

Professional-facing digital health technology for the care of chronic pain patients: A scoping review

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Abstract

Background: Chronic pain is a highly prevalent condition, estimated to be affecting as many as 30% of people worldwide. The need for more innovative solutions for chronic pain management is clear, and Digital Health Technology (DHT) may be the best way to address this challenge. Much of the digital health research focusing on chronic pain focuses on patient-facing solutions, however, DHT for healthcare professionals is equally important to support evidence-based practice, which in turn improves patient outcomes. Despite this, no review has investigated the availability of professional-facing DHT for chronic pain management.

Objective: The overall aim of this scoping review was to identify the available professional-facing DHT for the purpose of chronic pain management. Specifically, the objectives were to investigate the components of the DHTs, the development methods, the user features, the outcomes and HCP perspectives on DHT for chronic pain care.

Methods: Databases including Medline, EMBASE, CINAHL, PsycInfo and Inspec were searched using a comprehensive search strategy developed for each specific database alongside an academic librarian. Two independent reviewers screened titles and abstracts for review inclusion, then conducted full-text screening. Any conflicts in each stage of the screening process were first resolved through discussion, then through a third independent reviewer. Data extraction and quality assessment was completed using the TiDIER checklist and QuADS. Qualitative analysis involved inductive content analysis (of user features) and thematic synthesis (of HCP perspectives).

Results: A total of 52 studies were included in the review, reporting on 44 professional-facing DHT. The included DHT were intended for remote patient monitoring, clinical decision support, assessment and diagnosis, education of HCPs or a combination. The most common target population for DHT use was multidisciplinary care teams; the most common setting for implementation was primary care. Approximately half of the professional-facing DHT had a connected patient-facing system. Inductive content analysis of the user features produced four themes: guiding initial consultation, supporting chronic pain management, facilitating ongoing patient management and supporting routine clinical duties. Thematic synthesis of HCP perspectives produced four themes reflecting factors affecting use of DHT in chronic pain care: additional value, integration into clinical workflow, ease of navigation, and trust in the DHT. Most of the included studies did not adequately report appropriate stakeholder involvement in a proper co-design of DHT; only three of the DHT were reported to have been developed with guidance from a system development framework.

Conclusions: There are various DHTs available for HCPs to use in the management of chronic pain. The included studies did not report adequate stakeholder involvement in the DHT development nor any specific frameworks to guide rigorous co-design. Therefore, future research should focus on developing professional-facing DHT with active involvement of stakeholders in the design process. Clinical Trial: The protocol for this scoping review is published in JMIR protocols (McCartney et al, 2024).

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Abstract

Background

Chronic pain is a highly prevalent condition, estimated to be affecting as many as 30% of people worldwide. The need for more innovative solutions for chronic pain management is clear, and Digital Health Technology (DHT) may be the best way to address this challenge. Much of the digital health research focusing on chronic pain focuses on patient-facing solutions, however, DHT for healthcare professionals is equally important to support evidence-based practice, which in turn improves patient outcomes. Despite this, no review has investigated the availability of professional-facing DHT for chronic pain management.

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Results

A total of 52 studies were included in the review, reporting on 44 professional-facing DHT. The included DHT were intended for remote patient monitoring, clinical decision support, assessment and diagnosis, education of HCPs or a combination. The most common target population for DHT use was multidisciplinary care teams; the most common setting for implementation was primary care. Approximately half of the professional-facing DHT had a connected patient-facing system. Inductive content analysis of the user features produced four themes: guiding initial consultation, supporting chronic pain management, facilitating ongoing patient management and supporting routine clinical duties. Thematic synthesis of HCP perspectives produced four themes reflecting factors affecting use of DHT in chronic pain care: additional value, integration into clinical workflow, ease of navigation, and trust in the DHT. Most of the included studies did not adequately report appropriate stakeholder involvement in a proper co-design of DHT; only three of the DHT were reported to have been developed with guidance from a system development framework.

Conclusions

There are various DHTs available for HCPs to use in the management of chronic pain. The included studies did not report adequate stakeholder involvement in the DHT development nor any specific frameworks to guide rigorous co-design. Therefore, future research should focus on developing professional-facing DHT with active involvement of stakeholders in the design process.

Keywords

Chronic pain, digital health, eHealth, clinician, health and care professional

Introduction

Chronic pain background

Chronic pain is a highly prevalent condition that is estimated to affect as many as 20-30% of individuals internationally [1,2]. Pain is distinguished as 'chronic' when it lasts for three or more months [3]. Treatment for chronic pain can vary significantly, with approaches ranging from pharmacological interventions (for example, analgesics and opioid therapy) to non-pharmacological, alternative interventions (for example, Cognitive Behavioural Therapy and physiotherapy) [4]. Chronic pain care and treatment can be complex, particularly as mismanagement can lead to significant adverse effects such as opioid dependency [5]. Research contributing to safe, effective treatment of patients with chronic pain is essential to reduce issues around mismanagement of chronic pain.

Due to its prevalence, pain is one of the main reasons why people seek healthcare [1]. This has resulted in a significant economic impact, with estimated costs of chronic pain to the economy reaching billions around the world [6-8]. Moreover, the COVID-19 pandemic has exacerbated these economic challenges, as healthcare resources were diverted from chronic pain care to more emergency situations [9]. Certainly, this combination of challenges has led to a reconsideration of traditional methods of care for chronic pain and has highlighted the importance of being flexible to more novel methods of healthcare delivery [10-12].

Digital health technology for chronic pain

One of the ways in which chronic pain care can be addressed innovatively is through digital health technology (DHT). DHT can provide a unique opportunity to mitigate the challenges of chronic pain care, cost-effectively [9,13]. In this review, the term 'digital health' will refer to all digital, electronic and computer technologies to improve health, including electronic health (eHealth), mobile health (mHealth), telemedicine or telehealth [14,15]. As definitions of digital health are continuously evolving and there is no universally accepted nomenclature, such terms are often used interchangeably in the literature [14,15]. Components of DHT used for chronic pain may include mobile or tablet applications, web applications, wearable health technology (WHT), artificial intelligence (AI) and telemedicine. Such DHT can be used for the purpose of chronic pain self-management [16] or digitally delivered physical therapy [17]. DHT may be particularly beneficial for chronic pain care, as it addresses some of the aforementioned challenges by offering remote care and reducing the impact in certain areas of healthcare service provision e.g., lack of resources, waiting lists, limited availability of the healthcare workforce [18,19].

Health and care professionals in chronic pain care

Health and care professionals (HCPs) are essential to effective chronic pain care; specifically, HCP involvement on a multidisciplinary level is integral to quality chronic pain care [2,20]. Furthermore, it has been suggested that chronic pain must go beyond simply 'multidisciplinary' care and be targeted more holistically through 'interdisciplinary' care, which denotes a more specific coordination of care and communication between HCPs from different disciplines [21]. Chronic pain is thought to have a biopsychosocial cause; therefore, care is best targeted through the coordination of the biological, psychological and social factors contributing to the condition [22]. Moreover, primary care clinicians are thought to be especially important to effective chronic pain care [20,23]. Despite this, much of the literature on DHT for chronic pain focuses on systems solely intended for patients (for self-management), without HCP involvement. HCP involvement has also been highlighted as an important factor and facilitator in the adoption of DHT, particularly as collaboration with key stakeholders in co-design is essential for the development of usable systems

for sustainable implementation [24].

Previous studies on the perspectives of HCPs have also underlined the potential of DHT as a useful tool, for example, for the purpose of HCP education and patient follow-up [19]. DHT which targets HCP education may have particular utility in improving chronic pain care, as negative attitudes and lack of knowledge have been identified as significant barriers in chronic pain management [25]. Additionally, national guidelines for chronic pain care state that HCPs must have the best possible resources and support to manage patients, which could potentially be supported by DHT designed for HCPs i.e., professional-facing systems [23].

Previous research

Previous reviews on DHT for chronic pain have focused primarily on determining the effect on patient outcomes, with many of the investigated interventions being patient-facing (i.e., designed for the use of patients) for the purpose of self-management [18,26-29]. The results of these reviews show that DHT has positive outcomes for patients with chronic pain, such as reduced pain intensity, improved quality of life, coping skills and adherence to exercise [18,26-29]. Although these reviews highlight the utility of patient-facing DHT to improve chronic pain management, it is equally important to focus research on and gain a more in-depth understanding of professional-facing DHT. DHT for HCPs in chronic pain care may help ensure evidence-based care and adherence of best practice guidelines, which would ultimately improve patient outcomes. Certainly, DHT for the use of HCPs in the management of chronic pain exists; for example, for the purpose of clinical decision support [30]. One previous scoping review investigated DHT for musculoskeletal care available in the allied health industry but did not focus on chronic pain nor on non-allied health industry professionals [31]. However, to our knowledge, no previous reviews have investigated the available professional-facing DHT for care of patients with chronic pain.

Review question

The question this scoping review will address is: what professional-facing DHT (i.e., designed specifically for the use of HCPs) are available for the management of chronic pain?

Specific objectives include:

1. To investigate the components of existing professional-facing DHT for the management of chronic pain, including: (a) their target populations; (b) the settings they implemented in (e.g., hospital); (c) whether they are connected to a patient-facing DHT application; (d) what data they collect; (e) whether they are standalone or integrated into larger systems; and (f) their security/privacy considerations.
2. To investigate the methods with which the DHT are designed and developed: whether they developed with adequate stakeholder involvement in co-design, and if they are guided by specific frameworks.
3. To analyse the user features of the DHT.
4. To provide an overview of the outcomes of the DHT measured by the included studies.
5. To analyse HCP perspectives on use of the DHT in the management of chronic pain.

Methods

A systematic scoping review was conducted in accordance with the Joanna Briggs Institute (JBI) methodology for scoping reviews [32] and reported in accordance with the PRISMA-ScR statement for scoping reviews [33]. The completed PRISMA-ScR checklist is available in Multimedia Appendix 1.

Protocol and registration

The protocol for this scoping review was published in JMIR protocols [34]. As this is a scoping review, PROSPERO registration did not apply.

Eligibility criteria

Inclusion of studies was guided by the PCC framework (population, concept, context), in accordance with the guidance in the JBI methodology for scoping reviews. For a more detailed overview of the eligibility criteria following the PCC framework, refer to McCartney et al [34].

Table 1: Table describing the eligibility criteria of population, concept and context (PCC) for study inclusion in the scoping review

PCC	Eligibility criteria
Population	HCPs that are involved in chronic pain care (including but not limited to nurses, pharmacists, general practitioners, physiotherapists, occupational therapists, psychologists, and social care professionals).
Concept	DHT intended to assist HCPs in management of adult (≥ 18 years old) chronic pain patients (all types of chronic pain according to NICE guidelines and ICD-11). DHT must be designed to be chronic pain-specific.
Context	No restrictions on context; research and clinical settings considered.

^a PCC = population, concept, context; HCP = health and care professional; DHT = digital health technology; NICE = National Institute for Health and Care Excellence; ICD-11 = International Classification of Diseases 11th Revision

Inclusion criteria

Studies were included if they reported any DHT designed and intended for the use of HCPs for the management of adult chronic pain (Table 1). The types of eligible studies included interventional, observational and descriptive studies fitting the inclusion criteria. No restrictions were placed on time-frame. The search was completed in July 2023.

Exclusion criteria

Studies were excluded if they reported DHT which were not professional-facing or chronic pain-specific. Specifically, the exclusion criteria included:

- DHT were considered not professional-facing if the intended end-user were not HCPs i.e., studies reporting self-management DHT solely for patient use.
- DHT were considered non-chronic pain-specific if they were not specified as intended for chronic pain management or diagnosis (for example, DHT for acute or general pain, non-specific pain or non-chronic cancer pain management). This also included studies reporting the use of technology on chronic pain populations, which were designed for other uses (for example, general healthcare management/existing electronic health systems not tailored specifically towards chronic pain care)).
- Studies reporting non-adult care of chronic pain (under 18 years old).
- Unpublished papers/protocols and gray literature.
- Studies reported in a non-English language.

Search strategy

Comprehensive search strategies were developed using subject heading specific to databases Medline, EMBASE, CINAHL, PsycInfo and Inspec (Multimedia Appendix 1). Search terms for chronic pain were developed using the terms used in the NICE guidelines for the care of adult chronic pain [35]. Further details regarding the development of search strategies are available in

McCartney et al [34].

Study/source evidence selection

Search strategies were implemented on each database, duplicates were subsequently removed and final search results were uploaded onto Covidence. Two independent reviewers (HM and AM/MI) screened the titles and abstracts of the initial search results, against the eligibility criteria. Following this, full texts of potential studies identified were screened again by two independent reviewers (HM and AM/MI). Authors of the studies which were unavailable were contacted to request access. Conflicts in both screening stages were resolved first through discussion, then through a third independent reviewer (HKR, NMW or RM). Backward-citation screening was also completed.

Data extraction and quality assessment

Data extraction and quality assessment of 20% of the included studies were completed by two independent reviewers (HM and AM). As the rate of agreement between the two independent reviewers (HM and AM) for data extraction and quality assessment was high at 97% and 97% respectively, the rest was completed by one reviewer (HM). The data extraction tool was adapted from the Template for Intervention Description and Replication (TIDieR) checklist [36] and the quality assessment was conducted using the Quality Assessment for Diverse Studies (QuADS) [37]. This is available in the published protocol [34].

Data analysis and synthesis of results

Qualitative analysis methods were used to address review questions three and five. An inductive qualitative content analysis method was used to code the user features of DHT reported in the included studies and group these codes into main category themes through a process of abstraction [39]. HCP perspectives as reported by the included studies were analysed using the thematic synthesis method of extracting qualitative results, grouping codes into descriptive themes and subsequently developing analytical themes, as reported by Thomas and Harden [40]. In accordance with this method, quotes presented are direct quotes of study participants or key concepts/findings as reported by the study. Qualitative analyses were conducted on NVivo by HM and cross-checked by co-authors (AM, RM, HR and NW).

Results

Study selection

The initial search identified 7127 studies, of which 1829 were duplicates and subsequently removed. After screening full texts and backward citation screening, a total of 52 papers reporting 44 DHT were included. Reasons for exclusion are detailed in the PRISMA flowchart (Figure 1).

Quality assessment

The QuADS [37] was applied to 46 of the included studies; the remaining six papers were descriptive reports of the DHT therefore QuADS could not be applied due to lack of participant involvement and data collection [41-46] (as the QuADS criteria includes description of target population, sampling approach etc.). The mean QuADS score was 22.7/39 (SD=5.3), and the range was from 7-33; the individual QuADS scores for the 46 included studies are available in Multimedia Appendix 3. The criterion with the lowest quality score was 'justification for analytic method': most included studies did not provide a rationale for their chosen analyses, with the exception of five studies [47-51]. Another criterion of lower quality was 'evidence that the research stakeholders have been considered in research design or conduct', with most studies scoring one (out of 3) or below,

apart from seven studies which described more substantial stakeholder collaboration in both the DHT development and planning of the research [50,52-57]. The criteria with the highest quality assessment scores were in reference to appropriateness of study design and statement of research aims.

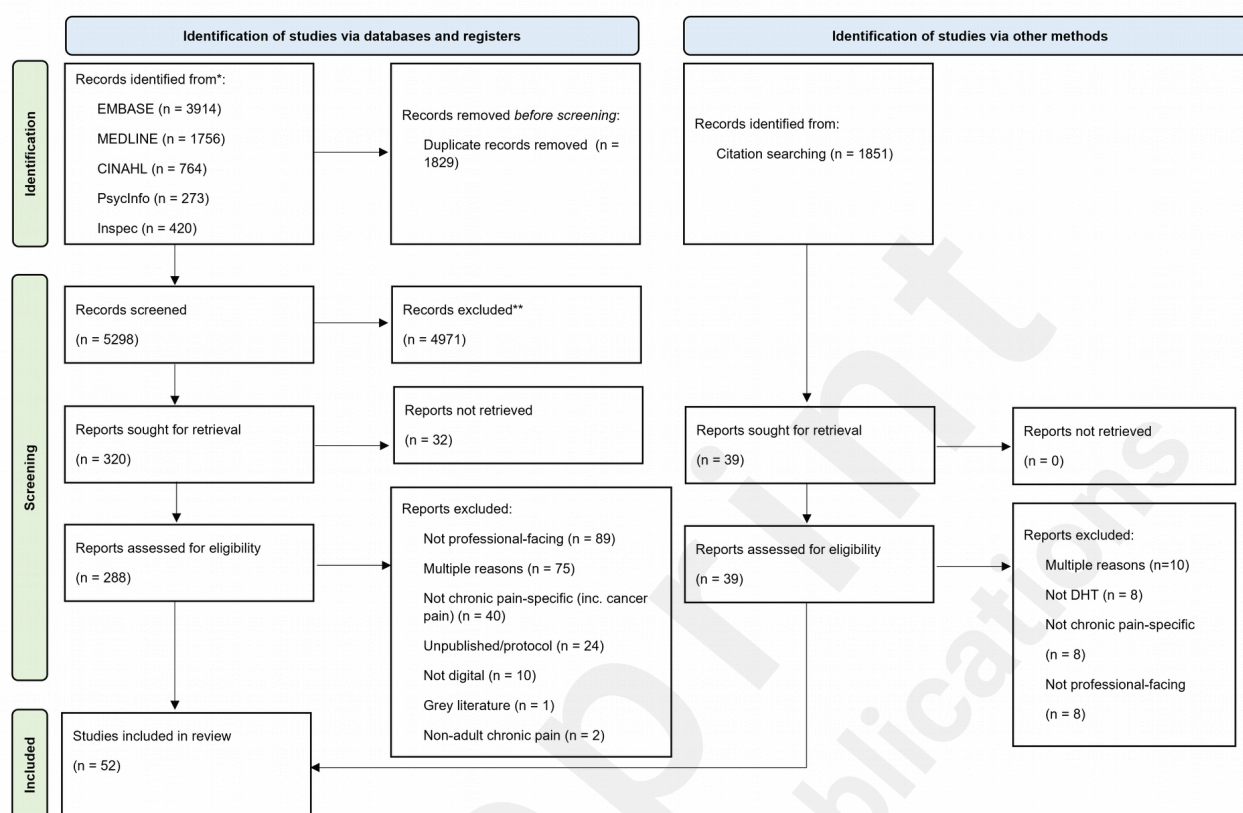


Figure 1: Flowchart to show selection of studies in the scoping review, adhering to PRISMA

Review objective 1: DHT components

The 52 included studies of the scoping review were varied in their characteristics; further details regarding individual study and DHT characteristics can be found in Multimedia Appendix 4 and 5.

Target population and setting

The type of chronic pain which were targeted by the reported DHT were as follows: general, unspecified chronic pain (N=12, 27%) [46,56,58-64], chronic non-cancer pain (N=5, 11%) [43-45,49,53,54,65-72], a specific type of arthritis (including rheumatoid arthritis, osteoarthritis, spondylarthritis, inflammatory arthritis, specific knee arthritis) (N=13, 30%) [41,47,48,51,55,73-81], a combination of arthritis (N=2, 5%) [52,82], chronic low back pain (N=5, 11%) [42,83-86], chronic headache (N=2, 5%) [87,88], spinal cord-related chronic pain (N=2, 5%) [50,57,89], chronic musculoskeletal pain (N=1, 2%) [90], endometriosis (N=1, 2%) [91] and temporomandibular disorder (N=1, 2%) [92]. There was a total of 16 different chronic pain conditions targeted by the DHT. The most targeted chronic pain condition was arthritis, with 15 DHTs (34%) specifically designed for arthritis care. The types of HCPs that were the target end-users of the DHT in each included study were also varied in their disciplines and were reported as follows: general, unspecified chronic pain (N=12, 27%) [46,56,58-64], chronic non-cancer pain (N=5, 11%) [43-45,49,53,54,65-72], a specific type of arthritis (including rheumatoid arthritis, osteoarthritis, spondylarthritis, inflammatory arthritis, specific knee arthritis) (N=13, 30%) [41,47,48,51,55,73-81], a combination of arthritis (N=2, 5%) [52,82], chronic low back pain (N=5, 11%) [42,83-86], chronic headache (N=2, 5%) [87,88], spinal cord-related chronic pain (N=2, 5%) [50,57,89], chronic

musculoskeletal pain (N=1, 2%) [90], endometriosis (N=1, 2%) [91] and temporomandibular disorder (N=1, 2%) [92]. There was a total of 16 different chronic pain conditions targeted by the DHT. The most targeted chronic pain condition was arthritis, with 15 DHTs (34%) specifically designed for arthritis care.

The target settings for the DHT also varied significantly across included studies. The most common type of setting was primary care (N=12, 23%) [41,56,58,62-65,68,77,83,85,90]. Some of the included studies did target secondary and tertiary care settings, such as hospitals (N=5, 17%) [60,73,75,87,91] and specific chronic pain departments/clinics (N=11, 21%) [46,49,54,59,66,67,69-72,88] and rheumatology (N=6, 12%) [47,74,76,78,80,81]. Almost half of the included studies reported implementation of the DHT in USA (N=22, 42%) [41,42,44-46,49,51,54,56,58,61-65,67-69,72,81,86,89] with the next most common country of setting being the Netherlands (N=5, 10%) [76,80,83,90,92].

DHT characteristics

Eight of the included DHT (18%) were reported by multiple papers focusing on different stages of the development process, i.e., initial requirement identification, user testing etc. [44-46,47,49,50,56-58,59,60,62-64,67,73]. The total 44 DHT reported by the included studies fell into five distinct categories: DHT aimed for remote patient monitoring (RPM; N=22, 50%) [43,47-49,51-54,59,60,65-67,69,70,73,75-78,80-82,86,90], clinical decision support (CDS; N=7, 16%) [41,46,61-64,72,74,83], assessment/diagnosis (N=2, 5%) [71,90], education of HCPs (N=3, 7%) [44,45,55,79] and a combination of the latter (e.g., RPM and CDS) (N=10, 22%) [42,50,56-58,68,84,85,87,88,89,92]. RPM systems supported the HCP in monitoring the patient's chronic pain primarily by tracking their symptoms through patient-reported outcomes (PROs), treatment progress or patient assessment completion. CDS systems supported the HCP in making clinical decisions through an automated procedure of inputting data to produce an output (e.g., treatment recommendation or suggested diagnosis), which was facilitated by a pre-determined decision tree or algorithm. The most common type of professional-facing DHT was for RPM (N=25, 57%), including three DHTs which had combined purposes of RPM and an additional area of care. Many of these DHT also had a connected patient-facing DHT interface from which information regarding patient symptoms (patient reported outcome measure (PROM)) were provided (N=26, 59%) [43,47-49,51-55,59,60,66,67,69-71,73,75-78,80-82,84,86,87,90,92]. The data collected by the DHT were mostly patient-related data such as results of clinical assessments (including PROs) on pain intensity, physical activity, disease activity, anxiety/depression etc. Notably, three DHTs collected patient data through a diary on a patient-facing interface (N=3, 6%) [43,80,87]. Only one DHT solution collected non-patient-related data: HCP user performance on an assessment (the purpose of which was education of HCP) [79].

The included DHT were designed to be accessed via different modalities; the most common modality was through online platforms and/or websites (N=19, 43%) [42-45,48,52-55,59,60,66,68,70,77,82-84,87,90,92], followed by computer or mobile/tablet applications (N=14, 32%) [41,46,47,49,51,56,58,62-64,67,71-73,80,81,88,89,91]. Notably, there was one VR application which targeted education of HCPs [79]. Many studies did not detail the specific modality of their DHT or reported use of an 'interface' or 'dashboard' (N=10, 23%) [50,57,61,65,69,74-76,78,85,86]. Most of the DHT were standalone systems; ten studies reported their DHT solutions (N=10, 22%) as having the ability to integrate into larger systems, although were still chronic pain-specific [46,51,52,61-64,68,84,88]. Only six studies (14%) specified the privacy and security considerations of the DHT solution reported i.e., authentication method to log in or secure storage of patient data on the DHT, although this was not always in great detail [47,52,53,66,80,90]. Further details of the included DHT are provided in Multimedia Appendix 5.

Review objective 2: Methods of DHT development

Many of the studies included in this scoping review did not focus specifically on the development of the DHT. Less than half of the DHT (N=20) were reported to have been developed with any stakeholder involvement, with many of the studies lacking specific details regarding level of involvement. With regards to specific stakeholders involved in the DHT development, 20 studies reporting 15 DHTs (34%) described some HCP involvement [46,49,50,52,53,55-61,64,67,69,71,80,81,85,90]; 13 studies reporting 11 DHTs (25%) described some patient involvement [49,52,54,55,59,60,67,69,71,77,80,81,90]; three studies reporting three DHTs (7%) described some non-specified 'stakeholder' or user-tester involvement [41,61,77] and five studies reporting four DHTs (9%) described some other stakeholder involvement (e.g., pain specialists or researchers, technical experts and software engineers) [59,60,68,88,90]. Although stakeholder involvement in the development is briefly mentioned in these latter studies, few studies reported any detailed co-design process. Notably, the development of only three DHT solutions (11%) were reported to have been led by a system development framework [46,53,55,64], which was the ADDIE (analysis, design, development, implementation and evaluation) [93], the Good Things Foundation Pathfinder Model for Digital Health Inclusion [94] and the John Hopkins University tool for development of clinical applications [95]. Only two of these studies reported use of a framework which focused specifically on digital health system development [53,55]. No studies reported the use of frameworks to guide both the intervention and system development. Two DHTs were described to have been developed using the principles of user-centred [81] or decision-centred [56,58] design, but no specific frameworks were mentioned.

Review objective 3: DHT user features

The inductive content analysis of the reported DHT user features gave rise to four themes which highlight categories of HCP responsibilities in chronic pain management: (1) guiding initial consultation; (2) supporting chronic pain management; (2a) managing opioid intervention and risk (sub-theme); (3) facilitating ongoing patient management; (3a) managing patient-reported outcomes (sub-theme); and (4) supporting routine clinical duties. User features supporting the management of opioid treatment was separated into an individual sub-theme within theme 2 of 'supporting chronic pain management', as consideration of opioid intervention is complex and is often considered separately in guidance for those with poorly managed chronic pain. Further details regarding individual user features can be found in Multimedia Appendix 5.

Theme 1: Guiding initial consultation

Many of the DHT reported in the included studies involve user features which would help to support the HCP in the initial consultation with the patient with chronic pain, which may include reviewing available patient information and diagnosis. This included functions that would assist the HCP in familiarising themselves with the patient's clinical background, such as access to patient medical history (current and past treatments) and past assessment results. Access to patient clinical background and history through the included DHT was the most reported user feature overall, with 15 of the DHT (34%) having this function available to HCPs [41,46,49,50,53,57,61,64,67,70,74-77,80,82,85,91]. The initial consultation may also include initial assessments such as consideration of "red flags" and identification of risks (for example, medical history indicating inclination to opioid dependency), which is supported by user features such as access to risk assessments. Diagnosis of chronic pain is supported by user features of many included DHT, including access to clinical assessments (such as the Brief Pain Inventory (BPI) [96,97] and the Pain Catastrophising Scale [98]) and most notably through diagnostic decision support (i.e., using pre-determined algorithms to generate automatic diagnosis) (N=8, 18%) [42,50,57,71,85,87-89,91]. A total of 30 included studies reporting 25 DHT (57%) included user features that guide the HCP in the tasks

involved in initial assessment; most of these DHT solutions were designed for RPM (N=12, 40%).

Theme 2: Supporting chronic pain management

The second categorical theme highlights the user features of the DHT which would assist the HCP following initial consultation of the patient, which may be the stage in which a practitioner would make decisions regarding treatment for pain management. The supported functions of the DHT which facilitate this include generation of future treatment recommendations via CDS, ability to prescribe medication (directly through the system) and direct access to treatment programs (i.e., to physiotherapy materials). The ability for the HCP to generate treatment recommendations using DHT was the most commonly reported user feature supporting chronic pain management (N=9, 20%) [49,56,58,61-63,65-67]. A total of 19 included studies reported 15 DHT (25%) with user features which facilitate HCP decisions regarding intervention, with the most common type of DHT being for CDS (N=9, 20%).

Sub-theme: Managing opioid intervention and risk

A sub-theme within this category of DHT user features supporting HCP management of chronic pain was 'managing opioid intervention and risk'. This sub-theme categorises the DHT user features that help the HCP specifically regarding opioid intervention of chronic pain. Functions supported by the reported DHT solutions that fall into this categorical theme include: visualisation of both the patient's current and previous opioid interventions [49,58,61-63,65-67] and access to patient opioid agreement/consent documentation [64,65]. A total of 11 included studies reporting seven DHT (16%) addressed the task of managing opioid intervention and risk; there was an even split between the type of DHT with this category of user features, with three DHT promoting CDS (7%), three DHT aiding RPM (7%) and one DHT supporting a combination of the latter (2%).

Theme 3: Facilitating ongoing patient management

This theme describes the user features which support the HCP in facilitating ongoing management for patients, which would follow initial consultation and prescribing of intervention. This was the task most commonly supported by the DHT user features, for example, to review treatment effectiveness or to prepare for follow-up consultations (i.e., reviewing information inputted by patients prior to the consultation). Included studies reported on DHTs which provided the HCP with information (i.e., assessment results) on patient pain, physical activity, psychosocial and anxiety symptoms, sleep, disease activity and patient goals, which could be used to continuously review patients (N=8, 18%) [41,42,50,57,61-63,68,71,74]. The most common type of DHT with user features to assist the HCP for ongoing patient management was RPM (N=25, 57%), presented by a total of 40 studies reporting 34 DHT (77%).

Sub-theme: Managing patient-reported outcomes

Many of the DHT with user features to support ongoing management reported having the ability to display patient-reported symptoms from connected patient-facing DHT including pain levels, physical activity, disease activity, quality of life, psychosocial symptoms and anxiety, sleep and physical symptoms (heart rate/blood pressure) (N=26, 59%). These connected patient-facing DHT were mostly intended for the patient to self-manage their chronic pain. Some of the DHT were described to display patient symptoms in a graphical format (change over time) or a body map and other DHT allowed HCPs to have direct access to a patient diary/log from a connected self-management DHT and assign specific PROMs for patients to complete if requiring further information for review. Nine of the DHTs allowed HCPs to communicate with patients using a chat function that connected to the patient-facing interface (20%), to allow patients to ask HCPs questions regarding the intervention [47,73], general communication with the care team [77,90] or for HCPs to

feedback to patients regarding care [48]. Notably, some DHT included features which allowed HCPs to be alerted to situations that required more immediate attention, for example, due to worsening disease activity [52,53,75,90].

Theme 4: Supporting routine HCP duties

This final categorical theme highlights user features which support other duties of the professional which may be viewed as more routine, i.e., tasks that require attention more frequently and not necessarily within consultation with patients, by all HCPs regardless of discipline. This includes user features of the DHT that allow HCP to carry out general healthcare-related duties such as functions for refreshing clinical knowledge to provide evidence-based care (accessing chronic pain-specific educational materials such as direct resource access links, case scenario assessments and up-to-date chronic pain guidelines) and for more operational duties (access to individual HCP caseloads, the ability to see/modify clinical notes and patient appointments, and notifications for new tasks to complete). The most common function within this category was to support the HCP in refreshing their knowledge of chronic pain, including access to care guidelines (N=11, 25%) [44,45,55,56,58,61-63,68,72,79,80,83,91]. One DHT also allowed HCPs to contact other professionals [77]. User features of this category were possessed by 17 different DHT (39%) reported by 21 studies, with the most common type of DHT being for RPM (N=8, 18%).

Review objective 4: Overview of outcomes

Due to the significant heterogeneity of aims and design of the included studies, there was also significant variation in the outcomes measured. Less than half of the included studies focused on outcomes related to the HCP (for example, perspectives of the DHT, rate of DHT usage) (N=24, 46%) [45,51,54-56,58,61-65,67,68,70-72,74,79-81,83,85,90,92]. One study reported measuring HCP-related outcomes on DHT user experience, but did not specifically report the results [53]. There were some studies that focused solely on patient outcomes (for example, clinical patient characteristics of change in pain intensity, quality of life and physical activity or intervention efficacy and adherence or patient perspectives on the DHT) (N=14, 27%) [52,57,59,60,66,69,73,75,76,78,82,86,87,91]. Cost-effectiveness of the DHT implementation was also measured as an outcome in three of the studies included in this review (6%) [47,48,77].

Review objective 5: HCP perspectives on use of DHT in chronic pain care

A total of 13 studies reported HCP perspectives, through qualitative methods such as interviews and open-response questionnaires. Studies ranged in their aims, falling into two categories of DHT 'development' and 'post-development': (1) six studies investigated HCP perspectives for the purpose of developing and refining a DHT prototype (user testing or usability studies) [51,55,56,58,64,81]; and (2) seven studies investigated HCP perspectives on their experience in using a developed DHT system (acceptability and feasibility studies) [54,74,80,83,85,90,92] (Figure 2). Many of these qualitative studies defined assessment of acceptability and feasibility in different ways; for the purpose of this scoping review, acceptability and feasibility refers to the included studies which focus on qualitatively investigating HCP perspectives following development of a DHT prototype. The thematic synthesis of these 13 studies gave rise to four analytical themes describing the factors that affect HCP use of DHT in chronic pain care: (1) additional value of DHT (with three sub-themes); (2) integration of DHT into clinical workflow (with two sub-themes); (3) ease of DHT navigation; and (4) trust in DHT.

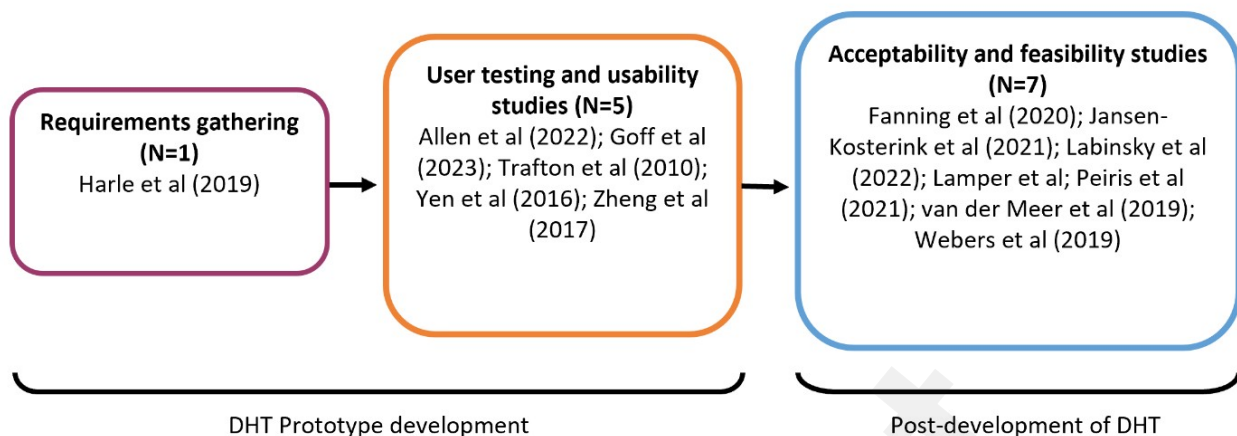


Figure 2: Qualitative studies included in the scoping review reporting health and care professionals' perspectives on digital health technology (DHT) for chronic pain management, divided into stages of DHT development (N=13)

Theme 1: Additional value of DHT

HCPs expressed that the DHT must add value by improving their professional experience beyond what was already offered by working non-digitally. The factors that contributed to the value of the DHT were if the DHT helped facilitate HCP clinical duties, if the DHT improved visualisation of comprehensive patient information and if the DHT consequently enhanced patient care and outcomes.

Sub-theme 1a: Facilitating HCP clinical duties

A highly reported experience of the HCPs was the desire for the DHT to facilitate clinical duties in a way that was more efficient. DHTs were seen as useful for a variety of clinical duties, for example: the DHT was observed as being useful in “*aggregating critical information that, in their current practice, was often scattered... and took time to find and synthesise into a coherent whole*” [58]. The DHT were helpful in “*work[ing] consistently with evidence-based medicine... support during decision making*” [83] and providing “*additional information*” [82]; some viewed the DHT as “*an extra treatment option above the existing option*” [90]. User-testing studies also highlighted HCP suggestions for adding value to DHT usefulness in clinical duties, for example: “*adding arthritis guidelines and setting it as a goal line in activity graphs*” [81]. Some HCPs saw the additional value of the DHT in improving their clinical practice depending on the context, i.e., “*positive experiences with [the DHT]... was mostly in a blended form*” [92]. Barriers to DHT implementation were also expressed by some HCPs, with some seeing the DHT as not adding value to their clinical duties, for example: HCP noted that “*you can’t have a tool for every presentation in general practice... this is something that should be up there (pointing to head) rather than ‘oh wait a second, let me use this tool’*” [85].

Sub-theme 1b: Visualising comprehensive patient information

One of the main reported ways in which the DHT had additional value was in improving visualisation of comprehensive patient information for the HCP. HCPs felt a “*strong need... to be presented with comprehensive patient history*” in the development of the DHT [58] and found the DHT to be useful for their clinical practice when this was provided in various ways, for example, authors reported: “*[HCPs] liked summary data in a trend format that ‘gives a nice, quick snapshot’ [and this is] ‘helpful’ for [the HCP] and patient to discuss issues and change treatment*” [81]. Included studies described that “*care providers appreciated the additional information for*

[preparing] their consultations, the insight gained from the evolution of important outcomes... over time in relation to medication use” [80]. Some HCPs thought that “data visualisation is in general much better with [the] tool” [74] and that DHT’s “graphical display of the results was especially of added value as it gave insight into the efficacy of the treatment” [90]. HCPs also suggested ways in which the DHT could better the visualisation of patient information, i.e., authors reported that the HCP “thought that while daily reports of pain or symptoms would be good for patient’s monitoring, [surgeons] would like to see summary changes by week or by month to make decisions” [81].

Sub-theme 1c: Improving patient care and outcomes

Included studies reported that a large contributor to HCP’s experience of DHT value was ultimately the impact on patient care and outcomes. HCP perspectives highlighted the usefulness of the DHT in improving patient care, for example: *“I think patients get the most annoyed when I suggest something that we have done before... so I think patients would like the most that I’ve remembered (in reference to having access to patient history through DHT)” [58]. HCPs expressed that the reported DHT “could be beneficial to many patients” [51]. Specifically, the included studies suggested the added value of the DHT for patient care in implementing “shared decision-making” [74], “patient reassurance” [85], “personalized (patient) care...increasing self-efficacy (for the patient)” [92], “patient empowerment” [83] and “better streamlining of care (leading to) better treatment results for the client” [83]. Much of this referred to DHT which had connected network of professional-facing and patient-facing systems. However, barriers to DHT use were highlighted as hindering to patient care and outcomes by some HCPs, particularly that the DHT could be at the “expense of patient-clinician interaction” [80] and “personal contact” [92].*

Theme 2: Integration of DHT into clinical workflow

A major factor in the implementation of DHT is the ability for the system to adapt to the HCP’s clinical workflow. HCPs expressed a desire for the DHT to easily accommodate to their current clinical environment and for there to be a balance in the time, effort and cost to implementation into clinical practice.

Sub-theme 2a: Adapt to current clinical environment

HCP perspectives emphasised the importance of adaptability of the DHT into their current clinical environment, i.e., that they would not have to significantly alter their responsibilities to accommodate use of the DHT in question. This was mostly reported by the HCPs as a source of challenge, with few commenting on the utility of the DHT in adapting to their current clinical environment. HCPs expressed that the issues could arise in adapting to the physical environment, for example: *“a lack of networked printers limited the usefulness of the [DHT]... software or hardware changes led to slowing of the system to the point that it was... disruptive to workflow” [64]. There was also reference to more logistical concerns, for example, authors described HCP concerns over “the implementation of such a mobile application into the clinical workflow and how it may impact patient care” [51] and that some HCPs “indicated that it is difficult for them to combine the [DHT] with other existing applications in their daily practice” [90], suggesting better integration into the professional routine (e.g., “the main influence to future tool uptake appeared to be integration into routine workflow” [85]).*

Sub-theme 2b: Balance in time, effort and cost

In line with HCPs concerns regarding DHT adaptability to their current clinical environment, HCP perspectives underlined balance in time, effort and cost as a factor in their use of DHT in chronic pain care (due to the lack of time in HCP work schedules). HCPs reported that, for successful integration of the DHT into the clinical workflow, implementation must not significantly increase

their time and effort nor the financial cost. Some of the DHT was seen as having a positive influence on the amount of HCP time and effort in clinical practice, e.g., in *“workload reduction, as the [DHT] could also be used by the practice nurse”* [83]. Authors stated that *“GPs indicated that the patient self-registration route was timesaving for them”* [90]. A balance in these factors is essential, as HCPs expressed the need for time-efficiency and *“brevity”* of information (i.e., *“quick scanning”* [64]), whilst also desiring comprehensive patient information (as stated in sub-theme 1b). HCPs were skeptical about *“having adequate time to use the [DHT], given time-constrained work schedules”* [58] and *“saw an extra investment in time, money and administration”* [92]. In terms of financial cost, HCPs found it *“concerning”* as costs were likely to increase with expanding future use [90]. Balance is also key regarding financial cost, as some HCPs were reported to perceive that *“some [of the DHT] features were worth this investment”* due to its additional value [92].

Theme 3: Ease of DHT navigation

A frequently mentioned factor in DHT usefulness by the HCPs was ease in navigation, regarding its user-friendliness and accessibility. User-testing studies in the development of the DHT prototype brought attention to HCP's system-specific suggestions to increase usability (e.g., to address *“confusing”* navigation [51]) and accessibility (e.g., changing data entry modules for increased accessibility for colour-blind HCPs [51]). Some HCPs praised the DHT in its ease of navigation, for example, a study reported that *“overall, [HCPs] indicated that the [DHT] is easy to use”* [90] and some practitioners thought that the DHT in question was *“user-friendly”* [83,92]. Most comments regarding issues in DHT navigation were reported in studies addressing prototype development and were subject to improvement in the future; few post-development studies identified any barriers in reference to navigation.

Theme 4: Trust in the DHT

HCPs conveyed a need to trust the DHT in providing good care, i.e., relying on the clinical accuracy of the information provided as well as the quality of the system. Some HCPs highlighted some concerns about the DHT containing *“accurate, trustworthy, and relevant information”* [58]. Practitioners expressed that *“one of the challenges is who put the information there?... the information has to be verified”* [58]. Accuracy issues with the DHT *“can generate insecurity in the user”* [74]. Studies on user-testing highlight HCP suggestions to improve clinical accuracy of information provided by the DHT, for example, authors reported that there was *“helpful feedback on the wording of [graphical user interface] elements, particularly the level of detail and vocabulary level most appropriate for primary care providers”* [64]. Some HCPs also experienced concerns about the quality of the DHT (e.g., *“underlying electronic health record data quality and... the ability... to consistently display the most relevant information”* [58]) whilst other HCPs chose to use their system due to its high quality (e.g., a study reported *“the six [orofacial physical therapists] who started using [the DHT] during the COVID-19 pandemic chose this platform due to its available content and its quality, and the positive experiences of other colleagues in the field”* [92]). Regardless of this conflict in opinion regarding specific DHT, it is clear that both the quality of the intervention content and the DHT system is an important factor in HCPs trusting the DHT and consequently its implementation.

Discussion

Principal findings

To our knowledge, this is the first scoping review to systematically investigate professional-facing DHT for the care of patients with chronic pain. This scoping review identified that various professional-facing DHT to support chronic pain management exist, with 52 included studies reporting 44 DHTs aimed at RPM, CDS, assessment/diagnosis and HCP education (or a combination).

The first objective was to investigate the components of professional-facing DHT, which varied significantly. The most commonly targeted population and setting of DHT use were multidisciplinary teams of HCPs for the care of arthritis (various types) in primary care. Over half of the reported DHT has a connected patient-facing interface, mostly for the purpose of RPM through patient-reported data collected on self-management mobile apps. The second objective was to investigate the methods of DHT development; many of the included studies did not specify this. Less than half of the studies reported any form of stakeholder involvement in DHT development and fewer studies reported a level of stakeholder involvement which would constitute proper co-design. The third objective was to analyse the user features of the available professional-facing DHT. The user features support the HCP in duties to guide initial consultation with patients, to support chronic pain management for patients (including management of opioid intervention and risk), to facilitate ongoing patient management following initial consultation (including management of PROs) and to support more routine tasks i.e., daily tasks that can occur outside of patient-professional interaction. The fourth objective was to provide an overview of the outcomes of the studies reporting the available professional-facing DHT, which differed significantly across the included studies. Notably, less than half of the included studies reported specific, professional-related outcomes and some focused solely on patient-related outcomes. Finally, HCP perspectives suggested that the DHT must fulfil the following requirements for successful implementation in practice. The DHT must have additional value to the HCP, must easily integrate into the clinical workflow of the user, must be easy to navigate and HCPs must be able to trust in the DHT.

Healthcare professionals and digital health

The findings of this review are in line with previous literature which focuses on digital health for professionals in healthcare. DHT has many benefits for HCPs, as it reduces clinical workload whilst enhancing work efficiency, therefore providing both financial and operational advantages [99]. Previous literature has highlighted DHT as a solution to mitigate some of the issues surrounding chronic pain management, such as limited resources for care [18,19,23]. This has been of particular value in a post-pandemic world, where healthcare services have been strained [99]. Digital health provides unique opportunities for HCPs, as a large proportion of the world's population have access to internet and smart technology, opening new possibilities for remote monitoring of patients [100]. Remote monitoring may be one of the main ways that DHT can provide benefits to both the HCP and patient, as it could improve professional efficiency [99] which consequently would have an impact on patient outcomes. The potential of remote monitoring through DHT is clearly a focus for exploration in digital health research on chronic pain. This is supported by the findings of this review in several ways: (a) the majority of the reported DHT were designed primarily with the aim of RPM; (b) much of the DHT had a connected patient-facing interface which could be used to monitor patient progress; (c) the main outcomes measured by the DHT were PROs; (d) analyses of the DHT resulted in a category of user features that can aid the HCP in facilitating ongoing patient management, particularly through management of PROs; and (e) synthesis of HCP perspectives showed greater visualisation of comprehensive patient information as a factor which would encourage professional's

use of DHT, which would be most significant in the remote monitoring of patients.

Indeed, it is important to take into consideration the needs of the HCP when considering chronic pain care [101]. Professional acceptance of DHT has been suggested to be influenced by the amount of time or work required to use the system and relevance of system information [102], which align with the results of this review. This review highlighted that HCPs place importance on the ability of the DHT to easily integrate into the clinical workflow and the trustworthiness of the DHT, which is in concurrence with the latter reasons for professional acceptance. For the most part, HCP perspectives were similar across the included studies with regards to the factors affecting their use of DHT, despite the significant heterogeneity in the types of DHT they were considering. This general agreement suggests that these factors should be taken into consideration when designing any DHT for HCPs. Such factors which affect professional acceptance of DHT use in chronic pain care is reflected in the literature focusing on other areas of digital healthcare; previous research on other conditions such as chronic obstructive pulmonary disease and hypertension has highlighted facilitators of HCP use of DHT including ease of integration into the clinical workflow [103], high usability [103,104] and the additional value of the solution (for greater access to patient data, to increase patient engagement and communication) [103,105,106]. However, despite research being conducted on HCP perspectives on digital health, professional-facing DHT may not be meeting its full potential of benefits due to lack of HCP acceptance and design input [107]. This may indeed be the case for the available DHT identified by this review, as the level of HCP input into the design was inconsistent across the literature.

The idea that there is a further, unmet potential of DHT that is directed at HCPs to support chronic pain management is reinforced by several findings of the current review. Although this review testifies not only to the availability but the variety of professional-facing DHT, few that were identified would improve the provision of holistic and interdisciplinary care. In fact, only one of the DHT solutions supported a feature that would allow HCPs to communicate with one another to coordinate care [77]; despite the main target HCP population for DHT use being multidisciplinary care teams. As aforementioned, digital health is explored as a method to complement traditional care as it introduces the potential opportunity to mitigate some of the challenges surrounding chronic pain care such as lack of resources [18,19]. The literature on chronic pain care emphasise the importance of holistic care, particularly as the evidence from research suggests biopsychosocial mechanisms of chronic pain [22]. Lack of resources is a major reason why many individuals with chronic pain are unable to access the specialised care that would promote evidence-based, interdisciplinary and holistic management of which is seen as the most ideal standard of chronic pain care [21,23]. DHT may provide a solution to this issue and be one way to make interdisciplinary care more accessible in the future. Certainly, DHT for professionals in healthcare is important to support evidence-based practice for HCPs and subsequently improve patient outcomes.

The importance of co-design

It is accepted that the involvement of stakeholders, particularly HCPs and patients, in the design of DHT is important for ensuring usability and successful implementation in healthcare practice [108-110]. Despite the recent rise in digital innovations for chronic pain [53] and the abundant availability of professional-facing DHT as demonstrated by this review, much of the research supporting DHT development still lacks adequate reporting of appropriate stakeholder involvement. Over half of the studies included in this review did not report any form of collaboration with stakeholders. Furthermore, the quality assessment of the included studies identified involvement of stakeholders as a criterion of low quality. All of this suggests that the literature in this research area is still sub-optimal as it lacks consistency in the reporting of digital health development. For standardisation in the reporting of digital health, the CONSORT eHealth checklist [111] was created and is occasionally consulted by clinical trials of DHT; a criterion within this checklist is 'describe the

history/development process'. It is clearly important to be able to access information regarding the specific development process of DHT. This is a criterion that many of the studies included in this review would fail to meet. This may also be due to the CONSORT eHealth checklist being a guide for RCTs in DHT research, which many of the included studies are not. To our knowledge, no guidelines exist for the standardisation in the reporting of studies to develop DHT, which mostly employ qualitative methods. This may be a major reason for inconsistencies in the literature on reporting of DHT development.

Although necessary due to its complexity, digital health in general often lacks stakeholder involvement, consequently limiting its adoption [108]. Again, this may be due to a lack of guidance on how to adequately employ co-design in digital health research [108]. Co-design refers to a method essential in DHT design, which involves direct and active involvement of stakeholders (most importantly, the end-users) in the whole design process from the early stages of conception [108-110]. This method is not consistently described or evaluated in the literature [112], which is reflected by the studies included in this review. Many of the studies that described some level of stakeholder engagement in the DHT development did not consistently report methods of which meet the co-design criteria of active collaboration across the whole process from design planning and conception. Although this suggests that these studies did not practice proper co-design in their DHT development, it may also be that the studies did not adequately report the involvement of stakeholders. The challenge of properly applying co-design methods in digital health research is thought to be due to high HCP workload, resulting in lack of time for sufficient active involvement [109]. However, increased time and effort for co-design application could lead to adoptable DHT which can eventually improve work efficiency for professionals [99], which in turn will inevitably have an impact on both professional and patient outcomes.

Implications for future research

The results of the current review show good availability of professional-facing DHT. However, the methods of DHT development are still lacking due to several reasons. Firstly, it is unclear from the included studies whether any of the DHT were developed through methods which adequately meet the standards of proper co-design and secondly, there is no evidence to suggest that any of these studies followed specific frameworks to guide both the intervention development and the system development. The use of frameworks would ensure that the design methods are rigorous to result in DHT which is evidence-based, with reliable clinical information and with high usability. Both are equally important to consider for DHT and should adhere to the principles of co-design through adequate involvement of end-users. HCP perspectives of the current review also strengthen this argument, as the ability for the professional to trust the DHT to provide clinically accurate information and usability were highlighted as factors that would encourage use of digital health for chronic pain care. Focusing on the rigorous development of the intervention and the background system through use of frameworks would result in fulfilment of the latter factors. For intervention development, frameworks exist such as the Medical Research Council (MRC) framework, which highlights the importance of iterative and rigorous development through an evidence-based approach of research and stakeholder engagement [113,114]. Iterative development has also been highlighted as particularly useful for improving usability of DHT [115]. Models that focus specifically on user-centred principles of DHT development, such as the Centre for eHealth Research (CeHRes) roadmap, also exist to guide system development [116]. These types of system development frameworks are beneficial to DHT research, as they focus more on usability. Future research on the development of professional-facing DHT should employ rigorous co-design through active involvement of stakeholders from the beginning of the process and may also benefit from using intervention and system focused frameworks which encourage co-design principles. This will help in ensuring evidence-based assistance for professionals, increased usability and consequently more

sustainable adoption of DHT.

In general, future research should also focus more on how DHT can help HCPs in providing chronic pain care. There is a clear interest in the potential for DHT to improve chronic pain care from the professional perspective, as demonstrated by the rationale supporting the many studies included in this review. However, much of the literature still focuses more on the patient perspective; many of the studies included in this review did not measure professional outcomes, focusing more on the connected patient-facing DHT. Future research on professional-facing DHT should also ensure to measure professional outcomes, not just patient outcomes e.g., HCP's use of DHT. Moreover, there are many literature reviews that focus on patient-facing DHT, but few exist on professional-facing DHT for chronic pain management. This scoping review was the natural first step to conducting further research on this topic. To our knowledge, there are no systematic reviews which investigate the effectiveness of professional-facing DHT for improving chronic pain care. As per the guidance in the JBI manual for evidence synthesis [31], a scoping review, which focuses on intervention availability, forms the prior step to a systematic review, which focuses on intervention efficacy. A systematic review may be necessary in the future to fully investigate the effectiveness of DHT for HCPs in chronic pain healthcare.

Implications for future development of DHT for practice

As discussed, the available DHT for professionals in chronic pain care are heterogeneous but may not necessarily meet the full potential for aiding HCPs, due to lack of professional acceptance and design input [107]. In addressing the objectives of this scoping review to investigate the professional-facing DHT components, user features and HCP perspectives, several gaps were identified which could be addressed to improve chronic pain care practice through digital health.

The lack of focus on providing holistic chronic pain care suggests that there is a potential gap for a professional-facing DHT solution which supports interdisciplinary care of chronic pain, allowing greater coordination of care and communication between multidisciplinary HCPs. The most commonly targeted setting for DHT implementation in this review was primary, which is where the majority of chronic pain conditions are cared for within the UK [23,35,117] and around the world [20]. Perhaps the impact of chronic pain is greatest on primary care, especially economically, which is a significant burden [117]. There may be an unmet potential in DHT to more comprehensively support primary care or to improve interdisciplinary care of chronic pain. However, context is also important to consider for future developers as the areas of care on which chronic pain has the greatest burden may be variable dependent on the healthcare system of the country.

Despite professional acceptance being essential, some of the system components of the reported DHT conflict with the themes highlighting HCP perspectives. The majority of the included studies reported their DHT to be standalone or did not mention an ability to integrate into larger, existing systems; however, the thematic synthesis highlighted integration into the current clinical workflow of the professional as a factor which would encourage use of DHT. Indeed, some DHTs may have this ability to integrate even if the included studies did not report this. The lack of ability to integrate exhibited by much of the existing DHT is actually emphasised as a factor that inhibits wider clinical use in one of the studies included in this review, due to inconvenience to the HCP [88]. For optimal application of professional-facing DHT in practice, future DHT may be best developed with the ability to integrate into existing systems to ensure easier assimilation into the clinical workflow of the end-user professional. Similarly, despite the trustworthiness of DHT being valued by HCPs, few studies reported any details regarding security and privacy. This is extremely important for the adoption of any professional-facing DHT solutions in practice, as such systems will likely contain sensitive patient data which requires protection. Developers of such systems should consider the factors inferred from the thematic synthesis of HCP perspectives on use of DHT for chronic pain management, ensuring that the system has additional value, integrates into the clinical workflow, is easy to navigate and

promotes professional trust in providing quality care.

Strengths and limitations

This is the first scoping review to investigate professional-facing DHT for care of patients with chronic pain. It is also the first review to conduct an analysis of the user features that support HCPs in chronic pain care through digital health, as well as the first to thematically synthesise HCP perspectives on the use of DHT specifically designed for professionals. Therefore, it is likely that this review is the most comprehensive report of chronic pain-specific DHT which supports professionals in healthcare. A major strength of this scoping review is the systematic process employed to screen reports for inclusion. A comprehensive search strategy was cross-checked by an academic librarian and results were screened by two independent reviewers for study inclusion. Furthermore, this review followed the scoping review guidelines set by the JBI and PRISMA, to ensure rigor. As a result, it is likely that most of the literature which supports professional-facing DHT for care of patients with chronic pain was captured by this review.

However, several limitations of this review exist which may have resulted in some relevant articles being missed for inclusion. Firstly, the search was limited to studies written in the English language, therefore systems from non-English speaking countries may have been missed. This is particularly important to note as a limitation, as there was significant variability in the countries the available DHT were developed in and designed for application in the healthcare systems of; other papers which report on updates or adaptations of the included DHT may be reported in non-English languages. Additionally, the search was limited to academic databases and excluded gray literature, and DHT solutions may be developed commercially or without publication of peer-reviewed research. Nonetheless, the interest of this scoping review was the availability of interventions which are evidence-based and therefore more likely to be implemented in real healthcare settings. This review showed that many of the studies reporting professional-facing DHT focus primarily on the connected patient-facing DHT and its impact on patient outcomes, with little information regarding the professional interface. Thus, there is a possibility that other relevant studies may have been excluded during the screening process due to a lack of focus on the HCP and resultant absence of information on the professional-facing DHT in the abstract. Finally, some relevant studies may have been missed due to the nomenclature of chronic pain. There is some variability in the chronic pain literature on how the condition is defined, i.e., how long pain must be experienced before 'acute pain' turns to 'chronic pain' [118]. This review used the ICD-11 guideline of pain experienced for three or more months, or if reported by the authors specifically as 'chronic', to assess eligibility. Some relevant studies may have been missed in the search if using any other definition of chronic pain, or if they did not specifically report that the DHT was for chronic pain care.

Conclusion

This scoping review is the first to investigate the availability of professional-facing DHT in care of patients with chronic pain. There is a clear interest in DHT for chronic pain care, for use of HCPs, as highlighted by the availability and variability of such solutions. However, focus on the professional in this research area is still limited. There is still some unmet potential in professional-facing DHT. The interest in digital health research specifically on remote monitoring of patients shows an unprecedented opportunity for greater access to and ease of care for both the patient and professional, which can be explored further in future research on DHT for chronic pain care. Research reporting on professional-facing DHT is lacking in proper co-design development. Future developers of professional-facing DHT should consider this when designing a new intervention.

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Data availability

All data generated or analyzed during this study are included in this published article [and its supplementary information files].

Conflicts of interest

None declared.

Author contributions

HM completed the screening of studies for review inclusion, data extraction, data analysis and wrote the manuscript. AM and MI contributed to the screening of studies. AM contributed to the data extraction. NW, HR and RM completed conflict resolution and contributed to the writing of the manuscript.

Abbreviations

All abbreviations are initially clarified in the main text. Abbreviations include:

HCP – health and care professional

GP – general practice

PCP – primary care practitioner

DHT – digital health technology

CDS – clinical decision support

RPM – remote patient monitoring

PROM – patient reported outcome measure

Other disclosures

No AI was used in any portion of the manuscript generation.

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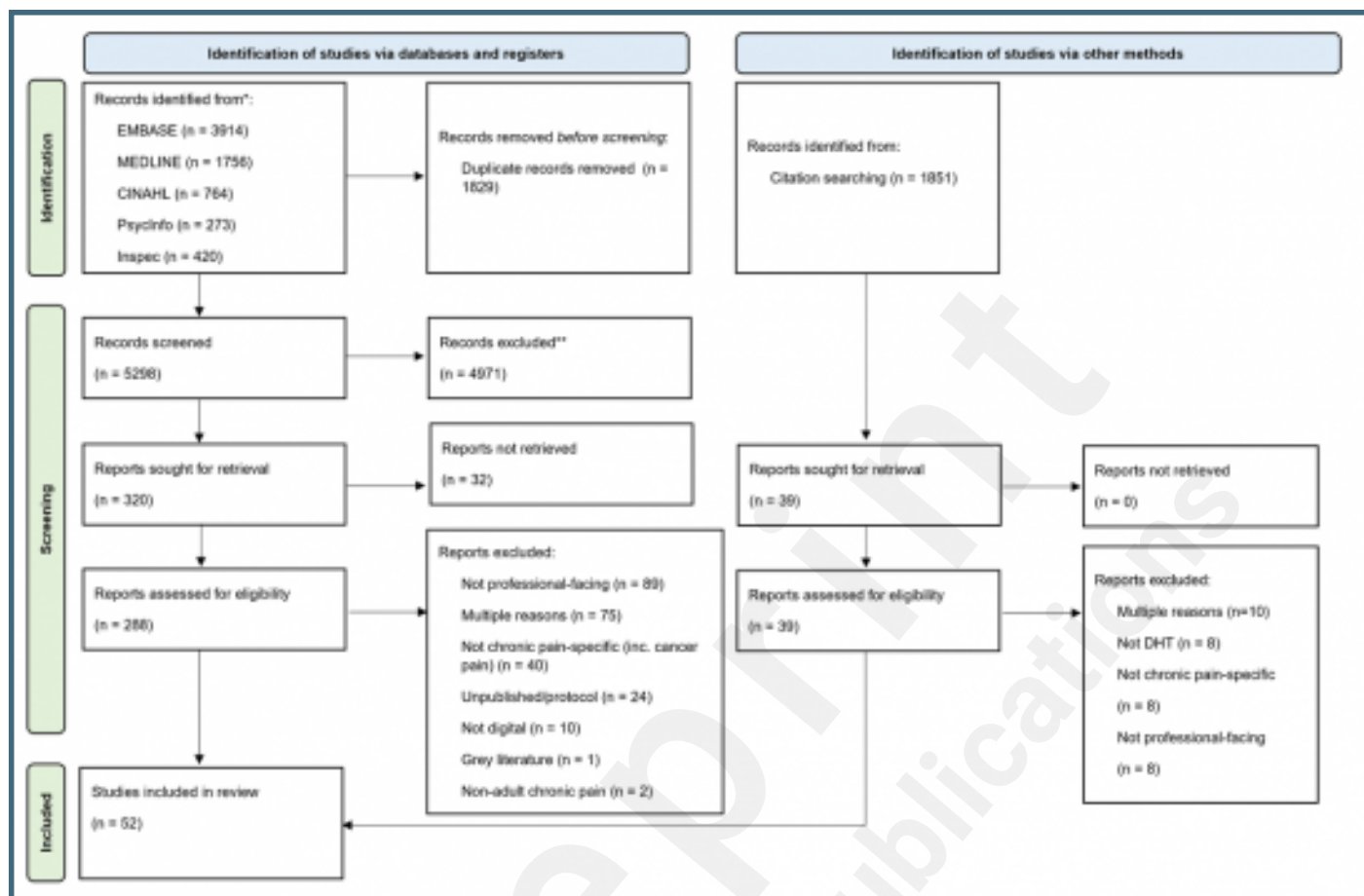
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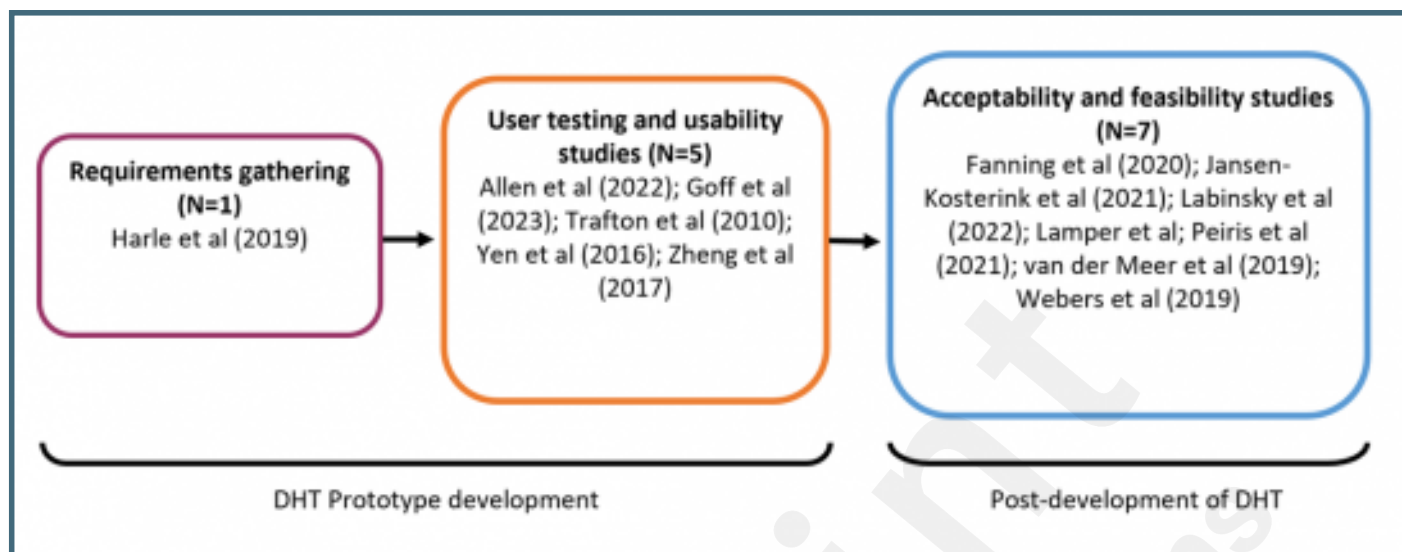
Supplementary Files

Figures

PRISMA flowchart.



Included studies reporting on HCP perspectives (N=13).



Multimedia Appendixes

Search strategies.

URL: <http://asset.jmir.pub/assets/66e278c73ef9c041a1b8b14959e38556.docx>

PRISMA-ScR checklist.

URL: <http://asset.jmir.pub/assets/79ba90007a9297b63501b505028cac19.docx>

QuADS scores for included studies (N=46).

URL: <http://asset.jmir.pub/assets/bbaaeecfd72acce4ac931266894c4b7b.docx>

Table 1: Table describing the characteristics of studies included in the scoping review (N=52).

URL: <http://asset.jmir.pub/assets/1ecf9d6779a6426f5dc26e82b0302edf.docx>

Tables describing intervention characteristics (including most common user features reported divided by category) (N=44).

URL: <http://asset.jmir.pub/assets/288be7809100a8c30dcbb3c05ff699ff.docx>