

Rapid Evidence and Gap Map of virtual care solutions across a stepped care continuum for youth with chronic pain and their families in response to the COVID-19 pandemic

Kathryn A. Birnie^{a,b,c,d,*}, Maria Pavlova^e, Alexandra Neville^e, Melanie Noel^{c,e}, Isabel Jordan^d, Evie Jordan, Justina Marianayagam^{d,f}, Jennifer Stinson^{d,g,h}, Diane L. Lorenzettiⁱ, Violeta Faulkner^a, Tiegghan Killackey^g, Fiona Campbell^{d,j}, Chitra Lalloo^{g,k}

Abstract

Poor access to pediatric chronic pain care is a longstanding concern. The COVID-19 pandemic has necessitated virtual care delivery at an unprecedented pace and scale. We conducted a scoping review to create an interactive Evidence and Gap Map of virtual care solutions across a stepped care continuum (ie, from self-directed to specialist care) for youth with chronic pain and their families. Review methodology was codesigned with 8 youth with chronic pain and 7 parents/caregivers. Data sources included peer-reviewed scientific literature, gray literature (app stores and web sites), and a call for innovations. Records were independently coded and assessed for quality. Overall, 185 records were included (105 scientific records, 56 apps, 16 web sites, and 8 innovations). Most virtual care solutions were applicable across pediatric chronic pain diagnoses, with the greatest proportion at lower levels of stepped care (ie, >100 self-guided apps and web sites). Virtual delivery of psychological strategies was common. Evidence gaps were noted at higher levels of stepped care (ie, requiring more resource and health professional involvement), integration with health records, communication with health professionals, web accessibility, and content addressing social/family support, medications, school, substance use, sleep, diet, and acute pain flares or crises. Evidence and Gap Maps are a novel visual knowledge synthesis tool, which enable rapid evidence-informed decision-making by patients and families, health professionals, and policymakers. This evidence and gap map identified high-quality virtual care solutions for immediate scale and spread and areas with no evidence in need of prioritization. Virtual care should address priorities identified by youth with chronic pain and their families.

Keywords: Virtual care, Chronic pain, Children, Adolescents, Evidence and gap map, COVID-19, Stepped care

1. Introduction

Pediatric chronic pain is a health emergency that affects 20% to 25% of youth, costs >\$19 billion USD annually, and highly impairs daily functioning for up to 50% seen in tertiary chronic pain clinics.^{24,28,59} Youth with chronic pain are at increased risk of chronic pain and mental health disorders into adulthood.^{25,55,56} Pediatric chronic pain affects and is affected by the broader social context (ie, parents, family, and peers).⁴⁰ Parents of youth with chronic pain experience greater anxiety, depressive, and post-traumatic stress symptoms, and parental distress has been associated with poor pain outcomes for youth.^{18,33,38}

The biopsychosocial model highlights reciprocal associations between biological, psychological (ie, emotional and cognitive), and sociocultural aspects of pain.²³ This model necessitates a multidisciplinary approach that includes pharmacological, physical, and psychological therapies.³² Depending on the severity of pain and disability, interventions for pain fall across a continuum of health professional involvement and resource intensity that can be increased or decreased depending on individual patient need (ie, a stepped care continuum), ranging from self-directed pain management (low involvement, low resource) to ongoing specialist consultations (high involvement, high resource).^{1,5}

Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

^a Department of Anesthesiology, Perioperative, and Pain Medicine, University of Calgary, Calgary, AB, Canada, ^b Department of Community Health Sciences, University of Calgary, Calgary, AB, Canada, ^c Alberta Children's Hospital Research Institute, Calgary, AB, Canada, ^d Solutions for Kids in Pain (SKIP), Halifax, NS, Canada, ^e Department of Psychology, University of Calgary, Calgary, AB, Canada, ^f Northern Ontario School of Medicine, Thunder Bay, ON, Canada, ^g Child Health Evaluative Sciences, The Hospital for Sick Children, Toronto, ON, Canada, ^h Lawrence S. Bloomberg, Faculty of Nursing, University of Toronto, Toronto, ON, Canada, ⁱ Health Sciences Library, Department of Community Health Sciences, University of Calgary, Calgary, AB, Canada, ^j Department of Anesthesia and Pain Medicine, The Hospital for Sick Children and University of Toronto, Toronto, ON, Canada, ^k Institute for Health Policy, Management, and Evaluation, University of Toronto, Toronto, ON, Canada

*Corresponding author. Address: Department of Anesthesiology, Perioperative, and Pain Medicine, University of Calgary, 2500 University Drive NW, Calgary, AB T2N 1N4, Canada. Tel.: 403-955-7809. E-mail address: kathryn.birnie@ucalgary.ca (K.A. Birnie).

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Improving access to and delivery of evidence-based treatments, as well as coordination of care, is a top priority identified by youth with chronic pain, their families, and health professionals.⁷ A recent review of systematic reviews of all interventions for pediatric chronic pain revealed minimal focus on patient-identified priorities.⁹ Furthermore, only 3 of 50 included reviews focused on virtual or remotely delivered care.^{3,11,30} Virtual care includes therapies that are accessed by the patient or family, or delivered to the patient or family by health professionals, using any form of communication or information technology (eg, telehealth/telemedicine, e/mHealth, text messaging, apps, web sites, telephone, and videoconferencing). Virtual care offers the potential to overcome system-level barriers that impair access to pediatric chronic pain management (eg, distance, cost, and limited local specialists).⁴⁴ Calls for virtual and stepped care treatment approaches for youth with chronic pain are emerging, and evidence supporting the effectiveness of these solutions is growing, particularly in response to the COVID-19 pandemic.^{11,17,44} A recent Lancet Commission on pediatric pain highlighted the growth in virtual care options; yet, very few are theoretically based and/or supported by evidence.¹⁹ The impact of the ongoing COVID-19 pandemic on youth with chronic pain is likely to be long-lasting, pervasive, and—if not addressed—may lead to increased rates of disability and suffering.¹²

The current scoping review addresses an urgent need to identify virtual care solutions that are readily available to youth with chronic pain, their families, and health professionals. Our goal was to create an interactive Evidence and Gap Map (EGM) of virtual care solutions at different levels of stepped care (Fig. 1) for youth younger than 18 years with chronic pain and their families during the COVID-19 pandemic and beyond. Evidence and gap maps are tools to enable rapid evidence-informed decision-making by multisectoral stakeholders, including patients and families, health professionals, decision-makers, and policy-makers.^{45,49} To ensure a patient-oriented focus, we partnered with youth with chronic pain and parents to identify the most relevant components of virtual care solutions.

2. Methods

2.1. Patient engagement

The project team conducting the scoping review included 2 youth with lived experience with pediatric chronic pain and a parent as

patient partners (E.J., J.M., and I.J.), in addition to pediatric pain health professionals and researchers (K.A.B., M.N. J.S., F.C., and C.L.), a health information specialist (D.L.L.), and clinical psychology and nursing graduate and postdoctoral trainees (M.P., A.N., and T.K.). Patient partners were full collaborators^{6,34} and were compensated as per best practices to reflect their expertise and contributions.^{42,43} They contributed to the co-design of content and language of the EGM, cofacilitation and interpretation of contributions of the youth and parent project advisory group (described in more details below), development of the project video, coauthorship, and mobilization of the findings from this scoping review.

2.2. Protocol and registration

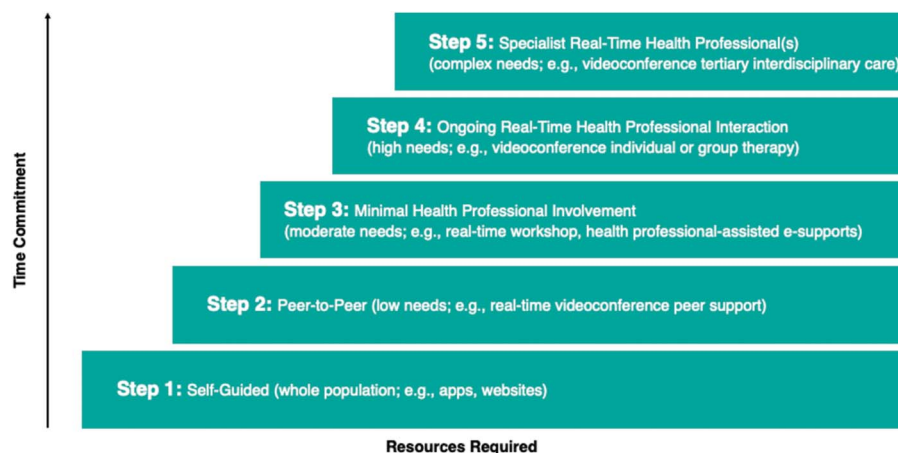
This scoping review^{2,31} was conducted using 3 sources of information including scientific literature, gray literature, and a call for innovations. Results of this review were subsequently synthesized in an interactive EGM. Evidence and Gap Maps are an interactive data synthesis tool. They provide an interactive visual overview of the breadth, availability, and quality of evidence in a given area.^{46,49} Evidence and Gap Maps provide a novel knowledge synthesis approach that can accelerate uptake of virtual stepped care solutions for youth with chronic pain. The interactive EGM visual summary provides an accessible and usable synthesis of knowledge strengths and gaps to inform practice, policy, research, and/or investment.^{46,49}

The PRISMA Extension for Scoping Reviews⁵¹ and the GRIPP-2 checklist for patient and public involvement in research⁵⁰ guided quality reporting at each phase of this review. The review protocol was not registered in PROSPERO because it is not a systematic review; however, the review protocol and preliminary results are available publicly, in addition to an earlier phase of the project, as required by the funder.⁸

2.3. Eligibility criteria, search strategy, and conduct

2.3.1. Scientific literature search

Peer-reviewed scientific articles published in the past 10 years were identified for inclusion if they (1) discussed children and adolescents younger than 18 years reporting any type of chronic pain (ie, pain lasting >3 months); (2) were published in English; (3)



Model adapted from Mental Health Commission of Canada. Newfoundland and Labrador Stepped Care 2.0 e-Mental Health Demonstration Project. Health Canada; 2019.

Figure 1. Levels of stepped care.

evaluated any type of virtual care (eg, telephone, telehealth, telemedicine, mHealth, eHealth, online, and digital); and (4) were primary studies of any type with an identified purpose of evaluating virtual care solutions (eg, randomized controlled trials [RCTs], nonrandomized trials, observational studies, mixed methods studies, qualitative studies, case reports, dissertations, and conference abstracts). For our purposes, virtual care across a stepped care continuum was conceptualized as any type of pain management strategy delivered and/or accessed exclusively remotely using any form of communication or information technology. Five levels of the stepped care continuum are described with examples in **Figure 1** as adapted from the Mental Health Commission of Canada Stepped Care 2.0.³⁷ Studies were excluded if they required any in-person component. Systematic reviews were also excluded because they were otherwise included in another systematic review focused on identifying recommendations and best practices for virtual care delivery for youth with chronic pain and their families (PROSPERO registration: CRD42020184498; Birnie et al.,⁸ manuscript under review). The search strategy was developed in collaboration with a health information specialist team member (D.L.L.). Database searches were conducted in MEDLINE, CINAHL, Embase, PsycINFO, and Web of Science between June 9, 2020, and June 18, 2020. A sample search strategy is available in Supplementary Material 1 (available at <http://links.lww.com/PAIN/B388>).

2.3.2. Gray literature search

A gray literature search of mobile applications (apps) and web sites addressing virtual care for youth with chronic pain was conducted over 2 weeks in September to October 2020. Posts were also made during this time to the following professional listservs to further identify any relevant apps or web sites: Society of Pediatric Psychology, Pediatric Pain, and Pain in Child Health.

Apps were sourced through the 2 major smartphone operating systems: iOS (Apple App Store) and Android (Google Play Store). The Apple App Store was searched by a team member (V.F.) for any app with the key word “pain” in the title under the categories of “Health and Fitness,” “Lifestyle,” and “Medical.” The Google Play Store was searched with the key word “pain” in the search tool function with no imposed restrictions related to store subcategories. Apps were included if (1) they primarily addressed chronic pain; (2) they were available in English; (3) the primary goal of the app was to provide education, tools, or advice related to managing pain; and (4) children and/or adolescents were the intended users. This latter inclusion criterion was determined by screening the app titles and descriptions for words such as “child,” “pediatric,” “kid,” “teen,” “youth,” “young,” and “adolescent,” screening whether the app publisher was a pediatric focused organization, reviewing any specified ages for the apps’ intended user, and screening for the general presentation of the app (eg, app presentation depicting age-neutral images). Exclusion criteria included apps that clearly targeted adults and/or seniors, and e-books, which were defined as an app that did not provide any additional content or functionality beyond a textbook.

Relevant web sites were searched using the Advanced Google Search Engine with search term combinations drawn from the scientific literature search strategy. The first 10 pages of each search query were screened for relevance. A snowball-sampling method was also implemented such that any new sites found while searching for relevant sites were followed up for possible eligibility and inclusion. Web sites

were included if (1) they provided information, resources, and tools for self-help/management of chronic pain; (2) the primary intended users were children or adolescents with chronic pain, and their families; (3) they were available in English; (4) they were published by a pediatric-oriented organization; and (5) had been updated within the past 3 years. Web sites were excluded if they provided an article only introducing the concept of chronic pain or listing available in-person services.

2.3.3. Call for Innovations

Given that the above searches may have missed virtual care solutions that rapidly emerged in response to the COVID-19 pandemic and/or are currently under empirical investigation, we conducted a call for demonstrated and emerging virtual care innovations that support pain, mental health, substance use, and functioning in youth reporting pain in partnership with the Canadian Foundation for Healthcare Improvement (CFHI) and Solutions for Kids in Pain (SKIP). This call for innovations followed methodology previously used by CFHI in other areas of emerging health practices (eg, dementia).¹⁰ The call for virtual care innovations was launched in partnership with SKIP and CFHI in early August 2020 and remained open until September 30, 2020.

Eligible applications included those from health care organizations (public or private), the community, government, or social service sectors. Eligible applications had to be based in Canada and/or have a current Canadian site as stipulated by CFHI’s focus on the Canadian health system. Applicants completed an online written application, which included a description of the virtual care innovation, its application to date with youth reporting pain and their families, its focus on addressing pain, mental health, substance use, and/or functioning, any completed or ongoing evaluation, involvement of youth/families in its development or design, and needed tools, personnel, technology, and estimated cost for implementation. The call was distributed through email to pediatric chronic pain programs in North America, Listservs (Society of Pediatric Psychology, Pediatric Pain, and Pain in Child Health), patient organizations (PainBC), and partners (SKIP and CFHI).

All applications were reviewed by an independent Merit Review Panel codeveloped by SKIP and CFHI. The Merit Review Panel comprised 16 individuals, including youth with lived experience with chronic pain (n = 1), parents/caregivers of youth with chronic pain (n = 3), Canadian and international health professional (n = 4) and policy experts (n = 4) in the prevention and/or management of pediatric chronic pain or virtual care, and Canadian experts in quality improvement or health service implementation (n = 4). All applications were adjudicated based on 4 criteria related to (1) innovation and partnership with children/youth, families, care partners, and others; (2) evaluation and impact; (3) potential for successful spread; and (4) potential for long-term success and sustainability of the innovation.

2.3.4. Study selection

Database search results were imported into EPPI-Reviewer for study selection. Two project team members (M.P. and A.N.) screened all scientific abstracts and subsequent full-text studies for eligibility, in duplicate using EPPI-Reviewer.²⁰ Search and initial screening of apps and web sites was conducted by a team member (V.F.). Apps and web sites were then manually entered into EPPI-Reviewer with additional

screening for eligibility by a project team member (M.P. or A.N.). All disagreements were resolved through consensus and/or consultation with another project team member (K.A.B.). Applications reviewed by the Merit Review Panel in the Call for Innovations were also entered manually into EPPI-Reviewer.

2.4. Data collection process

2.4.1. Youth and parent advisory group

In addition to the 3 project patient partners, a cross-Canada group of 5 youth with lived experience with chronic pain and 3 parent/caregiver advisors was convened for two 1-hour advisory group meetings in August 2020 to identify and prioritize components of virtual solutions to be coded and identified in the EGM. Advisory group members were identified through an open public call for advisors posted on social media and shared through partner organizations (eg, SKIP) as well as the team's own networks. All advisors were compensated for their time (\$30/hour).⁴³ These advisory group sessions were codesigned and coded by project patient partners (I.J., E.J., and J.M.), along with project team members (K.A.B., M.P., and A.N.). A written summary of engagement session 1 was provided at the start of engagement session 2 to confirm the research teams' understanding of the advisory groups' ideas and priorities.

The codes of virtual care solutions to be included in the EGM were derived from these advisory sessions and knowledge of relevant outcomes for pediatric chronic pain clinical trials,³⁶ with continued collaboration and input from project patient partners. As a direct result, higher order and lower order codes were selected for inclusion in the EGM and are listed in **Table 1**. Input from patient partners allowed for clear labelling of the virtual care components and contributed to the development of descriptions for each level of stepped care to make them understandable for the map's intended users (eg, youth with chronic pain and their parents; policy makers).

2.5. Data coding and quality ratings

Three team members (K.A.B., M.P., and A.N.) independently coded all records for the following information: data source (scientific literature, gray literature, or call for innovations); type of study (eg, RCT and mixed methods study); level of scientific evidence (critically low, low, moderate, and high); technology platform (eg, videoconference, telephone, and smartphone); relevance to level of stepped care (**Fig. 1**)³⁷; and user age (children and adolescents) and components of virtual care solutions identified above by patient partners, the advisory group, and for pediatric chronic pain treatment studies.³⁶

All records were independently assessed for quality using the Mixed Methods Appraisal Tool (MMAT-v2018) as applicable and appropriate across study types, including qualitative, quantitative RCTs, quantitative nonrandomized, quantitative descriptive, and mixed methods studies.^{26,39} The MMAT provides 2 methodological criteria screening questions for all study types, followed by 5 methodological criteria questions relevant to each specific study type. Each question is responded to with "yes," "no," or "cannot tell." Although the MMAT does not provide a single quality summary score, one was developed by the team to create a filter of scientific evidence quality for the interactive EGM (high, moderate, low, and critically low). Using this MMAT, studies were given a rating of high quality if they met 4 to 5 of the

methodological quality criteria indicated for the appropriate study type checklist (response of "yes"), moderate if they met 2 to 3 criteria, low if they met 1 criterion, and critically low if they met none of the criteria. Studies were rated as not meeting a criterion on the MMAT if the study actively reported not meeting the criteria or if the criteria could not be evaluated from the scientific article (response of "cannot tell"). Apps and web sites, as well as emerging innovations with no empirical evaluation, were given a critically low-quality rating.

3. Results

3.1. Study selection

Scientific database searches identified 6305 records. Removing duplicates resulted in 4031 unique abstracts to be screened. Of these, 3715 records were removed as not eligible, and 316 records were retained for full-text review. Gray literature search identified 305 apps and 16 web sites with no duplicates. Eight innovations were identified through the CFHI/SKIP call for innovations. The identified apps, web sites, and innovations were retained for full-text review. Of the 645 records retained for full-text review, 460 were excluded. One-hundred eighty-five records met the inclusion criteria. See **Figure 2** for the PRISMA review flowchart with reasons for full-text exclusion.

3.2. Study characteristics

Given the large number of records meeting review inclusion criteria and the open access availability of the records and their codes in the resulting interactive EGM, a list of references for all records is included as Supplementary Material 2 (available at <http://links.lww.com/PAIN/B389>), in lieu of repeated citations throughout the results summary. Each record included in the EGM contains its title (publication, app, or web site), summary description (scientific abstract and app store description), authors, publication year, URL, and scientific publication details (journal, volume, issue, page numbers, and DOI) or app details (eg, user rating, cost, issue/version, and age range of intended user).

Of the 185 records meeting the inclusion criteria, 105 scientific records (56.8%; ie, 40 conference abstracts/articles and 65 scientific articles), 56 apps (30.3%), 16 web sites (8.6%), and 8 innovations (4.3%) were included. Of the 105 scientific records and 7 innovations (study type was not applicable for 1 innovation), the most frequent study type was RCTs (27.6%, $n = 31$) or mixed methods studies (25.9%, $n = 29$), followed by observational studies (17.0%, $n = 19$), pre-test to post-test designs (16.1%, $n = 18$), qualitative studies (10.7%, $n = 12$), case series (1.8%, $n = 2$), and a validation study (<1%, $n = 1$). No case studies were identified.

3.3. Types of populations

Most records (49.7%, $n = 92$) included samples with differing primary or secondary chronic pain diagnoses. Twelve (12.4%) percent of the virtual care solutions focused on headache ($n = 23$), and 11.9% ($n = 22$) focused on juvenile idiopathic arthritis and/or other pediatric rheumatoid conditions. The rest of the records included youth with abdominal pain (10.8%, $n = 20$), sickle cell disease (9.2%, $n = 17$), widespread/back pain (3.2%, $n = 6$), other types of pain (1.6%, $n = 3$), or complex regional pain syndrome (< 1%, $n = 1$). No studies focusing on pain associated

Table 1**Coded components of virtual care solutions included in evidence and gap maps.**

Higher order code	Lower order codes
Symptom tracking	Pain Anxiety/mood Physical functioning Sleep Nonprescription substance use
Medications	Medication list Side effects Medication reminders Medication tracking
Psychological strategies	Pain education Relaxation Mindfulness Increasing activity (eg, scaffolding and goal setting) Thinking strategies (eg, cognitive strategies) Communication skills (eg, problem-solving skills) Pain flare planning
Physical and lifestyle strategies	Sleep Diet Exercise/movement
Social/family components	Peer mentorship/support Parent engagement (eg, strategies for parents/caregivers) Sibling engagement
Health professional communication	Asynchronous Real-time Computer-generated
School resources	School accommodations Information for teachers
Emergency/crisis strategies	Help for pain flares Distress/crisis information (eg, suicidality)
User experience (ie, evidence or data addressing)	Functionality Usability Accessibility (as per Web Content Accessibility Guidelines 2.0) Acceptability Feasibility Customizability
Integration with the health record	Direct to electronic health record Standalone tool Print or email report
Intended user	Individual (ie, youth with chronic pain) Group (ie, multiple youth with chronic pain) Family/caregiver only Not reported (ie, information not available) Health professionals
Type of pain or diagnosis	Mixed chronic pain conditions Abdominal pain (eg, irritable bowel disease/irritable bowel syndrome) Arthritis/rheumatological conditions (eg, juvenile idiopathic arthritis) Headache/migraine Neurodevelopmental disorders Complex regional pain syndrome Sickle cell disease Widespread pain/back pain Other

with neurodevelopmental conditions were identified. One of the clinical innovations did not specify pain diagnosis or condition.

The majority of identified records (79.5%, $n = 147$) were intended for both children and adolescents. Almost 16% (15.7%; $n = 29$) of the records were intended for adolescents (aged 13 years and older), and almost 5% (4.9%; $n = 9$) of the records were designed for children (younger than 13 years).

3.4. Levels of stepped care

Most identified virtual care solutions (63.2%, $n = 117$) were self-guided (ie, level 1 of stepped care) of which 47.0% was apps ($n = 55$), 36.8% was scientific literature ($n = 43$), 13.7% was web sites ($n = 16$), and 2.6% was from the call for innovations ($n = 3$). Twenty-three percent (23.2%; $n = 43$) of records were classified

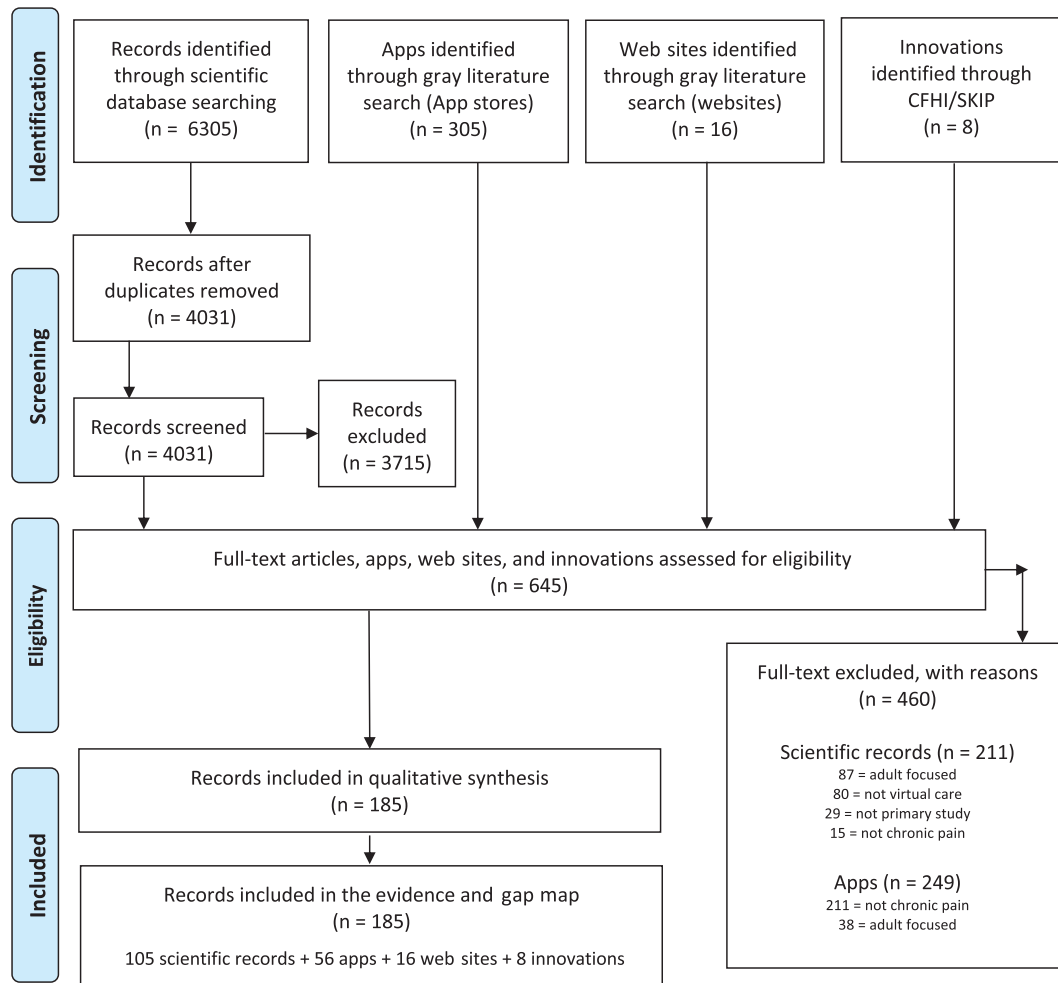


Figure 2. PRISMA flow diagram.

as requiring minimal health professional involvement (ie, level 3 of stepped care) of which 93.0% was scientific literature (n = 40) and 7.0% was from the call for innovations (n = 3). The rest of the solutions were peer-to-peer (level 2 of stepped care; 6.5%, n = 12) of which 83.3% was scientific literature (n = 10) and 16.7% was from the call for innovations (n = 2); required ongoing real-time health professional interaction (level 4 of stepped care; 5.4%, n = 10) of which 90.0% was scientific literature (n = 9) and 10% from the call for innovations (n = 1); or involved specialist real-time health professional interaction (level 5 of stepped care; 1.6%, n = 3) of which 100% was from the scientific literature.

3.5. Technology platform

Half of the identified virtual care solutions were offered for smartphones or another type of device (eg, a video game system) (50.2%; n = 93). Access to a web site or a computer was needed for 39.5% of the virtual care solutions (n = 73). Eight percent (8.1%; n = 15) of records involved teleconference, and 2% (2.2%; n = 4) of virtual care options were telephone-based (eg, using a telephone for a conversation or texting).

3.6. Components of virtual care solutions

Virtual care solutions were further characterized by the presence or absence of specific components as derived from the youth and

parent advisory sessions (described above), knowledge of relevant outcomes for pediatric chronic pain clinical trials (ie, PedIMPACT),³⁶ and patient partners. Codes are listed in **Table 1** and include symptom tracking, medications, psychological strategies, physical/lifestyle strategies, components for social functioning and/or family engagement, school resources, emergency/crisis strategies, health professional communication, integration with health records, user experience, and intended user.

3.7. Symptom tracking

Eighty virtual care solutions (43.2% of the total records) involved symptom tracking. Of these 80 solutions, the majority included pain tracking (96.3%, n = 77). In addition, the following symptoms were trackable using the solutions: physical functioning (55.0%, n = 44), mood and/or anxiety symptoms (42.5%, n = 34), sleep (31.3%, n = 25), and nonprescription substance use (3.8%, n = 3).

3.8. Medications

Thirty-three virtual care solutions (17.8% of the total records) included a medications component. Of these 33 records, most solutions included a list of medications (72.7%, n = 24) and/or medication tracking (57.6%, n = 19). The solutions also included

information on side effects (12.1%, $n = 4$) and medication reminders (21.2%, $n = 7$).

3.9. Psychological strategies

Over half of the identified virtual care solutions (56.8% of the total records, $n = 105$) involved psychological strategies for managing with chronic pain. Of these 105 solutions, most virtual care solutions offered pain education (76.2%, $n = 80$), strategies to increase activity (64.8%, $n = 68$), and/or relaxation strategies (55.2%, $n = 58$). In addition, psychological components of virtual care solutions included cognitive/thinking strategies (41.0%, $n = 43$), communication skills (30.5%, $n = 32$), mindfulness exercises (21.9%, $n = 23$), and/or creating a plan for pain flares (21.9%, $n = 23$).

3.10. Physical and lifestyle strategies

Only 51 of the identified virtual care solutions (27.6% of the total records) included physical and/or lifestyle strategies. Of these records, 90.2% ($n = 46$) offered exercise and/or movement strategies, 66.7% ($n = 34$) included sleep strategies, and 35.3% ($n = 18$) offered information regarding diet.

3.11. Social and/or family engagement

Forty percent of the identified records (40.0%; $n = 74$) included elements of social and/or family engagement. Of these 74 records, 75.7% ($n = 56$) engaged parents and/or 32.4% ($n = 24$) included peer-to-peer communication. Only 2 records (2.7%) included sibling engagement.

3.12. School resources

Almost 3% (2.7%; $n = 5$) of the total retained records included school resources. Of these 5 records, virtual care solutions included information on school accommodations (80.0%, $n = 4$) and information for teachers (60.0%, $n = 3$).

3.13. Emergency/crisis strategies

Seven percent (7.0%; $n = 13$) of the identified records contained emergency/crisis strategies, including information on helping with pain flares (84.6%, $n = 11$) and distress/crisis resources (15.4%, $n = 2$).

3.14. Health professional communication

Almost 28% (27.6%; $n = 51$) of the identified virtual care solutions involved communication with health professional(s), with most communication being asynchronous (62.7%, $n = 32$), followed by real-time communication (43.1%, $n = 22$) and computer-generated communication (3.9%, $n = 2$).

3.15. Integration with health record

Most identified virtual care solutions (71.9%, $n = 133$) were standalone tools that did not involve integration with health records. Almost 29% (28.6%; $n = 38$) of these solutions allowed for sharing of content with health professionals through email and/or printing. Only 10% of these solutions (9.7%; $n = 13$) integrated with health records directly.

3.16. User experience

Almost half of the identified records (48.6%, $n = 90$) reported on aspects of user experience. Of these 90 records, 52.2% ($n = 47$) of the records were customizable, 43.3% ($n = 39$) included acceptability ratings provided by users, 32.2% ($n = 29$) included feasibility ratings, and 30.0% ($n = 27$) reported on the usability of these virtual care solutions. Only 8.9% ($n = 8$) of the solutions included accessibility options, and 7.8% ($n = 7$) reported functionality of the solutions.

3.17. Intended user

Nearly all the identified virtual care solutions (93.0%, $n = 172$) included elements/modules for individual youth use. Almost 29% (28.5%; $n = 49$) of the solutions included content for family and/or caregivers, 13.3% ($n = 23$) included content for health professionals, and only 2 (1.2%) offered content for groups.

3.18. Quality of evidence

Of the 185 records, the largest proportion (42.2%; $n = 78$) were rated as critically low quality, followed by high quality (24.3%, $n = 45$), low quality (22.7%, $n = 42$), and moderate quality (10.8%, $n = 20$). All apps and web sites were rated as critically low quality. More detailed quality ratings for each included record are available in Supplementary Material 3 (available at <http://links.lww.com/PAIN/B390>).

3.19. Synthesis of results

Data from the scoping review were visually synthesized in an EGM using EPPI-Mapper.²⁰ **Figure 3** presents a static version of the EGM summarizing the number and quality of included records. Rows of the EGM reflect each of the 5 levels of stepped care (**Fig. 1**), while each column captures coded higher order components of virtual care solutions. Each cell shows the number and quality of evidence for virtual care solutions on that combination of stepped care level and virtual care solution components. The full interactive EGM is publicly available and lives open access on the web (www.partneringforpain.com/portfolio/virtual-care; direct link: <https://partneringforpain.com/wp-content/uploads/2020/11/10-17-120-9-37.html>), in addition to a brief introduction video and policy brief (English and French language). Any individual can interact with the EGM to sort the data using the EGM filters. Researchers can email the study team (corresponding author in this article and as listed with the EGM information online) to have their research study or other info added to the EGM. Records included in the EGM can be viewed altogether or sorted by identified codes or filters (ie, quality of the evidence, technology platform, or user age).

4. Discussion

4.1. Summary of evidence

This scoping review uses a novel knowledge synthesis tool (an interactive EGM), mapping 185 scientific records, apps, web sites, or emerging virtual care solutions for youth with chronic pain and their families across a stepped care continuum. The EGM identifies areas with existing high-quality, evidence-based virtual care solutions as well as areas where few or no solutions exist. This work is timely in its content and approach.⁵⁷ Poor access to pediatric chronic pain care is a longstanding patient-identified priority,⁷ and efforts to develop virtual care have been underway



Figure 3. Static version of the evidence and gap map with higher order components of virtual care. Interactive Evidence and Gap Map online at www.partneringforpain.com/portfolio/virtual-care.

for some time^{21,30}; however, the COVID-19 pandemic has necessitated immediate and widespread virtual pediatric chronic pain care at an unprecedented pace and scale.^{12,17,44} Patients, families, and health professionals are intended users of the virtual care solutions being studied and, as such, are also audiences of the resulting information. Evidence and gap maps are a form of knowledge mobilization to effectively and efficiently bridge the gap between research and practice or public knowledge. Knowledge mobilization is critical at a time of rapid health system change and pivot to virtual care during the COVID-19 pandemic. The public availability of this interactive EGM in a usable format enables efficient and evidence-informed decision-making by multistakeholder audiences (patients, families, health professionals, decision-makers, and policymakers).^{27,45,46,49} Furthermore, the mapping of virtual care solutions across a stepped care continuum responds to health system and policy calls to integrate stepped care models for virtual pain and mental health care,^{11,37} including post-natural disaster.³⁵

A number of key points were identified by mapping current evidence for virtual care solutions in this format. Most virtual care solutions were applicable to youth across childhood and adolescence with any chronic pain condition (chronic primary pain, headache/migraine, abdominal pain, rheumatological conditions, and sickle cell disease). More than 100 self-guided apps and web sites were accessible and relevant to all youth with pain and their families that offer symptom tracking and pharmacological, psychological, and/or physical and lifestyle pain management strategies (level 1 of stepped care). Apps reported the most customizability of available virtual care solutions for individual users. However, most self-guided apps and web sites lacked rigorous evidence or were not transparent in reporting so (considered critically low or low quality of evidence) consistent with previous systematic reviews.^{30,52}

Psychological strategies were more frequent than other pain management. On the one hand, this identifies the need for more virtual care solutions addressing pharmacological, physical, and lifestyle strategies to ensure a multimodal approach to pediatric chronic pain care³²; however, this finding is also promising in that it demonstrates the growing accessibility of psychological pain management which is often difficult to access outside of pediatric tertiary chronic pain clinics.⁷ This finding likely also reflects that the

delivery of psychological strategies is amenable to the virtual setting²¹ and the large number of evidence-based psychological interventions that exist for pediatric chronic pain.⁹ Psychological strategies were most readily self-guided (level 1 of stepped care) or with minimal health professional support (level 3 of stepped care). Psychological virtual care solutions focused primarily on pain education, relaxation, and behavioural strategies (eg, goal setting and gradual return to activity). The highest quality of evidence in the EGM was available for Internet-delivered psychological interventions for youth and their parents with minimal health professional involvement (level 3 of stepped care). Despite this, a Cochrane review of remotely delivered psychological therapies for youth with chronic pain demonstrated only a small effect of reducing pain severity for recurrent headaches.²¹ These small treatment effects could be due, in part, to pediatric chronic pain psychological treatments insufficiently addressing concurrent mental health concerns,¹⁴ such as anxiety, depression, and post-traumatic stress, that are highly prevalent amongst youth with chronic pain.⁵⁵ There is also a need to focus on treatment efficacy and utilization of novel study designs that simultaneously attend to implementation.^{19,53}

The EGM easily identifies a number of key areas lacking evidence. Virtual care was lacking at higher levels of stepped care, with only 7% of solutions offering ongoing individual or group therapies led by a health professional, or specialist/tertiary care (levels 4 and 5 of stepped care). Only 1 record reported on virtual delivery of tertiary care during the COVID-19 pandemic.¹⁵ Virtual care solutions rarely integrated into an electronic medical record or had the ability to communicate or share information with health professionals. Only a moderate number of virtual care solutions engaged parents, with very little peer support or content for siblings of youth with pain despite recognition that the social and family context is highly influential to pediatric chronic pain management.^{22,40} There was a general dearth of solutions addressing areas identified as important to youth and families, such as medication side effects and tracking, sleep, diet, nonprescription substance use, school resources, information for teachers, and acute pain flares or crises (eg, suicidality²⁹). Less than 5% of virtual care solutions addressed web content accessibility.⁵⁸ Finally, no virtual care solutions specifically addressed pain management for youth with neurodevelopmental disorders, despite the demonstrated need for pain management in this population.⁴

4.2. Patient engagement and partnership

This scoping review engaged 8 youth with lived experience with chronic pain and 7 caregivers/parents across a spectrum of engagement roles³⁴ ranging from full and equal team collaborators, merit review panelists, and advisors in codesign of the EGM. Inclusion of patient partners as well as an advisory group ensured that the resulting EGM focused on outcomes of relevance to youth and their families dealing with chronic pain in their everyday lives. Inclusion of patients and families in health research ensures greater relevance and more immediate impact of findings.^{16,47,48} Previous work by our group has revealed a sizeable absence of existing treatments for pediatric chronic pain, which addresses identified patient priorities.⁹ In the absence of input from patients and families, this review would likely have focused on chronic pain intervention outcomes recommended by PedIMMPACT³⁶; however, these recommendations did not integrate the voice of patients and families in their development. The identification and inclusion of numerous outcomes in the current EGM that were omitted from the PedIMMPACT recommendations³⁶ (ie, peer and family engagement, diet, emergency/crisis strategies, health professional communication, health record integration, and user experience) clearly demonstrate the value of engaging people with lived experience. Reports of patient engagement in health research predominantly focus on their involvement in empirical studies.^{16,47,48} This scoping review showcases how youth with chronic pain and families can be readily engaged in knowledge synthesis, as is increasingly being explored by evidence synthesis leaders, such as the Cochrane Collaboration.¹³

In addition to engaging patients and families, this work also emphasized the value of partnership with other stakeholders for whom the intended findings are targeted. An emphasis on knowledge translation or knowledge mobilization is critically needed to enable rapid transformative change in pediatric pain.¹⁹ Collaboration with SKIP, a Canadian knowledge mobilization network, and CFHI, a pan-Canadian government-funded health care quality and innovation organization focused on spread and scale of evidence-informed health care innovations, enabled inclusion of a national call for emerging and demonstrated innovations. The inclusion of team members directly engaged with policymakers in the Government of Canada's Canadian Pain Task Force also informed this scoping review methodology to enable its timeliness, relevance, and ability to rapidly provide evidence in response to recommendations from the Task Force regarding stepped care models, virtual care, and support for people living with pain during the COVID-19 pandemic and beyond.¹¹

4.3. Limitations

Although this multimethod scoping review strategy is wide reaching, several limitations are noted. The review was limited to English-language resources published or otherwise available within the past 10 years, decreasing the potential usefulness of the EGM to non-English-speaking stakeholders. Given the limited search functionality of the iOS and Google Play app stores, it is possible that relevant apps not using "pain" in the app name were missed. Efforts were made to identify these apps through other means, such as posting to professional Listservs and through scientific publications. However, primary mental health apps that may be used by some youth with chronic pain but do not specifically address chronic pain are not captured herein. CFHI has a Canadian-specific mandate which led to a restriction of the call for innovations on Canadian-based or

Canadian-implemented innovations in virtual care. This mandate means that the current EGM does not include the likely numerous emerging innovations implemented elsewhere in the world in response to the COVID-19 pandemic that have not yet been published in the scientific literature. However, a benefit of the EGM is that it is a living synthesis, and therefore, readers are encouraged to reach out to the corresponding author with eligible innovations that should be added to the map.

Several of the records in the EGM report on the same virtual care solutions across multiple records and/or data sources (eg, iCanCope or WebMAP). Unfortunately, there is no means of linking or grouping multiple records reporting on the same virtual care solution within EPPI-Mapper, potentially inflating the perceived quantity of virtual care solutions in a given area. Given that all apps and web sites were rated as critically low quality, it is also possible that the scientific evidence of some apps is underestimated. Furthermore, not all scientific records included in the map are open access, meaning that they are not available beyond the abstract to many stakeholders (eg, patients, families, decision-makers, and policymakers). Our patient-oriented definition of virtual care necessitated some engagement of patients and families to be included; thus, the numerous virtual innovations and resources intended for health professionals only were not included, but should be noted for their potential to increase access to care.⁴¹

5. Conclusions

This EGM of virtual care solutions for youth with chronic pain and their families presents an opportunity for researchers, health funders, health systems, decision-makers, and policymakers to rapidly (1) identify areas with high-quality evidence-based virtual care solutions for immediate scale and spread across communities, primary care, and the health system; (2) identify areas where few or no solutions exist for targeted virtual care development and research/policy prioritization; and (3) act to enable prevention, early intervention, and treatment of pain in youth and their families during this phase of the COVID-19 pandemic and beyond. Expanded implementation of virtual care is here to stay. It is critical that newly adopted or sustained implementation of virtual care solutions address priorities identified as relevant to youth with pain and their families.

Conflict of interest statement

The authors have no conflicts of interest to declare.

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Appendix A. Supplemental digital content

Supplemental digital content associated with this article can be found online at <http://links.lww.com/PAIN/B388>, <http://links.lww.com/PAIN/B389>, and <http://links.lww.com/PAIN/B390>.

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