of e-health programs, support for overcoming concerns privacy and enhancing self-efficacy in the use of technology, and integration of e-health programs across health services to accommodate the multi-morbidity with which older adults typically present.

Conclusion: E-health offers a potential solution to overcome the barriers faced by older adults to access timely, effective, and acceptable health care for physical and mental health. However, unless the barriers and facilitators identified in this review are addressed, this potential will not be realised.

Keywords: Mobile health, E-mental health, Acceptance, Engagement, Multimorbidity

Introduction

In recent years, rapid population ageing has become a worldwide phenomenon. In 2018, older people outnumbered children for the first time in history. By 2050, they are expected to make up 22% of the global population [1]. Commensurate with this growth is the need to ensure proper planning and delivery of health services and supports to facilitate full and happy lives across the age spectrum.

The wellbeing of older adults is diverse. While some lead physically active lives free of major health concerns, population ageing has also coincided with a sharp increase in non-communicable diseases (e.g., diabetes, cancer, and heart disease) [2], and in some older populations, the co-occurrence of multiple chronic conditions is as high as 77% [3]. Age-related factors, such as changes in social roles and familial relationships, retirement, and deteriorating physical health are also associated with increased mental health challenges [4, 5]. Crucially, 15% of older adults experience a mental health disorder [6], and a further 15% experience clinically significant depressive symptoms [7]. This makes the promotion and maintenance of mental health an equally important consideration alongside physical health for older adults. Facilitating access to health and mental health services and supports for older people is, thus, a global imperative.

* Correspondence: Jessica.Wilson@newcastle.edu.au
[1]Centre for Brain and Mental Health Research, University of Newcastle, Callaghan, NSW 2308, Australia
Full list of author information is available at the end of the article

Currently, health systems are not well aligned with the complex needs of older adults [8]; there is a tendency to focus on individual diagnoses rather than on treatment of the whole person [9–11]. Widespread endorsement of this 'single disease framework' by current health systems has arguably hindered the provision of integrated, 'patient-centred care' for older adults [11]. Consequently, and despite growing health and medical advances, the rate of mild-to-moderate disability of older adults has remained stable over the past three decades [6, 12], resulting in increased health service utilization [3, 11, 13–15]. At the same time, older adults often face unique challenges to accessing health services, including limited income or insurance, reduced mobility or disability, rural or remote location, and negative self-perceptions of ageing (associated with lower health-related quality of life) [16, 17].

e-Health (defined as any health service, platform, tool, or intervention delivered electronically) [18] has substantial potential to improve access to, as well as support the provision of efficient and effective care for older adults [19, 20]. Research shows that adoption of information and communication technology by older adults is increasing [21], and is perceived to be positive and essential to their everyday lives [22]. This creates significant potential to better support the health care needs of older aged adults within the current limitations of our health service systems. To date, two systematic reviews have explored the benefits of e-health for older adults, finding clinically significant improvements in health behaviors (increased physical activity and healthy eating) as well as psychological and health outcomes (memory and blood pressure) [23, 24] associated with the use of these technologies.

Despite the availability and potential benefits of e-health for older adults [25] barriers to uptake and use remain [23, 26]. Limited attention has been paid to how and why older adults choose to engage with e-health services, and the factors that impact on this. We sought to address this gap by reviewing the existing literature on barriers and facilitators to the use of e-health by older adults, with a view to informing the development and implementation of a targeted e-health intervention for older adults. The results of this review are discussed with reference to the key constructs of the Unified Theory of Acceptance and Use of Technology2 [27].

Methods
This review follows the Preferred Reporting Items for Systematic Review and Meta-Analyses, Scoping Review extension (PRISMA-ScR) guidelines [28], and uses a scoping review methodology outlined by Arksey and

O'Malley [29], and Levac et al. [30]. The choice to conduct a scoping review rather than a systematic review was informed by Munn et al. [31], who explains that systematic reviews focus on the synthesis of quantitative outcomes assessing the effectiveness of treatments and practice. In contrast, a scoping review is an appropriate method to a) identify the scope of available literature on a given topic; b) provide an overview of concepts relating to the topic; and c) identify gaps in the literature. Given the limited literature exploring barriers and facilitators to e-health use by older adults, a scoping review of the available evidence, and evidence gaps, was considered most appropriate.

Eligibility
Individual studies were included in the review if they: (i) were published in the English language; (ii) constituted outputs of empirical research (either quantitative, qualitative or mixed methods); (iii) were published in a peer-reviewed journal; and (iv) reported on participants aged 60 years and over. Studies were excluded if they: (i) were not written in the English language; (ii) constituted grey literature; (iii) were not published in a peer-reviewed journal; and (iv) reported on populations aged under 60 years. Sixty years was selected as the key age criterion, based on the United Nations definition of an "older" person, regardless of that person's individual history or where in the world they live [32]. Articles which met the eligibility criteria were included regardless of journal rank and impact factor, to ensure identification of a wide range of methodologies; particularly qualitative methodologies, which remain underrepresented in high impact biomedical journals [33]. Studies were included if they made any form of reference to uptake, acceptance, attitudes, benefits, influences, perceptions, usefulness, determinants of use, experiences, expectations, and beliefs in relation to e-health use by older people. e-Health was defined as any electronic, mobile, online-delivered health or mental health service, including passive (e.g., health information webpage or patient portal) and active (e.g., clinician-moderated) therapy [18].

Search strategy
A search of databases: CINAHL, Embase, Medline, Psychology and Behavioral Sciences, PsycINFO, and Scopus, was conducted by DBooth on 4th August 2020. No limit was placed on the date of databases searched. A combination of subject headings and keywords specific to each database was used in Medline, PsycINFO, Embase, and CINAHL. Keyword searches were used in Psychology and Behavior Science Collection and Scopus databases. See supplementary file for search strategy.

Fig. 1 PRISMA flow chart of study selection
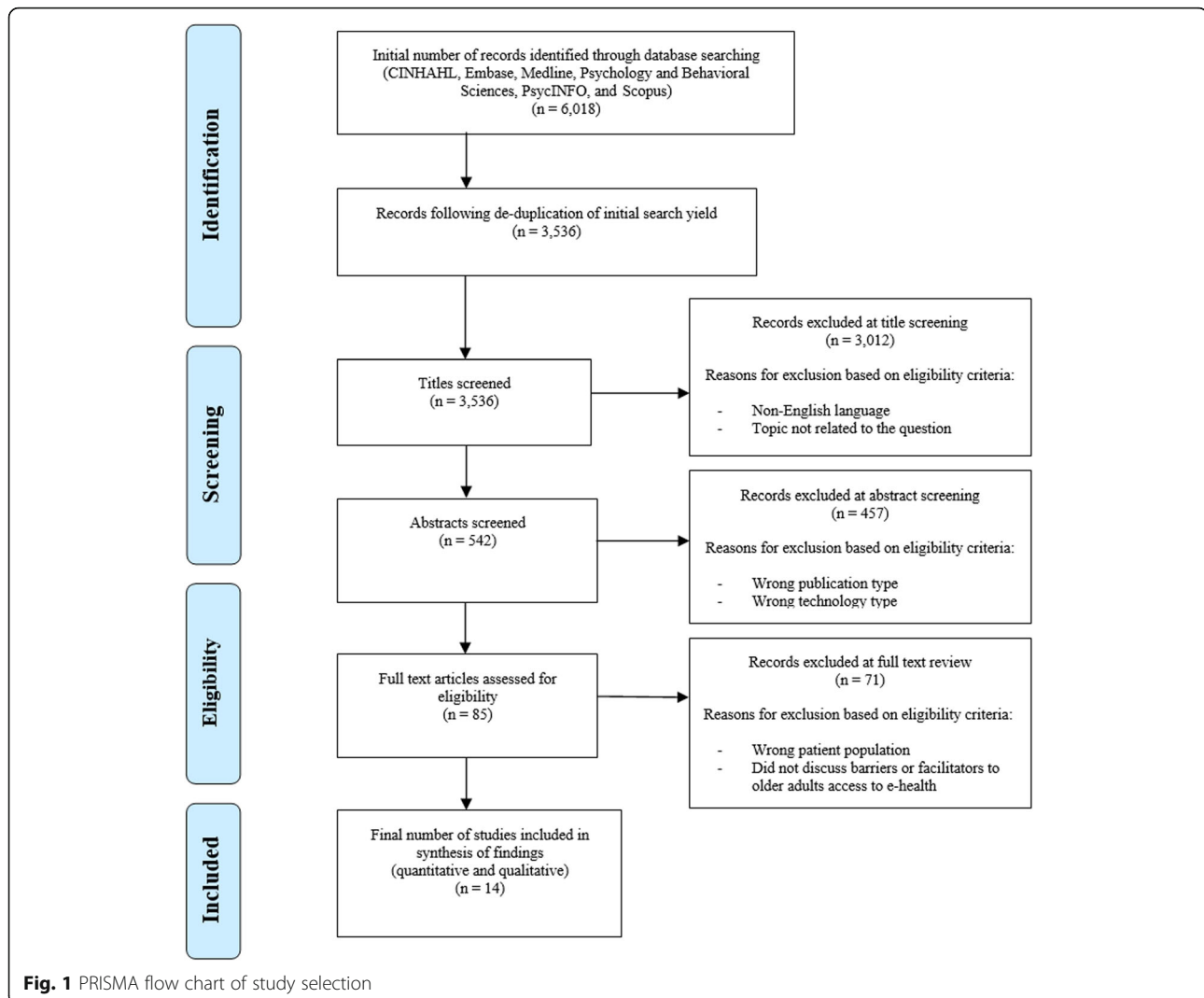
Screening

Figure 1 shows the PRISMA flow chart. A total of 3536 papers were identified and were uploaded to Covidence (https://www.covidence.org/), where all screening and data management was completed against the inclusion and exclusion criteria. After screening titles by the predefined eligibility criteria, 3012 were excluded, resulting in 542 papers. Following this, a further 457 papers were excluded based on abstract screening, leaving 85 papers for full text review, resulting in a total of 14 papers for extraction. It should be noted that the preliminary search for appropriate papers identified two studies with participants aged 50 years and older, which provided valuable information relating directly to the research question [34, 35]. A decision was made to include these studies, as the mean group age was greater than 60 years. JW performed the initial title and abstract screening phases of the review. Both JW and DBetts reviewed the full text publications for inclusions, with MH resolving any conflicts.

Analysis

Data was extracted from the 14 included studies according to the following fields: author and year, field (e.g., chronic disease or mental health), study design, study focus e.g., (prevention of diabetes or depression intervention), description of population including important demographics such as rural location or physical disability, age range and mean, recruitment country, technology type (e.g., tablet or PC), service or intervention (e.g., pain management application), barriers to access, and facilitators to access. Tables 1 and 2 displays these data. After familiarisation with each of the papers, preliminary coding of three papers was completed by JW and DBetts, and a codebook was created to guide the analysis of the remaining 12 papers by JW. Following this, codes were cross-referenced and synthesised into five thematic categories by JW and DBetts, with consultation from MH to resolve discrepancies. Key themes were discussed with reference to the Unified Theory of Acceptance and Technology Use 2, briefly outlined below.

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Table 1 Characteristics of included papers (*n* = 14)

Author & Year	Study design	Focus	Population (n, mean age)	Recruitment country	Technology
Bhattarai et al. (2020)	Qualitative interviews	App for pain self-management of arthritic pain	65+ years with arthritic pain (16, 73)	Australia	Smart phone
Bujnowska-Fedak & Pirogowicz (2014)	Quantitative survey	How to support elderly Polish people to access e-Health (preferences and attitudes)	60–90 years, supporters, and non-supporters of e-health (286, 74)	Poland	Any device with internet access
Cajita et al. (2018)	Qualitative interviews	Mobile health adoption in older adults with heart failure	66–83 years with heart failure (10, not reported)	USA	Smart phone
Coley et al. (2019)	Mixed methods	Prevention of cardiovascular disease and diabetes	65+ years with cardiovascular or diabetes risk factors (341, 68.7)	Finland, France & Netherlands	PC
Currie et al. (2015)	Qualitative interviews	Attitudes and acceptance of eHealth technologies by older rural people with chronic pain	60–74 years, rurally located people with chronic pain (4, not reported)	Scotland	PC, laptop, or tablet
de Veer et al. (2015)	Quantitative survey	Intention to use e-health	60–77 years (1014, not reported)	Netherlands	PC
Mishuris et al. (2014)	Qualitative interviews	Barriers to patient portal access - veteran specific	50–100 years, veterans (17, 61)	USA	PC or laptop
Nymberg et al. (2019)	Qualitative interviews	Beliefs, attitudes, experiences, and expectations of IT interventions for the prevention and treatment of chronic diseases	65–80 years with at least one chronic disease (15, 73)	Sweden	Any devise with internet access
Park et al. (2020)	Qualitative interviews	Perceptions and experiences of IT medication adherence	Range unknown, Veterans and non-veterans with history of coronary heart disease (28, 67)	USA	Smart phone
Pywell et al. (2020)	Qualitative interviews	Barriers to older adults' uptake of mobile-based mental health interventions	53–77 years with low mood (10, 68)	England	Smart phone
Rasche et al. (2018)	Mixed methods	Barriers to using health apps	61–82 years, general population (95, 67)	Germany	Smart phones and tablet
Still et al. (2018)	Qualitative interviews	Experience of African-Americans' using an app to manage hypertension	62–91 years with hypertension (21, 72)	USA	Smart phone
Van Middelaar et al. (2018)	Qualitative interviews	HATICE (Healthy ageing through internet counselling)	65–84 years with increased risk of cardiovascular disease (20, 71)	Netherlands	PC
Zibrik et al. (2015)	Mixed methods	Immigrant Chinese & Punjabi seniors' barriers and facilitators to e-health	60–79 years. Punjabi, and Chinese immigrants (55, not reported)	Canada	PC

Note. PC = personal computer

Theoretical framework

The Unified Theory of Acceptance and Technology Use (UTAUT) is one of the most comprehensive and widely used technology acceptance models [47]. UTAUT proposes that behavioural intention to use technology is affected by an individual's effort expectancy (degree to which the technology is perceived to be easy to use), performance expectancy (degree to which the technology is perceived to be useful), social influence (degree to which using the technology is supported by an individual's social network), facilitating conditions (the degree to which an individual believes to have the resources to use the technology) [48]. UTAUT2 adds three additional constructs to the original UTAUT—hedonic motivation (degree to which the technology is perceived to be enjoyable), price value (degree to which the technology is perceived to be affordable and cost-effective) and habit

(the degree to which technology use is influenced by the passage of time) [49]. UTAUT and UTAUT2 are most commonly applied using quantitative approaches. However, in this review UTAUT2 was applied as an analytical framework to facilitate deeper insights into the key findings from this review and identify areas for further research.

Results

Of the 14 papers identified, 12 reported on barriers, and 13 reported on facilitators of e-health use in older adults. The characteristics of these papers are summarized in Table 1.

The barriers and facilitators to older adults accessing e-health were each mapped into five thematic categories (1) *individual*, including intrinsic and extrinsic; (2) *technological*, including functionality, content, and

Table 2 Overview of findings

Factor	Category	Barrier	Facilitator
Individual	Intrinsic	Ageing limitations: reduction of hearing, sight, memory, and fine motor control [34, 36–39]. Perceived self-efficacy [35, 38, 40, 41]. Lacking confidence in e-health [42]. Fear and dislike of technology [37]. No interest in learning [37, 42].	Desire to learn [34, 36–38, 41]. Motivation to make a lifestyle change [19, 43]. Altruism: wanting to contribute to scientific progress [19, 41, 43].
	Extrinsic	Lack of experience/skills with e-health [35, 37] or technology [36, 38, 41]. Lack of knowledge of e-health [34, 35]. Previous negative experience [40]. Unmet expectations [37]. Lack of need to change [34, 36, 37, 39]. Fear that traditional services my perish [37]. Disbelief in efficacy of e-health [37, 39, 42]. Lack of external accountability [44, 45]. Inability to incorporate into routine [44]. Required effort [35, 38]. Cultural limitations such as language barriers and e-health detracting from time with family [38].	Belief that e-health services are of benefit [19, 34, 37, 40]. Convenience of e-health [45]. Ability to incorporate into current routine [40, 44, 46]. Previous experience and skills [19, 35, 36, 40]. Previous experience with e-health and required skills [19, 35, 36, 40]. Positive experience with technology generally [37]. Opportunity to learn new information [43].
Technological	Functional	Small screen and text [44]. Small icons, lack of colour contrast [36]. Complex functionality [42]. Poor functionality [35, 37, 41].	Ease of use such as audio feedback, and large and clear visual display [35, 36, 40, 41].
	Content	Lack of alerts [41]. Alert fatigue: reminders/emails/texts [46]. Condescending and impersonalized communication, inability to respond to reminders [46]. Overwhelming and difficult to understand content [35, 38]. Too much content on one page [44]	Personalized content [37, 44–46]. Use of reminders/alerts [41, 44, 46]. Use of images [46].
	Availability	Lack of access to electronic equipment [38]. Cost of electronic equipment and internet service [34, 36].	Free or low-cost electronic equipment [36].
Relational	Technological Support	No training/support to learn [36, 38]. No one to help troubleshoot issues [41]. Reliance on family for guidance, and lack of family's patience and understanding while learning [38].	Training/support to learn [36–39, 41]. Dedicated coach for training and continued support [41]. Peer-to-peer platform to share experiences [44]. Option for family/carer to provide support [34].
	Social Support	Lack of social interaction [37, 45]. Absence of interpersonal communication [35]. Communication through technology considered an 'inauthentic experience' [35].	Socially inclusive and community-based information [38].
Environmental	Location	Poor/unreliable internet [45].	Availability to rural/remote populations [45].
Organizational	Privacy	Health information concerns [35, 42, 46].	
	Trust	Unknown accuracy of information [37, 38, 42]. Not knowing who people are communicating with [35]. Concern over management of emergency situations [37]. Concern over Western Medicine's prioritization of medication [38].	Recommandation from physician [36, 43]. Content designed by experts in the field [45]. Access to specialists through platform [34]. Authenticity: platform with clear credentials [35].
	Data sharing	Lack of communication between health platforms [37].	Sharing of health information between health care providers [39, 44, 46].

Note. Individual = persons' individual attributes including physicality, cognition, experience, skills, and knowledge; technological = the use of the technology, including device functionality, content, and availability; relational = person-to-person engagement and support; environmental = location context and characteristics; organizational = structure, capabilities, and development of the service

availability; (3) *relational*, including technological support and social support; (4) *environmental*, including location; and (5) *organizational*, including privacy, trust, and the sharing of data (see Table 2).

Individual (*n* = 14)
Intrinsic
Intrinsic barriers (including physical, sensory, intellectual ability, and motivation) were discussed by nine of the included studies. Physical ageing was the most prevalent barrier to accessing e-health, with hearing and sight limitations being the most common [34, 36–38]. Concerns about memory were also reported [38], particularly with

remembering passwords, and the acquisition of new information [39]. Additionally, the reduction of fine motor control (i.e., trembling hands) made it difficult to interact with devices, particularly those with small screens [34, 37]. Perceived self-efficacy regarding the use of technology was discussed as a barrier by four of the included studies. Discussion about perceived efficacy focused on: i) the difficulties of using technology [38] and e-health [40]; ii) concerns about the use of digital mental health technologies [35]; and iii) feelings of incompetence [41]. Other intrinsic barriers included a lack of interest in learning, and a fear or dislike of technology [37, 42].

Intrinsic facilitators were discussed by seven studies. Of these, five highlighted a willingness and desire to learn [34, 36–38, 41], finding that participants who articulated an innate sense of curiosity and interest in technology were more willing to use e-health, and more likely to engage and explore various e-health platforms. Other facilitators were a motivation and desire to make a lifestyle change [19, 43] and a desire to contribute to scientific progress by trialling e-health programs in the context of research [19, 41, 43].

Extrinsic

Extrinsic barriers (external factors outside the individual) were discussed by nine studies. These included inexperience with e-health [35, 37] or with computers/technology in general [36, 38, 41], and an overall lack of awareness of e-health opportunities [34, 35]. Some studies reported that participants had previous negative experiences [40] or unmet expectations [37] in relation to e-health services; a preference for traditional health care services [34, 36, 37, 39]; or a genuine fear that, if unused, traditional health services may cease to exist [37]. Stigma around e-health services in some studies extended to a disbelief in the reported advantages of technology [37], lack of confidence in the use of technology as a health service [42], and a belief that telephones (smart phones) are for telephone communication only and not for health services [39]. Other studies reported that the perceived lack of routine and structure (external accountability) provided by e-health services [44, 45] created a barrier to incorporate e-health into daily routines [44], and a perception that learning to engage with e-health involves more effort than reward [35, 38]. Cultural barriers, including second language difficulties and the cultural value of technologies detracting from time with family were also noted [38].

Extrinsic facilitators were identified by eleven studies. These included a perception that e-health services are of benefit [19, 34, 37, 40] and have the potential to support health care management [37], independent living [40], and self-managed care [39, 43, 46]. One study identified the convenience afforded by e-health programs, allowing participants to progress their care at their own pace and accommodating issues such as reduced mobility [45]. Three studies found that the ability to incorporate e-health into participant routines facilitated their use of these services [40, 44, 46].

Six studies focused on participants' previous experiences of, and skills relating to, e-health programs [19, 35, 36, 40], finding that prior exposure to, or experience of, e-health [35] and previous positive experiences with technology more generally [37], facilitated the use of e-health in the future. A related finding was that for some

participants the opportunity to learn new information acted as a facilitator for engaging with e-health [43].

Technological (*n* = 11)
Functional

Six studies discussed functional barriers related to the design of e-health programs and their interface with older end users. Problematic features included small screen and text [44]; small icons and lack of colour contrast between text and background [36]; and complex functionality that assumes the user has experience with the technology [42]. Poorly functioning platforms, including problems with logging in and navigation [41], and faulty IT systems that did not function as intended [35, 37] were also barriers to use.

Functionality (ease of use) was identified as a facilitator to e-health use in four studies [35, 36, 40, 41]. For example, de Veer et al. highlighted the importance of platforms that are 'pleasant' to interact with, and Cajita et al. identified useful features for older adults, such as a large visual display and audio feedback for users [36, 40].

Content

Five studies discussed barriers relating to content, such as built-in reminder systems to reinforce e-health use. Lack of alerts or reminders was a barrier reported by van Middelaar et al. [41]. On the other hand, participants trialling a medication adherence application reported 'alert fatigue', from too many reminders [46]. Participants in this study also reported condescending communication (praise for taking medication), impersonal messages, and an inability to respond to messages (facilitates memory) as barriers to continued use [46]. Regarding service content, the large amount of information offered across e-health services was perceived as overwhelming and difficult to understand [35], particularly when the information included complex medical terminology [38]. Additionally, having too much content on one page was a barrier to use [44].

Five studies discussed the content of e-health services as facilitators, highlighting the need for specifically curated, personalized content, that aligns closely with user needs [37, 44–46]. Additionally, three studies found that e-health use was facilitated by reminders and alerts about content [41, 44, 46], and the use of images to facilitate memory and attention in relation to medication [46].

Availability

Barriers relating to e-health availability were discussed by three studies. These included a lack of access to the required electronic equipment (i.e., smart phone, tablet, or computer) [38] and the cost to purchase and upgrade this equipment, as well as the cost of an internet/mobile

data or wi-fi service [34]. In particular, cost was a barrier for older adults who were on a limited or fixed income such as a pension [36]. Participants in Cajita et al. stated that the cost of the required equipment outweighed the perceived benefit of engaging with e-health [36]. In contrast, one study found that free, or low-cost, electronic equipment such as a computer or smart phone facilitated the use of e-health by older adults [36].

Relational (*n* = 7)
Technological support
Three studies found that a lack of technological support (e.g., training, troubleshooting, and guidance) provided alongside e-health programs was a barrier to uptake. For example, participants in two studies stated that they would have felt more encouraged to use e-health if they were given adequate training and support in using the technology [36, 38]. Participants in another study were discouraged from using an online counseling platform because there was no support to troubleshoot issues [41]. Reliance on family for support and guidance, and a lack of patience and understanding from family members while participants were learning to use the mobile technology, was also highlighted as a barrier [38].

Seven studies identified technological support as a facilitator to e-health use by older adults. Five studies found that uptake was facilitated by training and support in relation to the technical aspects of a program [36–39, 41]. Findings highlighted the need for a dedicated coach to provide training, and continued feedback, to support participant engagement and progress through the e-health program [41]. Additionally, Bhattarai et al. found that peer-to-peer based platforms allowed participants to share knowledge and experience, thereby facilitating e-health engagement [44]; while Mishuris et al. found that family and carer support could facilitate e-health use [34].

Social support
Lack of social interaction was discussed in three studies as a barrier to e-health use. Not seeing a person face-to-face, whether it be a doctor or peers in a group setting, was a key deterrent to e-health uptake [37, 45]. For participants using a mobile-based mental health intervention, the lack of interpersonal communication was perceived to detract from the therapeutic process, with communication via technology considered an 'inauthentic' experience for this age group [35].

One study found that inclusive, community-based approaches to designing and implementing e-health supported uptake by participants, such as peer-led health information sessions, and receiving information from the community was particularly important for diverse ethnocultural groups [38].

Environmental (*n* = 1)
Location
Unreliable or unavailable internet services in rural and remote locations, were discussed as barriers in one study [45]. On the other hand, one study focusing on older adults in rural and remote communities [45] addressed environmental factors relating to location, finding that e-health reduced the need to travel long-distances to health care appointments.

Organisational (*n* = 10)
Privacy
Concerns about privacy and security were raised by participants in three studies [35, 42, 46]. In one study, 28% of respondents surveyed viewed privacy as a barrier to using e-health [42]. Additionally, participants using a mental health intervention expressed concerns about who was accessing their health information, and how information was being shared with practitioners [35]. No studies identified specific facilitators relating to privacy.

Trust
Mistrust of e-health was reported across four studies, with a lack of trust in the accuracy of the information contained in e-health being the greatest concern [37, 38, 42]. Other issues of trust related to participants' uncertainty about who they were communicating with, particularly about mental health issues [35]; and appropriate management of emergency situations [37]. Additionally, Chinese and Punjabi immigrants in Zibrik et al.'s study expressed a distrust in e-health due to a perceived association with Western medicine's prioritization of medication over natural therapies [38].

Five studies discussed trust, with two identifying that e-health services recommended by a physician were more likely to be used by older adults [36, 43]. In one study, this recommendation took the form of a letter inviting patients to participate in an e-health program from their trusted practitioner [43]. Further, participants were more likely to trust e-health services that were designed by experts in the field [45], provided access to specialists [34], and provided a clear purpose and transparent credentials [35].

Data sharing
One paper identified a lack of information communication between health platforms and professionals as a barrier, with participants expressing a desire for e-health services to be streamlined, and information to be shared [37]. Supporting this finding, [37] three studies in which e-health platforms had the capability to share data with health services found that this facilitated the use of e-health [42].

Discussion

This scoping review sought to explore barriers and facilitators to the use of e-health by older adults, with the aim of informing future development and uptake of digital health and mental health interventions for this age group. The Unified Theory of Acceptance and Use of Technology2 (UTAUT2) was used as an analytical framework to further examine the findings and identify opportunities for future research.

Analysis of the five thematic categories resulted in three broad implications for the development of future e-health services for older adults. These relate to the 1) design of the e-health service; 2) training and education provided to increase e-health literacy; and 3) perceived authenticity of the service. Contextual implications are discussed as a sub-theme.

Design of the e-health service

Consideration of the specific needs of older adults in the design of digital health services was one of the most significant factors impacting uptake and ongoing use of e-health services in this review. Consistent barriers related to the functionality of e-health platforms and problems with the user interface, such as small screens, text, and images. These barriers reflect a lack of consideration of physical difficulties associated with ageing, such as poor eyesight, hearing, and memory, which can hinder older people's engagement. Findings also showed that older people can become overwhelmed by new information and alerts, and by challenges associated with altering or customising the user interface to their individual needs, creating barriers to uptake. Conversely, when the design of e-health services addresses the needs of older adults, engagement increases. Specifically, e-health services that were accessible, pleasant to use, had larger screens, such as a tablet or desktop/laptop, larger font size, audio features, notifications, and diverse, curated content showed greater uptake. Based on these findings, the following features should be considered in the design of e-health services: i) offering services that are accessible across multiple technologies including tablets and computers; ii) features such was audio feedback, large text size, and a notification system that allows users to set how and when they are notified, enabling engagement with platforms in a manner that best suits the individual; and iii) including wide and diverse information that can be curated for the user based on their circumstances, reducing the need for navigation through content that may be irrelevant and overwhelming, while still offering a platform that addresses multiple health needs without requiring users to engage with different platforms, services, or professionals.

Findings from this review suggest that both useability and usefulness are important factors to consider when designing future e-health services. These factors align with the constructs of individual effort expectancy and performance expectancy in the UTAUT2 framework. In fact, one study included in this review applied the UTAUT, finding that effort expectancy and performance expectancy were both highly related to older people's intention to use e-health [40]. It should be noted that findings from other studies differ, suggesting that for older people, effort expectancy is more important than performance expectancy in predicting the uptake of digital technologies [50], however, this study did not specifically focus on the use of e-health services.

Useability and usefulness have been recognized as important components of successful e-health uptake in the wider literature [51], with De Rouck et al. [52] noting that a thorough understanding of the factors that impact on the useability and usefulness of e-health services for specific end users would support technological design and effectiveness. Since older adults are not a homogenous group [2], their physical needs and ability to engage with digital platforms can vary. Consideration of age-related factors and allowing older adults to customize platform interfaces would provide them with more options to engage. To address these issues, findings from this review suggest that future e-health developers should not only consider the design elements described earlier in this discussion but should actively incorporate the feedback of older adults in their design, engagement, and delivery strategies. This process of consultation can be achieved using focus groups, individual interviews or surveys, and pilot studies – all of which can occur both pre- and post-development of e-health platforms.

Training and education to increase e-health literacy

Alongside design, a significant factor influencing the successful uptake of e-health by older adults was training and education in how best to use the technology to their advantage. The ability to use and benefit from e-health, known as e-health literacy, is an important part of ensuring the effectiveness of e-health program engagement and outcomes across the lifespan [53, 54]. In this review, effective training, and education to develop e-health literacy took two distinct forms—providing practical skills to support older adults' use of e-health programs and addressing misconceptions or previous negative experiences with e-health programs.

In relation to practical skills, common barriers were a lack of i) previous experience, ii) training on how to use the technological features of the program, and iii) access to formal or informal supports to troubleshoot problems. Yet, older adults who were provided with support, guidance, and training were more likely to express positive associations with e-health. Specific examples of

successful training and support included; addressing issues of discouragement and inexperience by providing a dedicated coach for initial and ongoing guidance; helping to build trust, encouragement, and motivation [41]; addressing a lack of basic computer skills by facilitating and offering low-cost group computer classes [38]; and including family and carers in initial training sessions so they could provide informal ongoing support [34]. Additionally, where support and training focused on the potential benefits of e-health, older adults were less likely to perceive it as difficult, incompatible with their current health and lifestyle needs, or ineffective as a treatment platform.

Application of the UTAUT2 suggests that providing older people with training and education in the use of e-health technologies may facilitate effort expectancy, performance expectancy and facilitating conditions. They also suggest that social influence may play a role in supporting ongoing engagement with e-health, supporting findings from a previous systematic review [55]. In contrast, de Veer et al. [40] found that social influence had no impact on e-health uptake, after beliefs about performance expectancy and effort expectancy had been taken into account. According to Venkatesh et al. [48] social influence only plays a role in a mandatory context. However, findings from this review suggest that receiving information and support from community members was important for older people, particularly those from diverse ethnocultural groups [38]. Future research should therefore explore the impact of social influence on e-health uptake by older people from specific cultural groups.

Authenticity

Findings from this review suggested that e-health uptake is enhanced when e-health services and service providers are perceived to be authentic (trustworthy and credible). Older adults were less likely to engage with e-health services when they were concerned about how their privacy would be protected. Additionally, some older adults expressed uncertainty about the appropriate sharing of their personal information with other health services, with one study reporting that participants favoured e-health programs that were streamlined across traditional service settings and shared pertinent information with appropriate health professionals across these settings [37]. The importance of establishing trust in e-health has been increasingly recognised as a key challenge for the field, with previous research suggesting that consumer confidence in information security and privacy is likely to influence how they choose to engage [56]. These concerns could be addressed by employing strategies to strengthen the authenticity of the e-health program. Strategies could include referrals to e-health

services from a trusted source such as a general practitioner or mental health service provider [36, 43], providing access to health and mental health specialists [34], and ensuring that e-health services practice effective collaboration in the management and sharing of relevant health information [39, 44, 46].

Findings from this review suggest that the impact of variables such as perceived credibility and trustworthiness on e-health uptake by older adults may warrant further exploration. While the UTAUT2 does not include a specific construct relating to trust, a recent study by [27] extended the UTAUT2 by adding two important factors, mass media (channels of communication—whether written, broadcast, or spoken—that reach a large audience) and trust (the subjective expectation with which consumers believe that a specific transaction occurs in a way consistent with their expectations). Application of these constructs in a small sample of Jordanian community members ($n = 7$) found that the adoption of a mobile banking technology was positively and significantly influenced by the mass media (television, radio and internet promotion) and trust (security and privacy of the mobile banking service) [27]. These additional constructs shed new light on the findings of this review. Viewed in combination, is possible to infer that targeted public health media campaigns to raise the profile, relevance, and credibility of e-health services, and articulate how to evaluate the credibility and utility of these services, may be effective in addressing some of the barriers to e-health uptake by older adults.

Contextual considerations

So far, this discussion has focused on three broad implications for the development of e-health services for older adults. While not as prominent in the literature, the sub-theme of contextual considerations nonetheless offered important insights for future development of e-health programs for older adults.

In some studies, financial factors were highlighted as a barrier to accessing e-health programs. Older adults who were retired, on a fixed income, or who lived in a remote location were less likely to engage with e-health programs. The ability to use technology was also restricted by the type of access to the internet, the cost of owning or upgrading a computer, or a perception that the cost of accessing e-health programs outweighed the benefits. Analysis of these findings using the UTAUT2 suggest that price value may be an important facilitating condition that plays a role in the uptake of e-health technologies by older people. Further research applying the UTAUT2 with this population is needed to determine the predictive power of this construct.

Findings from this review highlight the important issue of equity in accessing e-health, where a possible digital

divide exists beyond age or generational issues [18]. The notion of a digital divide broadly refers to the separation that can exist between those who have access to, and the ability to understand diverse technological resources, and those who do not [57]. Research in this area has found that structural inequalities such as low socioeconomic status, ethnicity, and education levels, often contribute to such disparities in the use of e-health programs [58, 59]. Further, Beard [12] suggested that challenges of appropriate resourcing and access to technology are likely to be more significant for older adults than for other groups; an observation supported by this review. Conversely, e-health also holds great potential for enhancing access to health and mental health programs for older adults, particularly those with disabilities or those who live in remote locations, with limited transport options.

Gaps in the literature and opportunities for future research

While literature on the impacts and efficacy of e-health for older adults is growing [19, 20], to date, few studies have focused on understanding the practical and conceptual barriers and facilitators for older adults in accessing e-health services. Given the rapid increase in population ageing, and the complex health and mental health challenges older people can experience, future research exploring the potential for e-health to respond to these challenges is essential. Research with a focus on digital *mental* health interventions for older people is needed, as this review identified only one study that focused on the use of e-mental health by older people. This finding is concerning given the prevalence of mental health concerns in older populations [4, 5], the increased risk of physical health problems in older adults with mental health problems [60], and Australian data indicating that older adults are the least likely of all age groups to access mental health services [61]. Future research is also needed to explore broader environmental and contextual factors impacting on e-health use by older people, as the existing literature tended to focus on individual, relational and design-related factors. Findings from one study suggested that including older people in the process of designing and developing e-health services may enhance their relevance for, and use by, this population. More research is needed to explore how older adults can best be included in the e-health design process.

Additional gaps in the literature were highlighted when applying the UTAUT2. Notably, findings from this review did not find evidence that specifically supported the constructs of habit and hedonic motivation. While three studies did find that e-health uptake was enhanced when participants were able to integrate the e-health service into their pre-existing routines, this finding does not directly address the construct of habit (the length of time from initially adopting and using e-health). Further research could address this gap by exploring whether the passage of time has an impact on e-health engagement by older people. While e-health services are not conventionally designed to be enjoyable, future research could also investigate what aspects of hedonic motivation might support engagement with these services. Finally, findings from this review suggested that the constructs of price value and social influence may facilitate the uptake of e-health services by older people. Of particular importance was the finding that these constructs may impact on specific groups of older people who are already experiencing higher levels of disadvantage, such as older people on low or fixed incomes, or older people from cultural or ethnic minority groups. This highlights an urgent need for future research examining factors that facilitate or hinder the use of e-health services by specific groups of older people, who may be particularly vulnerable or marginalised. Combining UTAUT2 with normative theories of social justice and equity may facilitate such efforts [47].

Limitations

This review has several limitations. Firstly, as non-English publications were excluded, any pertinent non-English language publications are likely to have been missed, possibly resulting in a culturally biased review. Secondly, while the inclusion criteria for this review enabled identification of a wide range of literature the use of broader search terms means that studies focused on more specific, narrow subject areas may have been missed. Finally, while PRISMA-ScR guidelines were adhered to at every stage of this review, the protocol was not registered.

Conclusion

Consideration of the specific barriers and facilitators that influence the use of e-health by older adults is critical to improve their use of e-health programs, and to realise the potential of technology to ameliorate the challenges associated with traditional healthcare for this group. Findings from this review suggested that older adults are more likely to use e-health services that are cognizant of their physical and functional needs, provide appropriate education and training to engage with e-health, address previous negative experiences of, and misconceptions about, digital health technologies; and employ strategies to enhance the perceived trustworthiness and credibility of e-health. Further research is needed to explore the practical and conceptual barriers and facilitators for older adults in accessing e-health.

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Supplementary Information

Additional file 1.

Acknowledgements
Not applicable.

Authors' contributions
J.W and D. Betts completed the literature search for included studies. J.W wrote the introduction, methods, and results (barriers), and prepared all tables, figures, and references. M.H wrote the discussion with D. Betts, supported J. W and D. Betts with the thematic analysis, reviewed and provided feedback on the whole article. D.Betts wrote the results (facilitators), and the discussion with M.H. D.Booth completed the database search. F.KL reviewed and provided feedback. The author(s) read and approved the final manuscript.

Availability of data and materials
All data generated or analysed during this study are included in this published article [and its supplementary information files], including PRISMA checklist, and raw extraction file.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
We have no conflict of interest to declare.

Author details
[1]Centre for Brain and Mental Health Research, University of Newcastle, Callaghan, NSW 2308, Australia. [2]School of Humanities and Social Science, University of Newcastle, Callaghan, NSW 2308, Australia. [3]University Library, University of Newcastle, Callaghan, NSW 2308, Australia.

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Publisher's Note

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Review

Implementation Strategies to Enhance the Implementation of eHealth Programs for Patients With Chronic Illnesses: Realist Systematic Review

Cecilie Varsi[1], PhD; Lise Solberg Nes[1,2,3], PhD; Olöf Birna Kristjansdottir[1,4], PhD; Saskia M Kelders[5,6], PhD; Una Stenberg[4], PhD; Heidi Andersen Zangi[7,8], PhD; Elin Børøsund[1], PhD; Karen Elizabeth Weiss[9], PhD; Audun Stubhaug[2,10,11], PhD; Rikke Aune Asbjørnsen[1,5,12], MSc; Marianne Westeng[1], MSc; Marte Ødegaard[13], MSc; Hilde Eide[1,14], PhD

[1]Center for Shared Decision Making and Collaborative Care Research, Division of Medicine, Oslo University Hospital, Oslo, Norway

[2]Institute of Clinical Medicine, Faculty of Medicine, University of Oslo, Oslo, Norway

[3]Department of Psychiatry and Psychology, Mayo Clinic, Rochester, MN, United States

[4]Norwegian National Advisory Unit on Learning and Mastery in Health, Oslo University Hospital, Oslo, Norway

[5]Center for eHealth and Wellbeing Research, Department of Psychology, Health and Technology, University of Twente, Enschede, Netherlands

[6]Optentia Research Focus Area, North-West University, Vanderbijlpark, South Africa

[7]National Advisory Unit on Rehabilitation in Rheumatology, Department of Rheumatology, Diakonhjemmet Hospital, Oslo, Norway

[8]Faculty of Health, VID Specialized University, Oslo, Norway

[9]Department of Anesthesiology and Pain Medicine, School of Medicine, University of Washington, Seattle, WA, United States

[10]Regional Advisory Unit on Pain, Oslo University Hospital, Oslo, Norway

[11]Department of Pain Management and Research, Division of Emergencies and Critical Care, Oslo University Hospital, Oslo, Norway

[12]Department of Research and Innovation, Vestfold Hospital Trust, Tønsberg, Norway

[13]University of Oslo Library, University of Oslo, Oslo, Norway

[14]Science Centre Health and Technology, University of South-Eastern Norway, Drammen, Norway

Corresponding Author:
Cecilie Varsi, PhD
Center for Shared Decision Making and Collaborative Care Research
Division of Medicine
Oslo University Hospital
PB 4950 Nydalen
Oslo
Norway
Phone: 47 90856339
Email: cecilie.varsi@rr-research.no

Abstract

Background: There is growing evidence of the positive effects of electronic health (eHealth) interventions for patients with chronic illness, but implementation of such interventions into practice is challenging. Implementation strategies that potentially impact implementation outcomes and implementation success have been identified. Which strategies are actually used in the implementation of eHealth interventions for patients with chronic illness and which ones are the most effective is unclear.

Objective: This systematic realist review aimed to summarize evidence from empirical studies regarding (1) which implementation strategies are used when implementing eHealth interventions for patients with chronic illnesses living at home, (2) implementation outcomes, and (3) the relationship between implementation strategies, implementation outcomes, and degree of implementation success.

Methods: A systematic literature search was performed in the electronic databases MEDLINE, Embase, PsycINFO, Scopus, Allied and Complementary Medicine Database, Cumulative Index to Nursing and Allied Health Literature, and Cochrane Library. Studies were included if they described implementation strategies used to support the integration of eHealth interventions into practice. Implementation strategies were categorized according to 9 categories defined by the Expert Recommendations for

Implementing Change project: (1) engage consumers, (2) use evaluative and iterative strategies, (3) change infrastructure, (4) adapt and tailor to the context, (5) develop stakeholder interrelationships, (6) use financial strategies, (7) support clinicians, (8) provide interactive assistance, and (9) train and educate stakeholders. Implementation outcomes were extracted according to the implementation outcome framework by Proctor and colleagues: (1) acceptability, (2) adoption, (3) appropriateness, (4) cost, (5) feasibility, (6) fidelity, (7) penetration, and (8) sustainability. Implementation success was extracted according to the study authors' own evaluation of implementation success in relation to the used implementation strategies.

Results: The implementation strategies management support and engagement, internal and external facilitation, training, and audit and feedback were directly related to implementation success in several studies. No clear relationship was found between the number of implementation strategies used and implementation success.

Conclusions: This is the first review examining implementation strategies, implementation outcomes, and implementation success of studies reporting the implementation of eHealth programs for patients with chronic illnesses living at home. The review indicates that internal and external facilitation, audit and feedback, management support, and training of clinicians are of importance for eHealth implementation. The review also points to the lack of eHealth studies that report implementation strategies in a comprehensive way and highlights the need to design robust studies focusing on implementation strategies in the future.

Trial Registration: PROSPERO CRD42018085539; https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=85539

Introduction

Electronic health (eHealth), defined as "health services and information delivered or enhanced through the Internet and related technologies" [1], has great potential for persons with chronic or long-term illnesses. For example, eHealth provides options for self-management, patient-provider communication, monitoring, and shared decision making [2-5]. A growing body of evidence indicates positive effects of eHealth services on patient health outcomes [6-9]. For example, telehealth is regarded as a safe option for delivery of self-management support [10], and internet-delivered cognitive behavioral therapy (ICBT) has shown promising results as an alternative to traditional face-to-face interventions among persons with chronic health illnesses [3]. Similarly, studies indicate that eHealth services can be effective in reducing hospital admissions for patients with chronic illnesses such as chronic obstructive pulmonary disease [11] and reducing symptoms of anxiety and depression [12] and may contribute to successful self-management of chronic pain [13]. Moreover, patients using eHealth services have reported high levels of acceptability and satisfaction [11,14], and health care providers have described clinical benefits from eHealth services [2]. Understanding more about the implementation of eHealth services for patients with chronic conditions, a large patient group with unpredictable disease trajectories and the need for coordinated long-term multidisciplinary follow-up, would be beneficial and could lead to successful implementation in other areas.

Even with a growing number of eHealth programs, many of which have shown promising results [15], the actual implementation of such programs into everyday use in clinical practice has proven to be challenging [16,17]. The implementation process can be demanding and requires significant effort to succeed [18]. The phase between the organizational decision to adopt an eHealth program and the health care providers' routine use of that program is multifaceted and complex [4,15,18]. Implementation strategies, defined as

"a systematic intervention process to adopt and integrate evidence-based health innovations into usual care" [19], can aid the implementation of eHealth programs into practice [18-20]. Implementation strategies constitute the how-to component of changing health care practice [20], and a number of known implementation strategies can possibly impact implementation success [19,21,22]. When implementation is initiated in a clinical health care setting, the use of implementation strategies refers to the concrete activities taken to make patients and health care providers start and maintain use of new evidence within the clinical setting. Implementation strategies are often part of an implementation plan, which describes what will be implemented, to whom, how and when, with the implementation strategies constituting the how-to in the plan. The implementation strategies can include a wide range of activities directed toward different stakeholders (eg, involvement of health care providers and patients, training and follow-up in the delivery of the clinical intervention, leadership engagement and internal and external support) [22]. The implementation strategies can be used as standalone (discrete) strategies or as a combination of strategies (multifaceted) [23]. Even though the research on implementation strategies is still in its infancy, there is a growing recognition that implementation will not happen automatically and that use of implementation strategies can be effective, particularly as they target those intending to use the new evidence directly [23,24].

Despite existing implementation strategy taxonomies and implementation process models (ie, practical guidance in the use of implementation strategies to facilitate implementation) [25], and the fact that some organizations have developed a set of implementation strategies for use in their own implementation processes [26], there is still limited understanding regarding which strategies to use and the relative importance of these strategies when promoting use of evidence-based interventions in clinical practice [22,27]. Notably, Greenhalgh and colleagues [28,29], who recently developed and tested a framework for nonadoption, abandonment, scale-up, spread, and sustainability

(NASSS) of health and care technologies, argue that technology implementation will not succeed until the complexities of multiple, interacting domains (eg, the illness, the technology, the organization, and the implementation process) are taken into account and addressed. With the exception of a few initiatives such as the one taken by the Greenhalgh group, little emphasis has been placed on the planning of and reporting on implementation strategies related to the implementation of eHealth interventions into practice [30,31]. Research literature has summarized different aspects of eHealth implementation [18], including barriers and facilitators [32-34], frontline staff acceptance of eHealth technologies [35], patient recruitment strategies [36], and eHealth implementation in rural areas [31]. However, the empirical research literature on strategies for eHealth implementation has not yet been reviewed or summarized. Also, the relationship between implementation strategies, implementation outcomes, and implementation success is rarely adequately described.

Implementation outcomes can be measured by means of various methods (eg, qualitative, quantitative, mixed), and the success of the implementation effort can be evaluated on the basis of implementation outcomes [37]. When seeking to understand implementation outcomes, researchers have stated that the relative importance of each single outcome measurement may vary in importance depending on stakeholders and may have different consequences depending on setting [37]. This indicates that implementation success is not necessarily derived directly from the implementation outcome measurements. Therefore, assessment of implementation success in addition to implementation outcomes can, as pointed out by Proctor and colleagues [37], play an important role in understanding and assessing the success of the implementation effort.

This project sought to further research and gain knowledge in this area through a systematic realist review. The realist review approach involves identifying how and why interventions work (or fail to work) in different contexts and examines the links between context, mechanisms, and outcomes [38]. Unlike classical systematic reviews, realist reviews focus not only on if the program works but also on how, why, and for whom [38]. The approach is often described as "what works for whom under what circumstances and why." As noted by Rycroft-Malone and colleagues [39], the realist review method is especially suited when conducting reviews on implementation, due to implementation processes' complex, multifaceted nature and the limited understanding of their mechanisms of action [39]. This systematic realist review aimed to summarize evidence from empirical studies regarding (1) which implementation strategies were used when implementing eHealth interventions for patients with chronic illnesses living at home; (2) which implementation outcomes were achieved; and (3) the relationship between implementation strategies, implementation outcomes, and degree of implementation success.

Methods

Overview

A systematic realist review, by means of an aggregative approach using predefined concepts (ie, implementation strategies and implementation outcomes) [40] was considered suitable to provide an explanatory analysis focusing on which implementation strategies were used, in what circumstances, how, and leading to which implementation outcomes. In addition, as an evaluation of the reported implementation outcomes, the degree of implementation success was summarized qualitatively based on the study authors' own definition. This review focused on the implementation of eHealth programs used by patients with chronic illness in their own homes. See Table 1 for details, key terms and definitions. The protocol for this realist systematic review has been registered and published in the Prospective Register of Systematic Reviews (PROSPERO; CRD42018085539).

Table 1. Key terms and their definitions.

Term	Definition
eHealth	Health services and information delivered or enhanced through the internet and related technologies [1]. Including but not limited to: - mHealth (mobile health): health practice supported by mobile devices [41] - Telehealth: using telecommunications and virtual technology to deliver health care outside of traditional health care facilities [42] - Patient portals (secure online websites that give patients access to personal health information) [43] For inclusion in this review, the eHealth program had to have patients/clients in their own homes as the primary users, optionally with support or involvement from health care providers. In this publication, the collective term eHealth is used unless a more specific definition is considered of essence.
Implementation	Process of putting to use or integrating evidence-based interventions within a setting [44].
Implementation strategy	Systematic intervention process to adopt and integrate evidence-based health innovations into usual care [19]. The Expert Recommendations for Implementing Change project has defined and sorted implementation strategies into a taxonomy consisting of the following categories: (1) engage consumers, (2) use evaluative and iterative strategies, (3) change infrastructure, (4) adapt and tailor to the context, (5) develop stakeholder interrelationships, (6) use financial strategies, (7) support clinicians, (8) provide interactive assistance, and (9) train and educate stakeholders [22].
Implementation outcome	Effects of deliberate and purposive actions to implement new treatments, practices, and services [37]. Proctor and colleagues [37] have defined and sorted implementation outcomes into the implementation outcome framework consisting of the following terms: (1) acceptability, (2) adoption, (3) appropriateness, (4) costs, (5) feasibility, (6) fidelity, (7) penetration, and (8) sustainability.

Literature Search

A systematic literature search was performed by the librarian (MØ) in the electronic databases MEDLINE, Embase, PsycInfo and Allied and Complementary Medicine Database (Ovid), Cumulative Index to Nursing and Allied Health Literature (EBSCOhost), Scopus, and Cochrane Library. The search terms were developed by the first author (CV) and the librarian (MØ) using a combination of keywords and database-specific headings and covered the period from January 1, 2006, to October 4, 2018. The starting point for the review period was set to the year of the first issue of the journal Implementation Science (2006), since there was a pronounced focus on implementation from that point, although some researchers had been working within this field earlier. The basic search strategy (Multimedia Appendix 1) was modified for use in each database. Additional studies were detected based on references and citations in the included studies.

Criteria for Considering Studies for the Review

Inclusion criteria for studies in the review were the reporting of implementation strategies used in the implementation of eHealth programs seeking to support adults with chronic illness in their own homes. Studies were included only if they provided a description of the implementation strategies they had used. Studies were, for example, excluded if they only mentioned training had been conducted or management had been involved without any further description of the content of the training or management engagement.

The following illnesses were included: chronic disease, arthritis, chronic pain, chronic obstructive pulmonary disease, obesity, diabetes mellitus, and mental disorder. Empirical studies in English, Dutch, and Scandinavian languages published in peer-reviewed journals were included. All study designs were included. Literature reviews, meta-analyses, theoretical articles, book chapters, editorials, study protocols, dissertations, studies published in abstract form only, and duplicates were excluded. eHealth programs involving primarily children, adolescents, and family care givers or solely for health care providers were excluded.

Study Selection Process

All titles and abstracts were reviewed by the first author (CV). Irrelevant publications (eg, studies focusing on non-eHealth programs) were excluded. Next, two of the authors (CV and one of the coauthors) independently reviewed titles and abstracts using the systematic review software Covidence (Veritas Health Innovation). When the authors were in agreement, the studies were included for full-text review. When the authors were not in agreement, the first author (CV) conducted a second review and subsequently made a decision. If there was doubt, the study was selected for full-text review. Next, CV and one of the coauthors independently reviewed full-text studies separately. When the authors agreed, the studies were included. If the

authors disagreed, the first author conducted a second review and subsequently made a final decision. The authors met several times during this process in order to discuss and reach agreement on the understanding of the inclusion and exclusion criteria.

Data Extraction and Evidence Appraisal

Data were extracted using a data extraction form developed by the authors for the purpose of this review relating to the study details, country of origin, design, setting, population, demographics, intervention, implementation framework, implementation strategies, implementation outcomes, and implementation success. NVivo software version 11 (QSR International) was used to organize and facilitate the extraction. The data extraction was guided by the aims of the review, focusing on (1) implementation strategies used, (2) implementation outcomes achieved, and (3) the relationship between implementation strategies, implementation outcomes, and degree of implementation success. The identified implementation strategies were sorted according to the 9 categories defined by the Expert Recommendations for Implementing Change (ERIC) project [22]. See Table 2 for specific description of implementation strategies. The identified implementation outcomes were sorted by the 8 categories in the implementation outcome framework defined by Proctor and colleagues [37]. See Table 3 for specific description of implementation outcomes. The taxonomies of ERIC and Proctor have been successfully used by other researchers [45-47] and were used in this review. Implementation success was extracted according to the study authors' own evaluation of implementation success in relation to the implementation strategies used, not based on a specific framework. The data extraction was conducted in two steps. First, implementation strategies, implementation outcomes, and implementation success were extracted separately. Next, these 3 sets of data were put together in a table to evaluate their interrelationships (eg, qualitatively assessing whether certain combinations were more common than others). The first author (CV) extracted data from all included studies. A second author (SMK) validated the data extraction of 25% (3/12) of the included studies.

Traditional quality assessment of the included studies in this review was not undertaken. The realist review methodology does not lean on the traditional study hierarchy assessment with the randomized controlled trials at the top, as it is acknowledged that multiple methods are needed to cover the entire picture of what works for whom and under which circumstances [38]. The relevance of the included studies was considered based on each study's ability to answer the research questions of the review, including that the studies had provided at least a minimum description of the content of the implementation strategies used to be incorporated. Rigor was considered related to the study authors' credibility based on the conclusions made in the included studies.

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Table 2. Implementation strategies (adapted from Waltz and colleagues [22]).

Implementation strategies	Description
Engage consumers	Involving, preparing, and intervening with patients and the market to involve them and increase demand for the clinical innovation
Use evaluative and iterative strategies	Planning and conducting the implementation process, including activities such as make a plan, assess for readiness, identify barriers and facilitators, evaluate performance and progress, and provide audit and feedback
Change infrastructure	Changing external structures such as legislation models, as well as internal conditions such as facilities and equipment
Adapt and tailor to the context	Tailoring the innovation to meet local needs and tailoring the implementation strategies toward the identified barriers and facilitators
Develop stakeholder interrelationships	Involving relevant internal and external stakeholders to support and move the implementation process forward
Use financial strategies	Changing the patient billing systems, fee structures, reimbursement policies, research funding, and clinician incentives
Support clinicians	Supporting clinical staff performance
Provide interactive assistance	Supporting implementation issues
Train and educate stakeholders	Providing written and oral training

Table 3. Implementation outcomes (adapted from Proctor and colleagues [37]).

Implementation outcomes	Description
Acceptability	Perception that a given treatment, service, practice, or innovation is agreeable, palatable, or satisfactory
Adoption	Intention, initial decision, or action to try or employ an innovation or evidence-based practice
Appropriateness	Perceived fit, relevance, or compatibility of the innovation or evidence-based practice for a given practice setting, provider, or consumer and/or perceived fit of the innovation to address a particular issue or problem
Cost	Cost impact of an implementation effort (incremental or implementation cost)
Feasibility	Extent to which a new treatment or innovation can be successfully used or carried out within a given agency or setting
Fidelity	Degree to which an intervention was implemented as it was prescribed in the original protocol or intended by the program developers
Penetration	Integration of a practice within a service setting and its subsystems
Sustainability	Extent to which a newly implemented treatment is maintained or institutionalized within a service setting's ongoing, stable operations

Results

Overview of Included Studies

The search generated 10,480 unique references. From these references, 5353 were excluded based on the title alone and an additional 4890 were excluded based on the abstract. The inconsistency in terms used in the research literature on eHealth and implementation strategies led to a large number of hits on irrelevant studies. Most of these studies were therefore excluded, and 237 studies were selected for full text evaluation. Following evaluation by two independent authors (ie, the first author and one coauthor), 11 studies met all inclusion criteria and were included [48-58]. In addition, one study was included based on a manual search of references and citations in the first 11 included studies [59]. See Figure 1 for details on the study selection process.

Figure 1. Flow diagram of the study selection process.
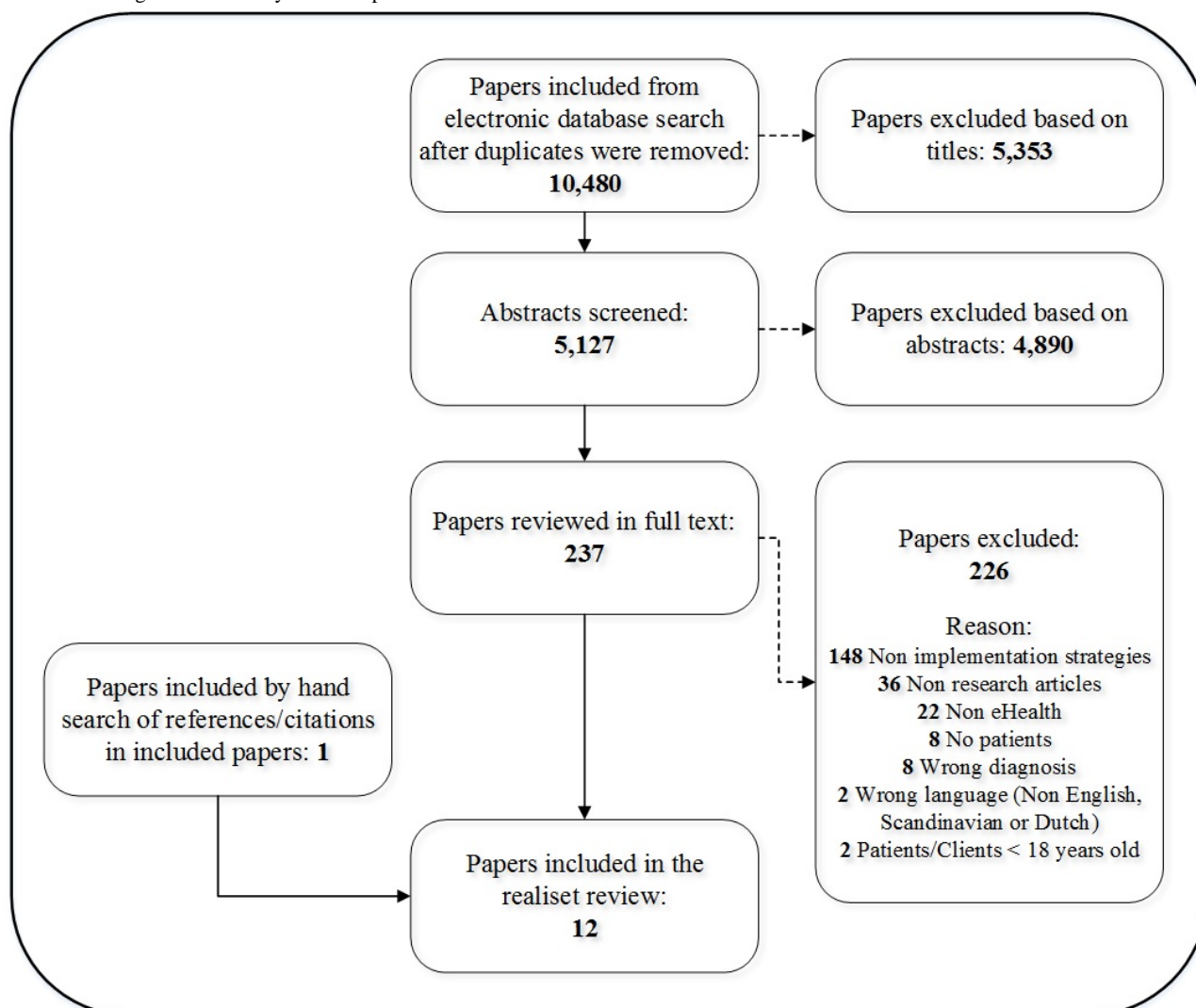
Seven of the 12 included studies used qualitative research design [48,50,52,53,55,58,59], 2 used quantitative design in terms of surveys [51,56], and 3 used mixed-methods design [49,54,57]. Of the final 12 included studies, 2 studies were conducted in the United States [50,54], one in Canada [51], 5 in the United Kingdom [48,52,53,55,59], 2 in the Netherlands [49,56], one in Norway [58], and one in New Zealand [57]. All 12 were published in English.

Two of the 12 included studies were conducted in early phases of the implementation (ie, up to 3 months after implementation startup) [50,56]. Four studies were conducted 4 to 12 months after implementation startup, defined as middle phase [48,49,53,55]. The remaining 6 studies were conducted more than 1 year after implementation startup, defined as late phase [51,52,54,57-59], and 4 of these had multiple data collection time points [51,52,54,59].

eHealth Programs and Patient Groups

Of the 12 included studies, 5 targeted the use of online clinical monitoring programs including patient-provider communication [48,52,53,55,59]. Three studies targeted use of ICBT [51,56,58]. Two used video consultations [49,54], one studied the

implementation of both video consultation and ICBT [50], and one targeted online personal health records [57].

Four of the 12 studies included patients with somatic illnesses (chronic obstructive pulmonary disease, chronic heart failure, and chronic pain) [48,53,55,56], 3 studies included patients with mental health challenges (anxiety and depression) [50,51,58], and 5 studies included patients with long-term illnesses in general [49,52,54,57,59].

Implementation Frameworks and Models

Of the total 12 studies, 8 used implementation frameworks or models to guide the analysis of implementation strategies and/or implementation outcomes. Two studies used the reach effectiveness, adoption, implementation, maintenance framework [50,54], and 2 studies used the normalization process theory [52,58]. Other frameworks/models were used by one study each: consolidated framework for implementation research [51], structurationism [49], promoting action on research implementation in health services [54] and the plan do study act cycle [55]. Finally, one study used the theoretical domains framework in combination with the technology acceptance model [56]. See Table 4 for details.

Table 4. Overview of included studies.

First author	Patient groups	eHealth	Setting	Implementation project	Implementation framework	Imple-mentation stage	Study design	Data collection
Bailey [48]	COPD[a]	Clinical monitoring	Sheltered housing	4 tenants used telehealth for 16 weeks	N/A[b]	Middle[c]	Case study (QUAL[d])	Self-report assessment, observation, focus groups, interviews, workshops
Boonstra [49]	Long-term illnesses	Video consultation	Homecare	From a database of 11,000 regular customers in 2006, 36 used the system	Structurationism	Middle	Single case study (MIXED)	Interviews, workshops, written reports, policy plans, meeting minutes, observations, quantitative data on system use
Fortney [50]	Depression	ICBT[e], *Beating the Blues*, video consultation	Primary care safety net clinics	Implement EBP[f] in 6 federally qualified health centers	RE-AIM[g]	Early[h]	Quality improvement methods (QUAL)	Qualitative needs assessments
Hadjis-tavropou-los [51]	Anxiety, depression	ICBT, *Wellbeing Course*	Community mental health clinics	ICBT implementation in 7 community mental health clinics	CFIR[i]	Late[j]	Process evaluation (QUANT[k])	Online survey
Hendy [52]	Long-term illnesses	Clinical monitoring, *WSD*[l]	Primary care trusts	Case studies of 3 sites forming the WSD program	NPT[m]	Late	Comparative, longitudinal, qualitative, ethnographic case study (QUAL)	Interviews, meeting observations, document review
Hendy [59]	Long-term illnesses	Clinical monitoring, *WSD*	Health and social care organizations	Case studies representing 5 large public sector health organizations	N/A	Late	Longitudinal, ethnographic case studies (QUAL)	Observations, document review, informal discussions, interviews
Horton [53]	COPD	Clinical monitoring	Homecare	During the 6-month implementation period, only 10 users had been recruited to the scheme	N/A	Middle	Case study (QUAL)	Focus groups, field notes, meeting minutes
Lindsay [54]	PTSD[n], anxiety, depression, insomnia, chronic pain, SUD[o]	Video consultation, *Video to Home*	VA[p] Medical Center	This 2-year project included 93 patients	PARIHS[q], RE-AIM	Late	Mixed-method program evaluation (MIXED)	Interviews, quantitative data on system use
Taylor [55]	COPD, chronic HF[r]	Clinical monitoring	Community health care	4 community nursing settings involved in 7-month program of action research	PDSA[s]	Middle	Case studies and action research methodologies (QUAL)	Workshop observations, focus groups, document review, field notes

First author	Patient groups	eHealth	Setting	Implementation project	Implementation framework	Implementation stage	Study design	Data collection
Terpstra [56]	Chronic pain	ICBT, *Master Your Pain*	Mental health care institutions	13 mental health care institutions	TDF[t], TAM[u]	Early	Descriptive design (QUANT)	Evaluation questionnaire
Wells [57]	Chronic illness	Online PHR[v]	Health delivery organizations	Health care organizations that had had a PHR in place for at least 12 months	N/A	Late	Grounded theory inductive approach (MIXED)	Interviews, Web-based survey
Wilhelmsen [58]	Depression	ICBT, *Mood-GYM*	General practice	3-day training package for GPs[w] on ICBT	NPT	Late	Qualitative study (QUAL)	Telephone interviews

[a]COPD: chronic obstructive pulmonary disease.

[b]N/A: not applicable.

[c]Middle: 4-12 months postimplementation startup.

[d]QUAL: qualitative.

[e]ICBT: internet-delivered cognitive behavioral therapy.

[f]EBP: evidence-based practice.

[g]RE-AIM: reach, effectiveness, adoption, implementation, maintenance framework.

[h]Early: 0-3 months postimplementation startup.

[i]CFIR: consolidated framework for implementation research.

[j]Late: >12 months postimplementation startup.

[k]QUANT: quantitative.

[l]WSD: Whole Systems Demonstrator.

[m]NPT: normalization process theory.

[n]PTSD: posttraumatic stress disorder.

[o]SUD: substance use disorder.

[p]VA: Veterans Affairs.

[q]PARIHS: promoting action on research implementation in health services.

[r]HF: heart failure.

[s]PDSA: plan, do, study, act.

[t]TDF: theoretical domains framework.

[u]TAM: technology acceptance model.

[v]PHR: patient health record.

[w]GP: general practitioner.

Implementation Strategies Reported

Overview

Nine of the 12 included studies reported the use of an overarching implementation strategy such as training [48,56,58], external facilitation [50,51,54], managerial strategies [59], action research [55], or a mixture of several discrete strategies [57]. Three studies did not describe any overarching implementation strategy, only describing the discrete strategies used [49,52,53].

When sorted according to the ERIC categories [22], 5 of the 12 studies reported implementation strategies within 7 or 8 categories [49-51,55,57], 2 reported implementation strategies within 5 or 6 categories [52,54], 2 reported implementation strategies within 3 or 4 categories [48,59], and 3 reported implementation strategies within 1 or 2 categories [53,56,58].

The category of implementation strategies most frequently reported was train and educate stakeholders (n=10), followed by change infrastructure (n=8), develop stakeholder interrelationships (n=8), use evaluative and iterative strategies (n=7), engage consumers (n=6), adapt and tailor to the context (n=5), use financial strategies (n=5), support clinicians (n=5), and finally provide interactive assistance (n=4). See Table 5 for details.

Table 5. Categories of implementation strategies [22] used in the included studies.

Studies	Engage consumers	Use evaluative and iterative strategies	Change infrastructure	Adapt and tailor to the context	Develop stakeholder interrelationships	Use financial strategies	Support clinicians	Provide interactive assistance	Train and educate stakeholders	Total categories reported	Overarching implementation strategy (study authors' description)
Bailey [48]	x		x						x	3	Training
Boonstra [49]	x	x	x	x	x	x	x			7	Not reported
Fortney [50]	x	x	x	x	x			x	x	7	External facilitation/mixed
Hadjistavropoulos [51]	x	x			x	x	x	x	x	7	External facilitation
Hendy [52]		x	x		x		x		x	5	Not reported
Hendy [59]			x		x	x		x		4	Managerial strategies
Horton [53]			x						x	2	Not reported
Lindsay [54]		x	x	x	x			x	x	6	External facilitation
Taylor [55]	x	x	x	x	x	x	x		x	8	Action research
Terpstra [56]									x	1	Training
Wells [57]	x	x		x	x	x	x		x	7	Mixed
Wilhelmsen [58]									x	1	Training
Total	6	7	8	5	8	5	5	4	10		

Engage Consumers

Six of the 12 studies reported trying to reach and engage patients as one of their implementation strategies. This included advertising about the eHealth program to patients within their own institutions and/or to the wider community by means of newsletters, webpages, television, radio, newspapers, and direct contact with patients [49-51,57]. Other implementation strategies reported used to engage patients were inclusion of patients in research activities [55] and technical setup and support for patients in their homes [48,49].

Use Evaluative and Iterative Strategies

Seven of the 12 studies reported use of different evaluative and iterative strategies, either as stand-alone strategies or in combination with other strategies. Three of the 12 studies had made an implementation plan [50,55,57], 1 study had a business plan [49], and 1 study had included the eHealth implementation in the organizational vision statement [57]. Three studies focused on readiness, barriers, and facilitators [50,51,54]. Five studies reported that they made use of multiple stakeholder teams [50-52,55,57], and 1 study reported support from local clinical champions [50]. Five of the 12 studies reviewed the implementation progress [51,52,54,55,57], and 4 of them provided audit and feedback by feeding the information about the implementation progress back to the clinicians [51,54,55,57].

Change Infrastructure

Eight of the 12 studies reported purchase or acquisition of new electronic equipment as an implementation strategy [48-50,52-55,59].

Adapt and Tailor to the Context

Four of the 12 studies reported that they had cooperated with clinical staff to ensure tailoring of the eHealth program to meet local needs and organizational capabilities [50,54,55,57]. One study had cooperated with involved stakeholders to obtain a consistent implementation plan [49].

Develop Stakeholder Interrelationships

Four of the 12 studies reported involving multiple stakeholder teams at the overall management level, including representatives of the participating organizations such as care delivery organizations, telecom firms, insurance firms, commissioners, and industry [49,51,55,57]. Onsite project teams were established in 4 of the 12 studies [49,52,55,57]. Onsite clinical champions supported and promoted adoption of the eHealth program in 5 studies [50,52,54,55,57]. Management support and endorsement were reported in 3 studies [52,57,59]. One study also had visited other clinics to discuss concerns and impart their knowledge and experience [57].

Use Financial Strategies

Five of the 12 studies reported that they had used financial strategies related to the funding of the implementation projects [49,51,52], future cost-effectiveness aspects [49], and future financial investment aspects [55]. Incentives directed toward physicians' performance indicators and monetary incentives and the use of gift card bonuses for clinicians were reported [57].

Support Clinicians

Four of the 12 studies had supported clinicians by recruiting new staff, establishing new roles, and supporting work process

redesign [49,52,55,57]. Reminders to clinicians to prompt them to use the new eHealth programs were also reported [51].

Provide Interactive Assistance

Four of the 12 studies reported that they had used external researchers, consultants, or practitioners to provide external facilitation in terms of problem solving and support [50-52,54]. Training for local superusers was also reported conducted [54].

Train and Educate Stakeholders

Ten of the 12 studies reported that they had conducted training and teaching for clinicians about the eHealth programs being implemented. The education was reported as containing aspects

related to the delivery of the clinical programs via eHealth [48,50-58], as well as technical aspects related to the eHealth software [48,51,57]. Six studies reported on the length of training and described a wide variety of time span, ranging from 2 to 3 hours [48,50,53] to 1 to 3 days [51,56,58].

Implementation Outcomes Reported

Overview

All the 12 included studies reported implementation outcomes, ranging from 1 to 6 in each study. The 3 most frequently reported were acceptability, penetration, and adoption. See Table 6 for details on implementation strategies used and implementation outcomes reported.

Table 6. Implementation strategies used and implementation outcomes reported in the included studies.

First author	Implementation strategies		Implementation outcomes										Implementation success
	Categories of implementation strategies used	n	Acceptability	Adoption	Appropriateness	Cost	Feasibility	Fidelity	Penetration	Sustainability	n	Study authors' evaluation of implementation success in relation to implementation strategies used
Bailey [48]	Engage consumers, change infrastructure, train and educate stakeholders	3	+/– [a]	+/–	N/A [b]	N/A	N/A	N/A	N/A	N/A	2	Successful due to training and follow-up support
Boonstra [49]	Engage consumers, use evaluative and iterative strategies, change infrastructure, adapt and tailor to the context, use financial strategies, support clinicians, train and educate stakeholders	7	+/–	_ [c]	–	N/A	–	N/A	–	N/A	5	Unsuccessful due to limited managerial agency and inconsistencies in some of the choices made during implementation phase
Fortney [50]	Engage consumers, use evaluative and iterative strategies, change infrastructure, adapt and tailor to the context, provide interactive assistance, train and educate stakeholders	7	N/A	N/A	N/A	N/A	N/A	N/A	+/–	+ [d]	2	Variable success across sites
Hadjistavropoulos [51]	Engage consumers, use evaluative and iterative strategies, develop stakeholder interrelationship, use financial strategies, support clinicians, provide interactive assistance, train and educate stakeholders	7	+	–	N/A	+/–	–	N/A	–	N/A	5	Successful due to ICBT[e] program, implementation processes, and external facilitation. Could have been even better if planned in advance, all staff in the health region were informed about ICBT, and more resources were available
Hendy [52]	Use evaluative and iterative strategies, change infrastructure, develop stakeholder interrelationship, support clinicians, train and educate stakeholders	5	N/A	–	N/A	N/A	N/A	N/A	+/–	–	3	Unsuccessful despite resources deployed
Hendy [59]	Change infrastructure, develop stakeholder interrelationship, use financial strategies, provide interactive assistance	4	N/A	N/A	N/A	N/A	–	N/A	N/A	N/A	1	Unsuccessful due to lack of trust in individual managers
Horton [53]	Change infrastructure, train and educate stakeholders	2	–	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	Unsuccessful despite training and follow-up support

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First author	Implementation strategies		Implementation outcomes									Implementation success
	Categories of implementation strategies used	n	Acceptability	Adoption	Appropriateness	Cost	Feasibility	Fidelity	Penetration	Sustainability	n	Study authors' evaluation of implementation success in relation to implementation strategies used
Lindsay [54]	Use evaluative and iterative strategies, change infrastructure, adapt and tailor to the context, develop stakeholder interrelationship, provide interactive assistance, train and educate stakeholders	6	+	N/A	N/A	+	–	–	+	+	6	Successful due to implementation facilitation strategy involving external and internal facilitators, especially clinical champions and training
Taylor [55]	Engage consumers, use evaluative and iterative strategies, change infrastructure, adapt and tailor to the context, develop stakeholder inter-relationship, use financial strategies, support clinicians, train and educate stakeholders	8	N/A	N/A	N/A	+/–	N/A	N/A	N/A	N/A	1	Mixed: 2 sites discontinued after first cycle because of competing priorities; positive experience of external facilitation by researchers and telehealth champions
Terpstra [56]	Train and educate stakeholders	1	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	N/A
Wells [57]	Engage consumers, use evaluative and iterative strategies, adapt and tailor to the context, develop stakeholder interrelationship, use financial strategies, support clinicians, train and educate stakeholders	7	+	N/A	N/A	N/A	N/A	N/A	+/–	N/A	2	Successful organizations actively communicated their vision; engaged leaders at all levels; had clear governance, planning, and protocols; set targets; and celebrated achievement. The most effective strategy for patient uptake was through health professional encouragement
Wilhelmsen [58]	Train and educate stakeholders	1	+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	Not successful due to lack of practical training of module follow-ups in the course
Total			8	4	1	3	4	1	6	3		

[a]Mixed/neutral outcomes.

[b]Not applicable.

[c]Negative outcomes.

[d]Positive outcomes.

[e]ICBT: internet-delivered cognitive behavioral therapy.

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Acceptability

Four of the 12 studies reported that health care providers had shown positive attitudes toward the eHealth program implemented [54,56-58]. One study reported low acceptability of their intervention [53]. Three studies reported mixed attitudes in that some were positive and some experienced the new eHealth program as a threat to or disturbance of their work [48,49,51].

Adoption

Four of the 12 studies reported challenges regarding the adoption of the eHealth programs into their clinical practice, describing difficulties motivating the clinicians to approach their clients with the new eHealth program [49,51-53]. Time available and time frame given were also reported to pose organizational challenges [48,52]. None of the included studies presented solely positive descriptions of the adoption of the eHealth programs.

Appropriateness

Only 1/12 included studies reported on appropriateness, stating that the technology might not always be appropriate, for example, if advanced age, poverty, or serious illnesses might amplify the clients' vulnerability [49].

Cost

Three studies mentioned costs. One study reported no additional costs related to the eHealth implementation [51], 1 study reported travel expenditures saved [54], and 1 study described being unable to calculate costs due to lack of robust data [55].

Feasibility

Four of the 12 studies reported low feasibility for their eHealth programs [49,51,52,54], describing the innovations as an interruption to the real work and as difficult to integrate with existing patient workloads.

Fidelity

Fidelity was reported in only 1 of the 12 studies, stating that high fidelity was difficult to achieve due to providers' need to remain flexible and the program needed to be adapted to the technology platform already present in the clinical setting [54].

Penetration

Four studies presented how many patients received an eHealth program [50,52,54,57], only one of which reported satisfaction with how many patients received the program [54]. Two studies indicated limited numbers of patients who received the eHealth program being studied, but did not provide exact figures [49,51].

Sustainability

Three of the 12 included studies reported sustainability. In two instances, the eHealth programs were sustained after the implementation efforts [50,54], while the third did not achieve sustainability [52].

Implementation Success Reported

All studies except one [56] reported on implementation success. The majority provided a direct [48,50,52,57-59] or indirect [49,53,54] description of how they defined implementation success. This spanned from concrete definitions such as "the

number of people in each site using the new service" [59] to more vague descriptions such as "change in terms of telecare appropriation was realized" [49]. As the assessment of implementation success was used as a means to evaluate the reported implementation outcomes in this review, and implementation success is often derived directly from the implementation outcomes, the two aspects (ie, success and outcome) were not necessarily mutually exclusive. Four studies reported that the implementation had been successful [48,51,54,57], while 5 studies reported unsuccessful implementation [49,52,53,58,59]. Two studies reported mixed results, with implementation being successful at some of the sites and unsuccessful at the others [50,55].

Relationship Between Implementation Strategies, Implementation Outcomes, and Implementation Success

In the 12 included studies, no relationship was detected between implementation strategies [22] and implementation outcomes [37].

Regarding implementation success, the implementation strategies management support and engagement, internal and external facilitation, training, and audit and feedback were directly related to implementation success in several studies. For example, management support and engagement were highlighted as important for implementation success in 1 study [57], and lack of trust or limited managerial agency was described as a contributing factor to implementation failure in 2 other studies [49,59]. Furthermore, external facilitation was reported to be important for implementation success in 4 studies [50,51,54,55]. Internal facilitation, especially the support and engagement of clinical or implementation champions, was highlighted as important for the implementation success in 2 studies [54,55]. In addition, training and education of stakeholders were used as implementation strategies in studies reporting successful [48,54,56] as well as unsuccessful implementation [53,58].

No clear relationship was found between the number of implementation strategies used and implementation success. For example, of 3 studies using a range of implementation strategies, 1 reported implementation success [51], 1 reported implementation failure [49], and 1 reported mixed results [55]. Furthermore, of 2 studies using training and education of stakeholders as the only implementation strategy, 1 reported implementation success [56] and 1 reported implementation failure [58]. There was no relationship between reported implementation success and use of implementation frameworks.

Discussion

Summary of Evidence and Comparison With Prior Work

This systematic realist review used the categorization of implementation strategies by the ERIC taxonomy [21,22] and the implementation outcome framework by Proctor and colleagues [37] as data extraction templates. As no specific framework exists for implementation success, this was qualitatively summarized based on the study authors' own

definition. The review identified and synthesized 12 studies examining implementation strategies, implementation outcomes, and implementation success related to the implementation of eHealth programs for patients with chronic illnesses. Findings show that there has so far been little focus on reporting implementation strategies for eHealth implementation where the patient is the main user of the program. Also, there appears to be great variety in implementation terms used and considerable vagueness in the description of implementation aspects, which led the authors to have to screen a number of irrelevant full-text studies. There were also challenges in the data extraction process due to inconsistence in terminology used in the studies. Other researchers have also pointed to inconsistencies in use of terminology and definitions related to implementation [20,60,61]. Due to great heterogeneity in the included studies with regard to types of patient conditions, eHealth interventions, and phases of implementation, it was not possible to detect any relationship between these factors related to implementation strategies, implementation outcomes, and implementation success.

A wide range of implementation strategies were used in the studies included in the review. The most frequently used categories of implementation strategies were train and educate stakeholders, change infrastructure, and develop stakeholder interrelationships. Included in the latter category is involvement of champions, which has also been identified as central to implementation success by other reviews [62,63]. Several of the included studies reported training of health care personnel as a preferred implementation strategy, and this strategy was also found to be widely used by others, even though effects appear inconsistent [62,64]. Despite recent evidence pointing to tailored implementations as effective [62,65], only 4 studies in the review reported that they had tailored the eHealth intervention to meet the context where the implementation took place. Also, several frameworks for technology implementation have pointed to the importance of contextual factors as key elements to address in order to succeed, including the CeHRes (Center for eHealth Research and Disease Management) roadmap [66] and the NASSS framework [28]. The limited use of tailoring so far in the implementation context could potentially be one explanation for the limited implementation success to date.

Implementation outcomes were reported in all 12 studies included in this review, with each individual study reporting between 1 and 6 implementation outcomes. The implementation outcomes most frequently reported were acceptability and penetration. As the included studies had not aimed to report on implementation outcomes, only a few of the terms in the implementation outcome framework [37] were covered. It is thus reasonable to assume that implementation outcomes were underreported in many of the included studies. Based on this, it was not possible to detect any clear relationship between implementation strategies and implementation outcomes in the review. However, it might not be a coincidence that these 12 studies that reported implementation strategies also reported implementation outcomes. Because when people really start to think about and report implementation strategies, they will also think about reporting at least some implementation outcomes.

In order to still allow for an evaluation of how successful the implementation had been when the implementation outcome framework was not suitable enough for a mechanism evaluation, implementation success was also included in this equation.

Regarding implementation success, 4 of the included 12 studies reported success, 5 reported lack of success, and 2 reported mixed results. Training and education of stakeholders showed mixed relations to implementation success, indicating that the content, duration, and facilitation of the training are important for training effectiveness. The studies offering the most training are not necessarily the most successful, indicating that other factors (eg, clinician motivation and intention to use the new eHealth program) also play an important role [4]. This review suggests that a combination of software training and training in how to use the technology in daily work may be necessary. These findings are in line with other reviews that have also highlighted training, support, and supervision as key factors in order for clinicians to start using new eHealth programs [30,35]. Due to the limited coverage provided by the implementation outcome framework, as described above, no clear relationship between implementation outcomes and implementation success could be detected in the review. For example, one of the studies showed that the implementation can be successful or experienced as successful even with negative scores on some of the implementation outcomes concepts [54]. However, in more than half of the studies in the review, there was coherence between the ratings on implementation outcomes and implementation success [49,50,52,53,55,57,59]. Due to the limited number of implementation outcome concepts covered, however, this finding must be interpreted with caution. Given a more comprehensive reporting on implementation outcomes, the coherence could have been different. The relationship between implementation outcomes and implementation success still appears a conundrum. This has also been pointed out by others [37] and should be further investigated in future studies. Although not the topic of this review, it is also worth mentioning that if the patient outcomes (eg, effect of the intervention) do not occur, positive implementation outcomes and implementation success does not have much impact.

Another important finding from the review is that several studies showed the implementation strategies related to management engagement to be directly related to implementation success. Other researchers have found leadership to be crucial in order to succeed with implementation of evidence-based practice and have also pointed to the setting in which the leader operates as being of importance [67].

The successful implementation efforts identified in this review, reaching sustainability for more than 1 year after start-up [51,54,57], were all related to use of a mixture of several implementation strategies and were also supported by internal and external facilitation. All of these studies also provided audit and feedback, one of the implementation strategies with evidence for effectiveness [62,68].

No clear relationship was found in the review between the number of implementation strategies used and implementation success. The successful implementation projects described used multifaceted strategies. However, one study used a single

strategy and was still successful [56]. This shows that the quality of an implementation strategy might be more important than the quantity, which is in line with a former review concluding that multifaceted strategies are not necessarily more effective than single strategies [64].

Despite the importance of describing and sharing information about unsuccessful implementations, the continued degree of unsuccessful implementation efforts is disturbing and gives cause for concern. It is, however, possible that the lack of a systematic implementation approach and the lack of employing proposed successful implementation strategies can provide explanation for this challenge.

Finally, the results from this review also indicate that reaching sustainability is and remains a challenge despite use and focus on implementation strategies.

Implications for Research and Practice

This systematic realist review clearly demonstrates a need for more studies that report on implementation strategies, implementation outcomes, implementation success, and the relationship among these in eHealth implementation. The research on implementation strategies is still in its infancy, and more work is needed to better understand how implementation strategies can contribute to improved implementation effectiveness [23].

This review also demonstrates the need for implementation planning at a very early stage—that is, already in the design and development phase of eHealth support and intervention programs. Low feasibility of many of the eHealth programs included in this review clearly shows an urgent need to include all stakeholders in the early phases of program development. Also, implementation planning must be included from the very beginning in order to adapt interventions to context and enable implementation. As such, using frameworks for eHealth development and implementation, such as the CehRes roadmap [66] that combines aspects from human-centered design, persuasive technology, and business modeling, can help address implementation aspects already in the phase of idea generation and problem identification.

When planning and conducting eHealth implementation in clinical practice, evidence is still lacking about proposing clear advice on how implementation strategies can be used effectively when implementing eHealth programs to support patients in their own homes. This review concludes, in support of existing research, that the question of which implementation strategies are the most effective under which circumstances still remains unclear [64]. Nonetheless, this review indicates that internal

and external facilitation, audit and feedback, management support, and training of clinicians are essential. Lacking more robust evidence on specific implementation strategies for eHealth implementation, general evidence on implementation strategies must be considered.

Limitations

This systematic realist review has limitations that need to be considered when interpreting the results. First, in order to get a manageable number of hits from the literature search, some limitations to the search strategy were necessary. Therefore, the search was performed on published studies only since 2006. Prior to 2006, the eHealth and implementation research fields were both in their infancy and few publications were assumed to exist. This review process showed the earliest publication included to be from 2008, supporting this assumption. Therefore, no publications were included from the period 2006 to 2008. Another restriction intended to keep the hits to a manageable number was to limit the chronic illnesses included.

Use of predefined categories for data abstraction and analysis has strengths as well as limitations. In the review, the ERIC project [22] and the implementation outcome framework [37] were used to guide the review process. There is a potential risk that aspects not covered in the two categorizations could be overlooked in the review, as different frameworks provide different lenses through which research problems can be analyzed [69]. The ERIC categories are comprehensive and posed some challenges regarding overlap between categories. Furthermore, as not all included studies had implementation aspects as their only focus, the data extraction process could have introduced potential risks of overlooking or omitting aspects of implementation strategies, implementation outcomes, and implementation success. Inconsistent use of language and terminology in the 12 included studies also made it challenging to sort and label implementation strategies and outcomes. The validation process conducted by two authors nevertheless showed no discrepancy in data extraction.

Conclusions

This is the first review examining implementation strategies, implementation outcomes, and implementation success of studies reporting on the implementation of eHealth programs for patients with chronic illnesses. Findings suggest that internal and external facilitation, management support, and training of clinicians are important factors for the success of eHealth implementation. The results also highlight the lack of eHealth studies reporting implementation strategies in a comprehensive way, pointing to the need for designing robust studies on implementation strategies in the future.

Conflicts of Interest

None declared.

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Multimedia Appendix 1

Search strategy.

[PDF File (Adobe PDF File)138 KB-Multimedia Appendix 1]

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Abbreviations

eHealth: electronic health
CeHRes: Center for eHealth Research and Disease Management
ERIC: Expert Recommendations for Implementing Change
ICBT: internet-delivered cognitive behavioral therapy
mHealth: mobile health
NASSS: framework for nonadoption, abandonment, scale-up, spread, and sustainability
PROSPERO: Prospective Register of Systematic Reviews