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ChiroSCOPE (Chiropractic Systematic Clinical Observation of Practice Evidence): preliminary evaluation of a web application for data collection within a clinical research network: a mixed methods pilot study

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Background: *Practice-based research networks (PBRNs) face challenges including time constraints, workflow disruption, and lack of standardized data collection protocols. We evaluated the usability of "Patient Progress," a web application designed to support PBRN data collection among Canadian chiropractors and their patients.*

Methods: *An explanatory sequential mixed-methods design was used. Ten chiropractors piloted the application over six months, collecting patient-reported outcome measures and clinical data from 60*

ChiroSCOPE (Chiropractic Systematic Clinical Observation of Practice Evidence) : Évaluation préliminaire d'une application web pour la collecte de données au sein d'un réseau de recherche clinique : Une étude pilote à méthodes mixtes

Contexte: *Les réseaux de recherche axés sur la pratique (RRAP) font face à plusieurs défis, notamment les contraintes de temps, la perturbation des flux de travail cliniques et l'absence de protocoles standardisés de collecte de données. Nous avons évalué la convivialité de « Patient Progress », une application web*

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This project was co-funded by the Association des chiropraticiens du Québec (ACQ) and MITACS acceleration program that enabled the recruitment of RH. MAB has received research grants from: Canadian Chiropractic Research foundation (CCRF), Fondation Chiropratique du Québec (FCQ), Association des chiropraticiens du Québec (ACQ), Ordre des chiropraticiens du Québec. MAB has also received speaker honorarium from the Canadian Chiropractic Association, OCQ and ACQ. He is a member of scientific committee of the World Federation of Chiropractic. All the other authors report no conflict of interest. The authors have no additional disclaimers, competing interests, or sources of support or funding to report in the preparation of this manuscript

All procedures performed in studies involving human participants were in accordance with the UQTR Ethics Committee for Research Involving Human Beings (Approval #: CER-22-284-07.02). Informed consent was obtained from all individual participants included in the study.
The data that support the findings of this study are not openly available but are available from the corresponding author upon reasonable request within six months of the manuscript publication. After that time period the data will be destroyed as specified within our ethical certification APP.

patients. Patient usability was assessed via the mHealth App Usability Questionnaire (MAUQ); chiropractor perspectives were explored through semi-structured interviews analyzed thematically.

Results: *Patients rated overall usability highly (mean 6.63/7). Chiropractor interviews identified key implementation barriers: lack of integration with existing practice management software, bilingual interface issues, questionnaire length, and recruitment challenges.*

Conclusion: *"Patient Progress" shows promise for PBRN data collection in chiropractic practice. Wider implementation requires seamless integration with existing software systems, interface improvements, and value-added clinical features to incentivize practitioner participation.*

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KEY WORDS: practice-based research; mobile applications; patient reported outcome measures; feasibility studies; chiropractic

conçue pour soutenir la collecte de données au sein d'un RRAP auprès de chiropraticiens canadiens et de leurs patients.

Méthodes: *Un devis séquentiel explicatif à méthodes mixtes a été utilisé. Dix chiropraticiens ont mis à l'essai l'application pendant six mois, collectant des mesures de résultats rapportées par les patients ainsi que des données cliniques auprès de 60 patients. La convivialité de l'application pour les patients a été évaluée à l'aide du questionnaire de convivialité des applications de santé mobile (mHealth App Usability Questionnaire), tandis que les perspectives des chiropraticiens ont été explorées par le biais d'entretiens semi-dirigés analysés de façon thématique.*

Résultats: *Les patients ont accordé une cote globale de convivialité élevée (moyenne 6,63/7). Les entretiens avec les chiropraticiens ont mis en évidence des obstacles clés à l'implantation : l'absence d'intégration avec les logiciels de gestion de pratique existants, des problèmes liés à l'interface bilingue, la longueur des questionnaires, ainsi que des difficultés de recrutement.*

Conclusion:*« Patient Progress » présente un potentiel prometteur pour la collecte de données dans le cadre d'un RRAP en chiropratique. Une implantation à plus grande échelle nécessitera une intégration harmonieuse avec les systèmes logiciels existants, des améliorations de l'interface ainsi que des fonctionnalités à valeur ajoutée afin d'encourager la participation des praticiens.*

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MOTS-CLÉS: recherche axée sur la pratique; applications mobiles; mesures de résultats rapportées par les patients; études de faisabilité; chiropratique

Background

Canadian chiropractors hold favourable attitudes and beliefs towards evidence-based practice (EBP).[1,2] EBP involves integrating the best research evidence, clinical expertise, and patient values and expectations to improve clinical decision-making, and patient health outcomes.[3] Despite this growing commitment to EBP and the availability of evidence-based clinical practice guidelines to support clinical decision-making,[4] a persistent gap between current evidence and its routine implementation in practice remains a concern for political leaders, service and insurance payers, and patients seeking chiropractic care.[1,5,6] This gap reflects not a lack of awareness of evidence, but rather the well-documented challenge of translating available research into consistent clinical behaviour: an evidence-to-practice implementation gap.

Practice-based research networks (PBRNs) represent a promising solution to bridge this implementation gap.[7-9]

PBRNs are defined as groups of ambulatory practices primarily devoted to the primary care of patients, with a common mission to investigate questions related to community-based practice.[10] PBRNs can take two main forms: registries, where a group of clinicians is connected through a common patient management system, or a substudy format, where clinicians opt into ongoing research-related activities.[11,12] These networks can collect a multitude of data from a large cohort of practitioners in routine clinical practice, enabling the establishment of a learning health system.[13,14] The creation of PBRNs in chiropractic practice provides an opportunity to describe practice profiles, reasons for consultation, clinical impressions, care provided, adherence to good practice recommendations, and therapeutic response.[9,15] The assessment of adherence to good practice recommendations is particularly relevant: by systematically recording clinicians' diagnostic decisions, treatment modalities, referral patterns, and therapeutic objectives for each patient encounter, PBRNs enable the comparison of documented clinical decisions against established evidence-based guidelines, providing an empirical measure of guideline adherence at the practice level.[8,9]

Critically, PBRNs contribute to narrowing the EBP implementation gap through two complementary mechanisms. First, by conducting research in routine care environments rather than academic tertiary centres, PBRNs generate findings on treatment *effectiveness* — including real-world outcomes such as patient satisfaction, functional recovery, and long-term harms — that clinical trials often fail to capture, producing evidence that is directly applicable to clinical decision-making.[8,9,16] Second, PBRNs support *bidirectional* knowledge translation: they not only generate new evidence but also engage practitioners as active research participants, fostering ongoing evidence uptake within a learning health system dynamic.[7,13,17,18] In this sense, PBRNs occupy a unique position at the interface between research and quality improvement, where generating practice-based evidence and implementing evidence-based practice are mutually reinforcing processes.[6,17]

Recent studies suggest that PBRNs may help understand clinical practice patterns and improve healthcare quality for MSK conditions associated with a significant societal burden globally.[9] Nonetheless, PBRNs face significant challenges, particularly regarding their long-term viability and sustainability.[9,17,19] The main challenge is obtaining ongoing funding to ensure their sustainability,[20] with infrastructure costs for a basic PBRN with part-time support staff estimated at approximately $70,000 USD annually[19]. Other challenges relate to clinician engagement, data collection protocols, and integration with existing clinical workflows.[5,9,21]

The implementation of appropriate technological tools into clinical settings can help overcome these challenges by facilitating the acquisition of clinically relevant data and reducing the logistical constraints associated with clinician participation in research. One such tool is "Patient Progress", a web-based application (APP) designed to establish a secure communication portal between patients and their chiropractors, thereby enhancing the monitoring and continuity of patient care. The APP generates readily analyzable data in JavaScript Object Notation (JSON) format. "Patient Progress" is accessible to all users via standardized web browsers, ensuring broad accessibility. Importantly, the platform enables researchers to access anonymized patient data, thereby supporting ethically sound and privacy-compliant clinical research. The systematic data collection enabled by the APP has the potential to support the implementation of longitudinal cohort studies within chiropractic clinics participating in the PBRN. By identifying modifiable prognostic factors and predictive factors of response to treatments, the APP may contribute to improved clinical decision-making and the advancement of more personalized care for patients. Moreover, the insights generated through the use of "Patient Progress" could support the broader implementation of a learning health system within the Canadian chiropractic profession.[13,22]

Usability encompasses three dimensions:ease of use and satisfaction, arrangement of system information, and usefulness of a technological solution.[23] The aim of this pilot study was to evaluate the usability of the "Patient Progress" APP among a group of chiropractors and their patients over the study period. Lessons learned will help refine the APP to improve the collection of clinical data in routine clinical practice.

Methods

An explanatory sequential mixed-methods approach (quantitative followed by qualitative)[24] was used to evaluate the usability (ease of use and satisfaction, arrangement

of system information, usefulness) of the APP among members of the chiropractic association of the province of Quebec (ACQ), Canada. In accordance with this design, the quantitative strand (MAUQ) was designated as the primary component, providing the initial assessment of APP usability. The qualitative strand was conducted subsequently to elaborate on and explain the quantitative findings. Priority was therefore assigned to the quantitative component, with the qualitative component serving an explanatory and complementary function.

Participants and recruitment

The sample size for this pilot study was determined based on feasibility considerations (convenience sample) for both clinicians and patients. ACQ's members, who were actively practicing chiropractors at the time of the study, were invited to participate via the ACQ email list and Facebook page between summer of 2022 and spring 2023. Chiropractors agreeing to participate were asked to complete a demographic questionnaire ("Chiro Preference"). The questionnaire included questions about their clinic (solo vs multidisciplinary practice, availability of on-site radiology services, as well as the number of new patients and treatments provided weekly), language generally used in practice, year of birth, academic training, and treatment modalities used.[25] Each chiropractor was trained and familiarized with the functionality and operation of the APP prior to the start of the study through an individual virtual "Startup" meeting.

Each chiropractor was instructed to invite ten consecutive new patients to use the APP during a six-week period. Interested patients consented to participate via the online consent form automatically sent with the first round of pre-first visit questionnaires. They were also asked to consent to their data being shared with the research team. Two weeks post APP implementation, a follow-up email was sent to each newly recruited chiropractor to inquire if they were encountering any problems or had questions related to the APP. A second meeting was scheduled for those who identified problems or had additional questions.

Data collection procedures

Quantitative data

Patient data

Patients who completed the pre-first visit questionnaires online received a link via email inviting them to open their account in the "Patient Progress" APP. When redirected to the APP, they first completed their profile with general information and then automatically sent the "Intake" questionnaire. This questionnaire included patient identification data, sociodemographic data, reasons for consultations, painful areas of the patient's body, comorbidities, red flags if present, and health measures self-reported by the patient regarding pain intensity and disability.

Patients were then invited to complete the "Brief Pain Inventory" measuring their level of pain and interference with daily life activities,[26] and two additional disability questionnaires depending on the main reason for consultation identified in the "Intake" questionnaire:

For lower back pain complaints: the "Keele STarT Back Screening Tool"[27] and the "Oswestry Disability Questionnaire"[28].

For complaints of neck, upper limb or lower limb pain: the "Neck Disability Index,"[29] "QuickDASH Outcome Measure,"[30] and "Lower Extremity Functional Scale"[31] respectively. All patients without low back pain also completed the "Modified MSK STarT Back Screening Tool," a prognostic tool for musculoskeletal problem complaints[32].

Usability assessment

To assess the usability of the APP, patients were invited to follow a link to access the mHealth App Usability Questionnaire (MAUQ),[23] measuring the "Patient Progress" APP usability across three dimensions: 1) ease of use and satisfaction, 2) arrangement of system information, and 3) usefulness, at the end of the pilot study in April 2023.

Clinician data

The treating chiropractor had access to the study questionnaires completed by their patients prior to their initial visit. After this first visit, the clinician was instructed to complete an initial report of findings. The first half of the initial report of findings (ROF) was automatically pre-populated by the APP based on intake data entered by the patient, allowing the chiropractor to review and supplement this information rather than entering it from scratch, thereby reducing documentation burden. The chiropractor then indicated:

1. The data collected during the initial interview
2. The clinical diagnosis(es)

3. The treatment plan for the current episode of care by specifying:
   - Number of recommended treatments
   - Frequency of care
   - Therapeutic objectives
   - Therapeutic modalities employed
   - Activity recommendations or functional limitations
4. Whether a request for consultation or interprofessional collaboration was required and, if so, the nature and reason
5. A prognosis for the patient's condition by specifying the overall expectation of clinical change

Clinicians were instructed to complete a re-evaluation report based on information entered in the APP during or after each re-evaluation. The report contained patient response to care, whether the patient's condition was resolved, the total number of treatments provided from initiation of care, and the number of additional treatments (if any) recommended for the current episode of care.

Qualitative data

Individual interviews of participating chiropractors were conducted to explore their views on the usability of "Patient Progress" and the feasibility of integrating it into their private practices. All interviews were conducted virtually on the TEAMS platform, recorded and transcribed verbatim using Google's transcription extension. The interview guide was constructed a priori to capture the experiences, including perceived advantages, disadvantages, barriers, and facilitators, of APP.

Integration of the quantitative and qualitative components occurred at three levels. At the design level, the explanatory sequential structure was explicitly designed so that the qualitative phase would elaborate on and explain the quantitative findings, with interview questions informed by the MAUQ dimensions. At the methods level, interview participants were recruited as a purposive subsample from the participating chiropractors, ensuring that qualitative data were grounded in the same practice context as the quantitative data. At the interpretation and reporting level, quantitative and qualitative findings were presented and discussed contiguously, allowing direct comparison and cross-validation of results.

Protocol modifications

Due to the slow recruitment of chiropractors in the study, the study period was extended from three to six months.

Data analysis

Descriptive analyses (mean and standard deviation for continuous data and frequency and percentage for categorical data) of the study questionnaires were completed using SPSS software.[33] The feasibility of implementing an APP for collection of clinical and patient management data was measured using the three dimensions of the MAUQ, and the average time to complete the questionnaires was also assessed. The time to complete each questionnaire was automatically recorded by the APP via server-side logging of initiation and submission timestamps.

Data were coded hierarchically using thematic analysis.[34] Interview transcripts were independently analyzed and coded by two researchers. Consensus on coding was reached through discussion between the two researchers, without external support. Codes were then clustered into categories and draft themes were generated and finalized by the same two researchers.

Ethical considerations

This study received ethics approval from the UQTR Ethics Committee for Research Involving Human Beings (CER-22-284-07.02). Informed consent was obtained from all individual participants included in the study.[35,36]

Results

Characteristics of participants

Participating chiropractors

We received notification of interest from 19 chiropractors, of whom 10 (53%) self-selected into the study by completing the required onboarding steps, including the demographic questionnaire and virtual 'Startup' meeting, within the recruitment window. The remaining nine did not proceed further after initial contact. The majority were men (70%), half (50%) practiced as solo practitioners, and nearly half (40%) had additional diplomas and/or training beyond their chiropractic degree (Table 1). Participants reported seeing an average of 3.8 (±0.83) new patients per week and provided approximately 90.5 (±10.45) treatments weekly.

Table 1.
Characteristics of chiropractors who participated in the pilot phase of ChiroSCOPE (n=10).

Characteristic	N(%) / Mean	Standard Deviation
Sex		
Men	7 (70%)	
Women	3 (30%)	
Other diplomas and/or training	4 (40%)	
Number of treatments per week	90.5	10.45
Number of new patients per week	3.8	0.83
Radiology service offered in the clinic	4 (40%)	
Type of practice		
Solo practice	5 (50%)	
Clinic with other chiropractors	2 (20%)	
Clinic with other health care professionals	3 (30%)	

Participating patients

A total of 82 patients recorded their profiles within the APP, and 60 patients (73%) agreed to share their data for the purpose of our pilot study (Table 2). Men and women were represented in nearly equal proportions (51.7% men, 48.3% women). Most patients reported French as their first language (88.3%) and were employed full-time (63.3%). Over half of patients (53.3%) reported having a family physician, and most had previously consulted a healthcare professional for their current presenting complaint, primarily osteopaths (13.3%), medical doctors (11.7%), chiropractors (10.0%), and physiotherapists (8.4%). However, approximately one-third (31.7%) reported not having consulted anyone beforehand. Patients took an average of 20.61 (±3.09) minutes to complete the initial questionnaires (as automatically recorded by the APP).

Table 2.
Characteristics of patients who participated in the pilot phase of ChiroSCOPE (n=60).

Characteristic	N(%) / Mean	Standard Deviation
Sex		
Men	31 (51.7%)	
Women	29 (48.3%)	
First language		
French	53 (88.3%)	
English	7 (11.7%)	
Employment status		
Part-time work	4 (6.7%)	
Full-time work	38 (63.3%)	
Temporary layoff	1 (1.7%)	
Student	2 (3.3%)	
On leave due to illness	1 (1.7%)	
Retired	5 (8.4%)	
Maternity/paternity leave	1 (1.7%)	
Missing	8 (13.3%)	
Family physician		
Yes	32 (53.3%)	
No	20 (33.4%)	
Missing	8 (13.3%)	
Health professional consulted before*		
Acupuncturist	1 (1.7%)	
Other	1 (1.7%)	
Chiropractor	6 (10.0%)	
Massage therapist	5 (8.4%)	
Medical doctor	7 (11.7%)	
Osteopath	8 (13.3%)	
Physiotherapist	5 (8.4%)	
None	19 (31.7%)	
Average time to complete questionnaires (minutes)	20.61	3.09

*Subjects might have chosen more than one answer

Patient pain and disability metrics

The mean pain score reported on the Brief Pain Inventory (BPI) on a scale from 0 to 10, for average pain, was 4.28 (±0.36), with worst pain at 6.22 (±0.37) and least pain at 2.39 (±0.31) (Table 3). The average time to complete the BPI was 2.12 (±0.27) minutes. Activity (4.37±0.44) and sleep (3.85±0.45) were the pain interference domains most affected.

Table 3.
Patient's BPI Scores and time to complete.

Pain level (0-10)	Mean	Standard Deviation
Time to complete (minutes)	2.12	1.99
Worst	6.22	2.71
Least	2.39	2.25
Average	4.28	2.66
Now	3.44	2.70
Activity	4.37	3.21
Mood	3.76	2.90
Walking	2.69	3.10
Work	3.22	3.15

Pain level (0-10)	Mean	Standard Deviation
Relations	2.06	2.44
Sleep	3.85	3.29
Enjoyment	3.31	3.28
Brief Pain Inventory (BPI) Scores Interpretation		
Measurement of pain interference on daily activities	3.32	2.44
Measurement of pain severity	4.08	2.26

Application usability

Quantitative usability assessment

Of the 60 patients using the APP, six completed the MAUQ. The low response rate likely reflects the fact that participating chiropractors did not automatically send the follow-up questionnaire through the APP; the research team subsequently distributed it directly to patients. For many patients, their episode of care had resolved several weeks prior to receiving the questionnaire, which may partly explain our low response rate, although we cannot confirm this definitively without systematic data on non-response. Patients rated all aspects of the APP highly, with overall mean scores exceeding 6.5 out of 7 across all categories (Table 4). The highest-rated statements were related to navigation consistency between screens (Q3, 6.83/7) and willingness to use the APP again (Q10, 6.83/7). The lowest-rated statement concerned the time required to use the APP (Q9, 6.33/7).

Table 4.
MAUQ Ratings for each statement (completed n=6).

Questions	Mean / N(%)	Standard Deviation
Q1 The app was easy to use.	6.67	0.52
Q2 It was easy for me to learn how to use the app.	6.67	0.52
Q3 The navigation was consistent when moving between screens.	6.83	0.41
Q4 The interface of the app allowed me to use all the functions (such as entering information, responding to reminders, viewing information) offered by the app.	6.67	0.52
Q5 Whenever I made a mistake using the app, I could recover easily and quickly.	6.50	0.84
Q6 I like the interface of the app.	6.67	0.52
Q7 The information in the app was well organized, so I could easily find the information I needed.	6.67	0.52
Q8 The app adequately acknowledged and provided information to let me know the progress of my actions.	6.50	0.55
Q9 The amount of time involved in using the app has been fitting for me.	6.33	0.82
Q10 I would use this app again.	6.83	0.41
Q11 Overall, I am satisfied with this app.	6.67	0.52
Q12 The app would be useful for my health and well-being.	6.50	0.55
Q13 The app improved my access to health care services.	6.67	0.52
Q14 The app helped me manage my health effectively.	6.67	0.52
Q15 This app has all the functions and capabilities I expect it to have.	6.50	0.55
Q16 The "Patient Progress" app provides an acceptable way of receiving healthcare services, such as accessing educational materials, tracking my own activities, and completing a self-assessment.	6.67	0.52
Comments or additional items to add related to your experience using the app:		
None or "No comment"	4 (66.67%)	
"Perfect"	2 (33.33%)	
Combined Ratings		
Ease-of-use	6.67	0.12
Interface and satisfaction	6.61	0.17
Usefulness	6.61	0.10
Overall	6.63	0.13

Qualitative usability assessment

Despite repeated efforts to recruit chiropractors for interviews, only four agreed to participate. Six main themes emerged from transcript analysis. These themes included: interface and ease of use; content and functionalities; integration into clinical practice; desired functionalities; considerations for research and professional development; consent and confidentiality.

Theme 1: Interface and ease of use

While chiropractors found sending questionnaires to patients generally straightforward, they identified several limitations. These included uncertainty about whether questionnaires had been successfully sent, difficulty in finding patient records, and problems with the bilingual interface for English-speaking patients:

> *"[...] when I was sending the questionnaire, I wasn't sure if it had been sent or not. [...] The ques-*

tionnaire has been sent or there was no confirmation, so I remember the first time I sent them all twice because I really wasn't sure." (DC_A)

"We have many, many English speakers. And the APP, when we send an invitation to an English speaker, they have to take an extra step to access the English questionnaire, and that extra step doesn't work at all [...]" (DC_B)

Theme 2: Content and functionalities

Practitioners appreciated the comprehensive summary report of the patient's conditions generated by the APP:

"I liked that it gives us a fairly complete view of the patient's condition without it being really difficult." (DC_A)

However, they suggested improvements related to pain mapping, visual representation of symptoms, and refinement of the classification system for red flags:

"In the improvements, I would have a good pain mapping, but visual [...] the location of the pain that is, that is visually, let's say it would be red in such a place with the quality of the pain and then the intensity." (DC_A)

Theme 3: Integration into clinical practice

The most significant barrier to implementation was the duplication of work with existing clinical management systems. Chiropractors emphasized that integration with their current systems would be essential for wider adoption:

"[...] it would really need to be an APP integrated with the system that is already in use because otherwise it makes things too duplicative. That's really the main thing because the rest is actually interesting, and it was quite comprehensive, there was a lot of information, for me it was really the fact that it was done twice by patients [...]" (DC_C)

The additional time required to use the APP was also mentioned as a limiting factor:

"Well, it's the time it takes. I think, that's it, it takes quite a lot of time, it's relative. If it were integrated, it would help, it really comes down to integration with the system we already use, and especially not having to do it twice." (DC_C)

Theme 4: Desired functionalities

Participants suggested several enhancements that would increase the APP's value.[37] These included:

A personalized dashboard showing treatment outcomes for specific conditions:

"[...] for such conditions, such age group, well usually, it takes one visit to have a significant improvement. Yes, that can be interesting. [...] I think that to convince the patient that it's worth starting care, that, that can be interesting. And also guide us towards what type of approach works best, yes." (DC_B)

The inclusion of specific evidence-based recommendations:

"[...] exercise programs or treatment recommendations based on the diagnosis. According to the evidence. That's fun, uh, to remind me that: Oh yes, if I did such a thing, it's true that for that condition, it works well so that's fun." (DC_B)

The availability of patient educational resources:

"I dream of an informative video on practice adapted to Quebec with a French version and an English version, you could introduce it in your video in your APP." (DC_B)

Theme 5: Considerations for research and professional development

Participants valued the research potential of the APP and its ability to provide insights into treatment effectiveness:

"The concept appeals to me in the sense that I find it fun to collect data for research." (DC_B)

"[...] for such type of patients. Well, we did such type of intervention. And here's what the patient

reports as a result, so we could more easily specify which technique or which approach has better results for a type of patients XYZ." (DC_A)

To increase practitioner participation, interviewees suggested targeting groups of chiropractors who practice similar techniques:

"To engage a group of chiropractors who practice the same kind of treatment. [...] It could be much easier, to test the APP. Because the chiropractor could extract the outcomes of patients and validate the treatment according to certain conditions." (DC_A)

Theme 6: Consent and confidentiality

Participants expressed concerns about the consent process, suggesting that patients might provide more informed consent after establishing a relationship with the practitioner:

"[...] once he has met with the practitioner in question. A questionnaire will be sent to him. To fill out the consent because I think having an influence from the patient, from the practitioner. It would be a bit tweaking things. And I don't think it would necessarily be free consent." (DC_D)

"I think that theoretically, it should be the patient, once he has met me [...] I think it should, it should be done once the patient has met the chiropractor so that there is a kind of bond of trust that is established [...]" (DC_D)

Discussion

The findings of this pilot study demonstrate that 'Patient Progress' is technically usable from a patient perspective, yet faces substantial implementation barriers at the clinician level that must be addressed before PBRN integration can succeed. Our findings highlight both the potential benefits and challenges of implementing this technology within a practice-based research network. Overall, while the quantitative assessment indicated high user satisfaction among patients who completed the questionnaire, clinician interviews highlighted several key areas for improvement that would facilitate broader implementation in clinical practice, particularly regarding integration with existing systems, interface refinements, and additional functionalities to increase value for practitioners.

Usability assessment

Among patients who completed the MAUQ, usability ratings were positive across all usability dimensions. The low MAUQ response rate likely reflects the logistical limitations of distributing the questionnaire outside the APP workflow, combined with the elapsed time since episode resolution, a finding that underscores the need for automated patient follow-up functionality. The APP could be enhanced with automated patient follow-up according to a predetermined schedule (e.g., 2 weeks, 1 month, 3 months, 6 months post-treatment). This would reduce the administrative burden on both practitioners and researchers while ensuring more consistent data collection timing. The high scores for navigation consistency and willingness to use the APP again suggest that responding patients found the core experience satisfactory. However, the slightly lower rating for time involvement aligns with the chiropractors' concerns about questionnaire length. This finding is consistent with previous research by Parmanto *et al*.,[38] who found that completion time is often a limiting factor in the adoption of mHealth APPs, particularly for initial assessments that require more comprehensive data collection.

The qualitative feedback received from the chiropractors during the interviews revealed more nuanced usability considerations that would not have been captured through quantitative assessment alone. Integration of the APP with existing clinical workflow emerged as the most significant barrier to implementation—a challenge commonly reported in health information technology adoption studies.[39,40] The need for duplicate data entry creates an additional burden for clinicians already constrained by time limitations in busy practice settings. This finding aligns with the results of Lalji *et al*.,[9] who identified challenges related to clinician engagement and data collection protocols as barriers to successful PBRN implementation.

This divergence represents the study's most salient point of triangulation: patients who completed the MAUQ rated the APP highly across all usability dimensions, whereas chiropractors identified substantial barriers to its implementation in clinical practice. This contrast, access-

ible to us only through the integration of quantitative and qualitative methods, reveals that patient-facing usability does not necessarily translate into clinician-facing feasibility. Quantitative assessment alone would have produced an overly optimistic picture of the APP's readiness for broader implementation, while qualitative data alone would have lacked the standardised usability benchmarks provided by the MAUQ. The integration of both strands was therefore essential to capturing the full complexity of the implementation context.

Considerations for practice-based research networks

Our findings have important implications for the development and sustainability of PBRNs in chiropractic practice. The difficulty in recruiting chiropractors for this pilot study—requiring an extension from three to six months—reflects the challenges outlined by Davis et al.[19] regarding the long-term viability of PBRNs. Time constraints and workflow disruption present significant barriers to practitioner engagement, suggesting that future PBRN initiatives must offer clear value propositions to incentivize participation.

Interestingly, participating chiropractors recognized the research potential of the APP despite implementation challenges. Their suggestions for features such as personalized dashboards, evidence-based recommendations, and aggregate outcomes data indicate a desire for tools that not only facilitate research but also provide immediate clinical value. This finding supports Menear et al.'s framework for value-creating learning health systems, which emphasizes the importance of bidirectional knowledge flow between research and practice.[13]

Technical and design considerations

Several technical issues emerged that require attention in future APP development. The bilingual interface problems represent a particularly significant barrier in the Canadian context, where both French and English are official languages. Similarly, the lack of confirmation messages when sending questionnaires created uncertainty among clinicians. The study highlights the importance of robust pilot testing prior to implementation.

The concerns regarding pain mapping and visualization tools reflect practitioners' desire for more intuitive data representation. As Bach *et al*. demonstrated in their clinician dashboard development work, visual representation of pain patterns can significantly enhance clinical decision-making.[41] Incorporating such features could increase the APP's utility and appeal to practitioners.

Ethical and procedural considerations

The chiropractors' concerns about the timing of consent procedures raise important ethical considerations. Their suggestion that consent might be more appropriately obtained after establishing a patient-practitioner relationship merits careful consideration. While pre-visit consent aligns with research ethics principles of obtaining consent before data collection begins, it may create barriers to participation if patients lack context about the purpose and value of the research. This also applies to secondary use of data that involves informed consent from patients for the storage and use of their data to answer future research questions. A balanced approach that provides adequate information while building on established trust relationships may be optimal.

Limitations

This study has several limitations. First, the sample of chiropractors was small (n=10) and consisted of practitioners who had previously expressed interest in research participation, potentially creating selection bias toward more research-engaged clinicians. Only four agreed to participate in qualitative interviews, which limits the breadth of perspectives captured in the qualitative component. Second, the patient response rate for the mHealth App Usability Questionnaire was low, introducing response bias toward those with more positive experiences and compromising the primacy of the quantitative strand as intended by the explanatory sequential design. As a result, the qualitative findings assumed a greater influence on the conclusions, which should be interpreted with caution given the small interview sample. Third, the extension of the study period from three to six months due to recruitment challenges may have influenced the results, as early adopters might differ from those recruited later. Fourth, data saturation cannot be claimed given the small interview sample; it is possible that additional perspectives would have emerged with a larger sample.

The integration of quantitative and qualitative methods also introduced specific limitations. The extensive quantitative reporting burden placed on chiropractors during

the pilot may have contributed to fatigue and reduced willingness to participate in subsequent qualitative interviews.

Future directions

Based on our findings, several recommendations emerged for future development and research. First, integration capabilities with existing practice management systems should be prioritized to minimize duplicate data entry. Second, user interface improvements—particularly regarding confirmation messages, patient search functionality, and bilingual support—are needed to enhance usability. Third, adding value-creating features such as personalized dashboards and evidence-based recommendations could increase practitioner engagement. Finally, larger-scale studies involving diverse practice settings and patient populations are needed to evaluate the scalability and sustainability of the APP within a broader PBRN context.

Future research should also explore the impact of the APP on clinical outcomes, practitioner behaviour change, and research productivity. Longitudinal studies examining the APP's role in facilitating evidence-based practice and contributing to a learning health system would be particularly valuable.

Conclusion

This pilot study evaluated the usability of the "Patient Progress" APP for data collection within a chiropractic practice-based research network. While limited in sample size, patient feedback on usability was positive, and the APP demonstrated feasibility for systematic clinical data collection in a real-world chiropractic context. Chiropractors identified several implementation barriers (workflow integration, time constraints, and language) that must be addressed before broader deployment. The findings highlight a fundamental tension in PBRN research tools: they must balance research utility with clinical relevance to ensure practitioner adoption, and seamless integration into existing workflows is a prerequisite rather than an enhancement.

"Patient Progress" shows potential as a foundation for a learning health system within the Canadian chiropractic profession, supporting both the generation of practice-based evidence and the implementation of evidence-based practice. Realizing this potential will require technical refinements and larger-scale evaluations.

Authors contributions: FH, MAB, SM and AB conceived and designed this study. DH and RH performed the data collection under the supervision of MAB and FH. Data analysis was performed by RH, DH, MAB and FH. Interpretation of the results was done by FH, RH and MAB. FH, RH and MAB performed the first draft of the manuscript. All authors have reviewed drafts and the final version of the manuscript and have agreed to its publication.

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Appendix 1.
Interview guide

Interviewer Introduction
Hello, my name is XXXXX, I have been given the mandate to explore improvements to the "PatientProgress" application that would facilitate its use and implementation.

Advantages and Disadvantages of the Application

Main Questions	Supplementary Questions	Clarification Questions
Can you tell me about the advantages you have observed with the application?	What advantages would you like to have with the application? • From your point of view? • From your patients' point of view? • From your assistant's point of view?	• Can you tell me a little more? • Can you tell me more? • Can you give me examples?
Based on your experience, what are the disadvantages related to using the application?	• From your point of view? • From your patients' point of view? • From your assistant's point of view?	
What information would you like to have? What functions would you like to have?	• For your patients? • For your practice? • In a dashboard?	

Barriers and Facilitators

Main Questions	Supplementary Questions	Clarification Questions
In general, what are the barriers to using the application?	• From your point of view? • From your patients' point of view? • From your assistant's point of view?	• Can you tell me a little more? • Can you tell me more? • Can you give me examples?
What elements would facilitate the use of the application?		
What improvements would you like in the next version of the application?		

Closing
Is there anything else we haven't addressed that seems concerning to you?

OR

Do you have anything else to add concerning the application?

Grille d'entretien

Présentation de l'intervieweur
Bonjour, j'ai reçu le mandat d'explorer les améliorations de l'application «PatientProgress» qui permettraient de faciliter son utilisation et implantation. Au cours de l'entretien, j'aimerais que nous abordions les thèmes suivants : la criminalité et la victimation, le désordre et les incivilités (nuisances), la perception de la sécurité ou le sentiment de sécurité et l'appréciation des services à la population. En ayant ces thèmes en tête…

Avantages et inconvénients de l'application

☐ Pouvez-vous me parler des avantages que vous avez constaté avec l'application? ☐ Quels sont les avantages que vous aimeriez avoir avec l'application?	☐ Selon votre point de vue? ☐ Selon le point de vue de vos patients? ☐ Selon le point de vue de votre assistante?	☐ Pouvez-vous m'en dire un peu plus ? ☐ Pouvez-vous m'en dire davantage ? ☐ Pouvez-vous me donner des exemples ?
☐ D'après votre expérience, quels sont les inconvénients liés à l'utilisation de l'application?	☐ Selon votre point de vue? ☐ Selon le point de vue de vos patients? ☐ Selon le point de vue de votre assistante?	
☐ Quelles informations aimeriez-vous avoirs ? ☐ Quelles fonctions aimeriez-vous avoir?	☐ Pour vos patients? ☐ Pour votre pratique? ☐ Dans un tableau de bord?	

Barrières et facilitateurs

☐ En général, quelles sont les barrières à l'utilisation de l'application? ☐ Quels éléments faciliteraient l'utilisation de l'application? ☐ Quelles améliorations aimeriez-vous dans la prochaine version de l'application?	☐ Selon votre point de vue? ☐ Selon le point de vue de vos patients? ☐ Selon le point de vue de votre assistante?	☐ Pouvez-vous m'en dire un peu plus ? ☐ Pouvez-vous m'en dire davantage ? ☐ Pouvez-vous me donner des exemples ?
☐ Est-ce qu'il y a d'autres éléments que nous n'avons pas abordés et qui vous semblent préoccupants ? OU ☐ Avez-vous quelque chose d'autre à ajouter concernant l'application ?		