BMJ Open

What is the current state of precision rehabilitation? Protocol for a scoping study with a consultation phase

Annie Pouliot-Laforte ,[1,2] Evemie Dubé,[2] Dahlia Kairy ,[3,4] Danielle E Levac[2,4]

To cite: Pouliot-Laforte A, Dubé E, Kairy D, *et al*. What is the current state of precision rehabilitation? Protocol for a scoping study with a consultation phase. *BMJ Open* 2025;**15**:e094119. doi:10.1136/bmjopen-2024-094119

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (https://doi.org/10.1136/bmjopen-2024-094119).

Received 23 September 2024
Accepted 23 December 2024

[1]Department of Physical Activity Sciences, Faculté des sciences, Université du Québec à Montréal, Montreal, Quebec, Canada
[2]Azrieli Research Center UHC Sainte-Justine, Montreal, Quebec, Canada
[3]Institut Universitaire sur la Réadaptation en Déficience Physique du Québec, Centre de recherche interdisciplinaire en réadaptation du Montréal métropolitain, Montreal, Quebec, Canada
[4]School of Rehabilitation, Université de Montréal, Montreal, Quebec, Canada

Correspondence to
Prof Annie Pouliot-Laforte; pouliot_laforte.annie@uqam.ca

ABSTRACT

Introduction Precision health can be described as the right intervention, at the right time, for the right person, with a focus on monitoring and maintaining health in a longitudinal approach. Despite an increasing focus on precision approaches in medicine, their application in a rehabilitation context remains unexplored. As such, a greater understanding of the current state of the literature is required, in combination with clinician, researcher and healthcare manager perspectives regarding barriers and facilitators to the practical implementation of precision rehabilitation in clinical practice.

Objective Describe and map the current state of knowledge regarding precision rehabilitation to identify gaps in knowledge and inform future research directions and clinical implementation strategies.

Methods and analysis A scoping study will be conducted following current methodological recommendations (Peters *et al*, 2021) and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses—Scoping Review Extension guidelines. A convergent mixed-methods design will combine quantitative and qualitative findings. A search in Medline, CINAHL, Embase, Scopus, Web of Science and PsycINFO databases will be conducted for articles published between 2010 and 2023 referring to the concept of precision rehabilitation. Two reviewers will complete an abstract and full-text review based on eligibility criteria; data will be extracted from accepted papers using a data extraction framework. Results will be aggregated and synthesised using descriptive and thematic analyses. The consultation phase will involve a purposeful sampling of key stakeholders (clinicians, researchers and managers) in large North American rehabilitation centres. Semi-structured individual interviews will be conducted and analysed using deductive thematic analysis. Convergent mixed-methods data analyses will combine quantitative and qualitative datasets to highlight similarities and differences between the current literature on the subject and the understanding of stakeholders.

Ethics and dissemination Ethical approval has been obtained from the Research Ethics Board of the Sainte-Justine University Health Centre (no. 2024–6324). Results will be disseminated through professional networks, conference presentations and publications in scientific journals.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This scoping study will be the first to combine quantitative and qualitative methods to comprehensively map the current state of knowledge in precision rehabilitation.
⇒ The inclusion of a consultation phase with key stakeholders (clinicians, researchers and managers) from large rehabilitation centres enhances the practical relevance of this work and enables a more comprehensive understanding of facilitators and barriers to precision rehabilitation.
⇒ By excluding patents, dissertations and other types of grey literature, the study may exclude emerging innovations and sources of knowledge in this rapidly developing field.
⇒ The choice to eliminate potential 'precision' synonyms (such as 'personalised', 'customised' and 'predictive') from the search strategy may result in missing relevant papers.

INTRODUCTION

Precision health maximises population health and well-being by emphasising individual variations in biological, social, environmental and behavioural factors, continuous monitoring of individual health profiles to identify optimal intervention timepoints, facilitation of early disease detection and disease prevention and personalised interventions throughout the lifespan.[1–3] It extends the focus of precision medicine, which considers individual variations in biological, environmental and behavioural data to inform the diagnosis and treatment of diseases.[1] Following a systematic literature review, Schleidgen *et al*[4] defined personalised medicine as an approach that 'seeks to improve stratification and timing of healthcare by utilising biological information and biomarkers on the level of molecular disease pathways, genetics, proteomics as well as metabolomics'.[4] Adding complexity to the field is the ambiguity surrounding 'precision'-related nomenclature, with terms such as 'personalised', 'predictive', 'customised' and 'tailored' often used interchangeably, and with no consensus on their alignment with the concept of 'precision'.[1]

Advances in precision medicine are facilitated by the digitalisation of health data, rapid progress in genomic sequencing technologies and analysis and the availability of low-cost wearable technologies capable of objective, unobtrusive and frequent measurements.[2] Wearables can facilitate large-scale data collection in real-world contexts, supporting the massive databases required for artificial intelligence (AI) and machine-learning models to identify the characteristics of intervention responders and non-responders, facilitate early diagnosis, suggest optimal interventions and dynamically update intervention parameters in real time.[3]

Rehabilitation is defined as any service or activity that addresses or prevents an individual's impairments, activity limitations and participation restrictions.[5] The application of precision approaches in rehabilitation remains underexplored compared with medicine. French *et al* stated that 'precision rehabilitation focuses on preventing functional decline and maintaining functional independence and seeks to deliver the right intervention, at the right time, to the right individual'.[6] An editorial by Jette describing articles in a special issue of the *Physical Therapy & Rehabilitation Journal* devoted to precision rehabilitation emphasised that 'precision rehabilitation is about linking behaviour to biology to deliver patient-centred care' and that 'physical therapy stands at the intersecting frontiers of biologic, behavioural and population health research, making it the ideal environment for precision rehabilitation to thrive'.[7] Indeed, the emphasis in rehabilitation practice on promoting function throughout the lifespan requires taking complex interactions among biological, psychological, social and environmental factors into account in intervention decision-making.[8] Clearly, this process would be facilitated by comprehensive, accurate and longitudinal measurements of individual deficits, activity limitations and participation in physical, cognitive and psychological domains.[6 8] The potential of AI models to support the processing and analysis required to interpret these data may be limited by the typically small and heterogeneous study sample sizes in this field. As such, synthesising current evidence in precision rehabilitation may inform efforts towards establishing a consensus definition, understanding the potential use of AI in this context, and provide a clear direction for future research and implementation efforts. In addition to exploring the literature, it is important to explore how rehabilitation clinicians, researchers and managers understand precision rehabilitation and what they identify as facilitators and barriers to the implementation of precision approaches in clinical practice.

Using a scoping review methodology, this study aims to map the current state of knowledge regarding precision rehabilitation by describing the extent, scope and nature of the literature base, identifying similarities and differences with precision medicine and describing the role of technologies and AI in precision approaches. A consultation phase focused on stakeholder perspectives about precision rehabilitation implementation, facilitators and barriers complements the quantitative findings. Quantitative and qualitative findings will be synthesised following established mixed-methods research procedures[9] to provide a more comprehensive understanding of the findings.

METHODS AND ANALYSIS

The scoping study will follow the six methodological stages outlined by Arksey and O'Malley,[10] updated by Levac *et al*[11] and Peters *et al*.[12] Consultation phase procedures are informed by Buus *et al*,[13] who provide methodological recommendations to address current variations in the conduct and reporting of consultation phases in scoping studies. In particular, they emphasised the need for research ethics board approval to protect participants' interests and rights, adherence to established research methodologies and comprehensive documentation of data collection and analysis in consultation approaches.[13] Buus *et al* also recommended using a mixed-methods study design when undertaking a scoping study with a consultation phase. The method overview is shown in figure 1.

Reporting will follow the Preferred Reporting Items for Systematic Reviews and Meta-Analyses, Extension of Scoping Review[14] guidelines. We will use a convergent mixed-methods design[9] in which quantitative and qualitative data are collected in parallel, separately analysed and merged for dataset comparison. Quantitative results are findings from the scoping review (objectives 1–3), whereas qualitative results stem from the sixth phase of the scoping study process (consultation; objective 4). Considering quantitative and qualitative results in tandem enables a richer, more nuanced exploration of the research problem through varied data sources and analytical lenses.

Stage 1. Identifying the research question

The following research question guides the study: what is the extent, range and nature of the literature on precision rehabilitation? Additional research questions include the following:

a. How does precision rehabilitation differ from precision medicine?
b. What is the role of technologies and AI in precision rehabilitation?
c. For the consultation phase data, how do actors in the field describe precision rehabilitation and perceive its current state as well as its barriers and facilitators?

Stage 2. Identifying relevant studies

The search strategy will be developed using an iterative approach in collaboration with an academic librarian.[11] The scoping study will include articles retrieved from CINAHL, Medline, Embase, PsycINFO and Web of Science databases and published between 2010 and 2023. We will focus on the keyword 'precision' adjacent to 'rehabilitation' using database-specific Boolean operators (eg,

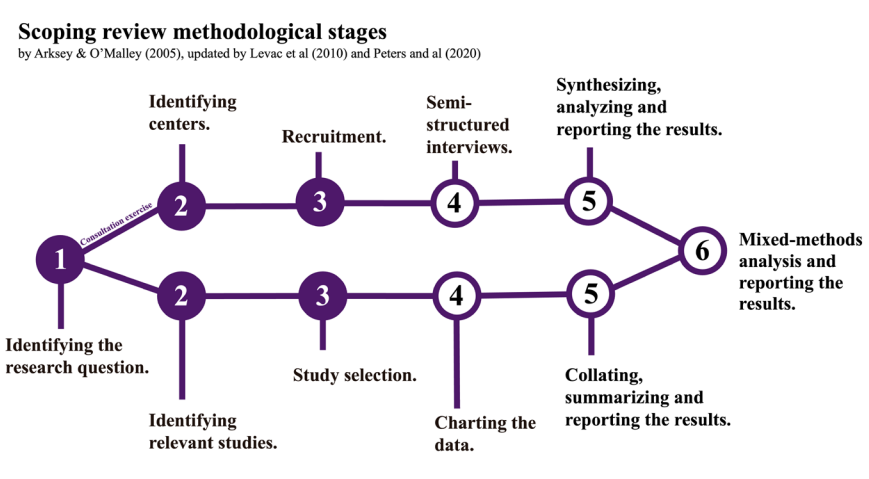

Figure 1 Scoping review methodological stages including the stages of the consultation phase with a convergent mixed-methods design. The filled circles represent the completed steps, and the white circles represent the remaining steps.

'precision adj2 rehabilitation') in the study titles, abstracts and keywords (see online supplemental appendix A for the search strings for each database). In collaboration with the librarian, the research team will not include potential precision synonyms such as 'personalised', 'predictive' and 'customised' in the search strategy, as preliminary searches including these terms result in a high number of irrelevant results.

Stage 3. Study selection

The inclusion and exclusion criteria are presented in table 1. Eligibility criteria were established using insights from preliminary searches. A few exclusion criteria were imposed given the broad scope of the research question. The inclusion criteria were as follows: publication date between 2010 (first appearance of the term precision health in the literature)[1] and 2023 and original research including protocol papers, editorials or perspective papers or reviews and referring to human participants in a rehabilitation context. No restrictions on the population type were applied. Articles were retrieved and imported into Covidence, a reference management and article screening software.

Duplicates were detected and removed using Covidence. Two authors screened titles and abstracts, with a third author resolving uncertainties. The same two authors undertook full-text screening, and disagreements regarding eligibility were resolved by the third reviewer. The complete flowchart illustrating the data selection process using Covidence is presented in figure 2.

Stage 4. Charting the data

A preliminary data extraction framework will be created using the categories presented in table 2. For reviews and editorials, the extraction will focus on study design trends and conceptual frameworks rather than primary data. For protocols, the focus will be on the described study design, target population and intended outcomes. Two reviewers will independently extract data from a random selection of 10% of the articles and meet to discuss discrepancies. Modifications to the data extraction framework will be made after discussion, if necessary. The reviewers will then divide the sample of articles and independently extract data.

Table 1 Inclusion and exclusion criteria for article selection

	Inclusion	Exclusion
Population	▶ Human participants of any description	▶ Human sample
	▶ Analysis of datasets (health records and epidemiological datasets)	▶ Evaluations of new technologies without human participants
Concept	▶ Studies that refer to the concept of precision rehabilitation	▶ Animal studies, in silico studies and testing of materials
	▶ Any studies collecting health-related clinical information	▶ Non-health outcomes including economic outcomes
Context	▶ Any geographical location or setting of any nature	▶ Not in a rehabilitation context
Type of evidence	▶ Primary research studies	▶ Patents
	▶ Protocol for planned studies	▶ Article for which the full text cannot be obtained
	▶ Full-text articles or conference proceedings	▶ Articles that are not written in English
	▶ Articles written in English and French	▶ Dissertations
	▶ Reviews and editorial articles (perspectives and position statements)	

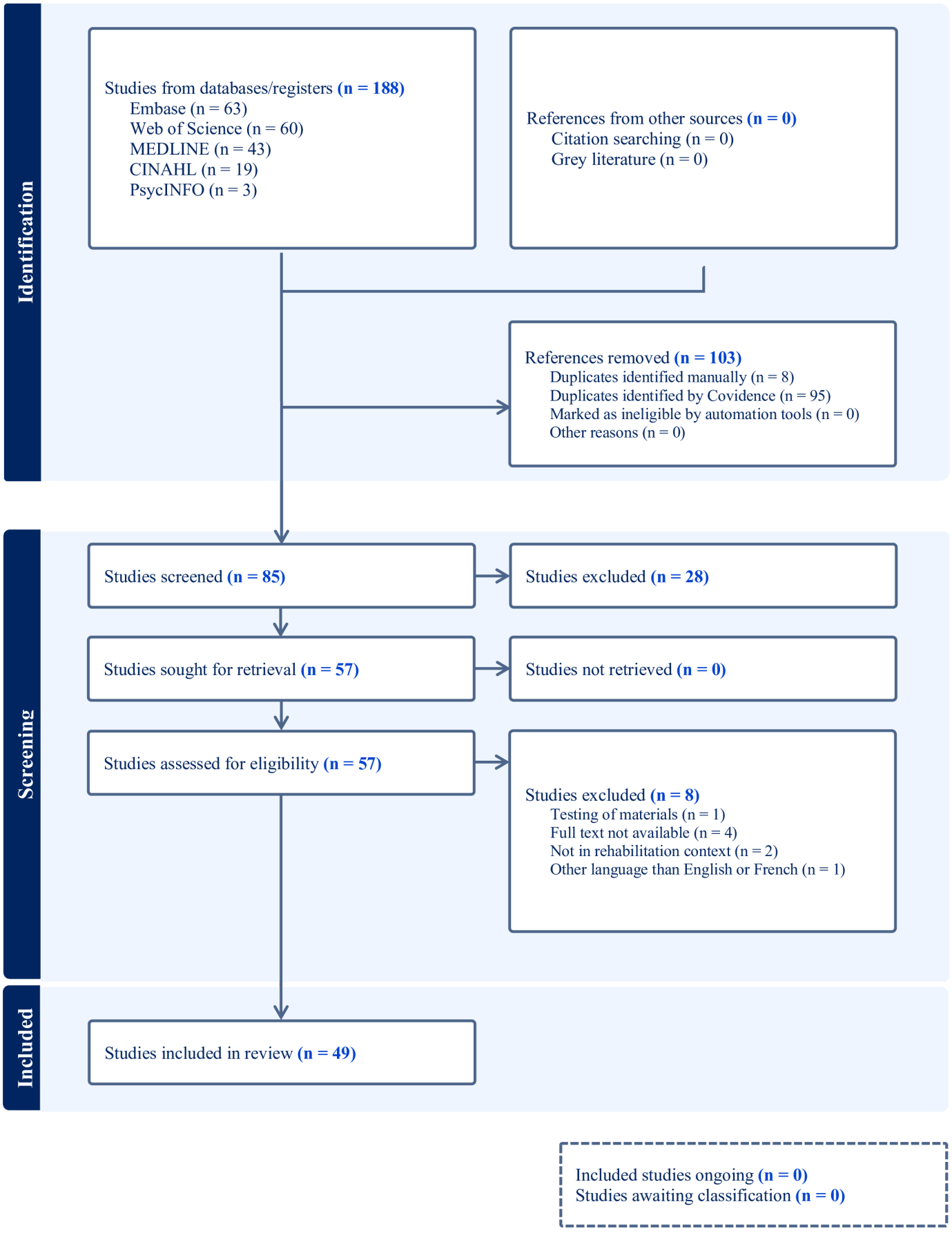

Figure 2 Preferred Reporting Items for Systematic Reviews and Meta-Analyses flowchart for the scoping review process.

Table 2 Data extraction framework

Main category	Subcategory	Description
1. Title		
2. Journal		
3. Year of publication		
4. Authors		
5. Country		Country of the corresponding authors' affiliation.
6. Aim of the study		Describe the stated aim of the study.
7. Study design	Study design and type of article	Describe the study design and the type of publication.
8. Population	Population description and focal health issue being monitored or addressed	Describe the type of population included in the study and the health issue being studied.
9. Domain of function	Body functions, body structures, activities and participation	Domain of function that is the focus of the study
10. Use of technology	Type of technology and purpose of use	Describe if technology was used in the study. If used, describe the type of technology and its purpose.
11. Use of AI/machine learning	Type of AI and purpose of use	Describe if AI was used in the study. If used, describe the type of AI and its purpose.
12. Results and conclusion	Main results, future research and limitations of the study	Describe the principal results of the study, future research and study limitations reported by the authors.
13. Definition of precision rehabilitation		Identify if a definition of precision rehabilitation is written in the article. If yes, extract the definition.

AI, artificial intelligence.

Stage 5. Collating, summarising and reporting the results

Descriptive, numerical and thematic analyses will be undertaken, and results will be presented in text, tables and charts. In addition to descriptive and demographic information regarding the characteristics of the included studies, the number of articles that included a definition of precision rehabilitation, used technologies and/or AI or machine learning and described the specific type and aim of use will be reported. Thematic analyses[15] will report similarities and differences in key concepts present in the definition of precision medicine and precision rehabilitation. In addition, the aims and objectives of the included studies will be categorised to synthesise the main areas of research efforts in precision rehabilitation. Thematic analyses[15] will identify gaps in the literature and facilitators and barriers to precision rehabilitation as identified by authors of the included studies.

Stage 6. Consultation exercise

The consultation phase, included as the qualitative component of the mixed-methods design, will add further perspectives and meaning to the scoping study.[10 11] The research team will follow recommendations from the critical review of the consultation exercise by Buus *et al*.[13] Specifically, the consultation exercise will be guided by the research question: how do actors in the field describe precision rehabilitation and perceive its current state and its barriers and facilitators? Data will be collected using semi-structured interviews. Purposeful sampling will inform the site selection of large rehabilitation centres in North America with diverse patient populations and an established focus on technology integration. At each site, potential participants will be identified using convenience sampling. Participants can be clinicians, researchers or healthcare managers, with a self-expressed interest in precision health or precision rehabilitation. Recruitment will take place via emails from a site representative. Sites will be recruited until data saturation is reached.[16] For feasibility purposes, the study will include a maximum of six participants at each site.

Semi-structured interviews will be conducted in person or via a secured virtual platform (Microsoft Teams; Microsoft Corporation, Redmond, VA, USA). The interview guide and questions are listed in table 3. Audios will be recorded and transcribed. Qualitative data will be analysed according to a qualitative descriptive approach for thematic analyses.[15] Following the first reading of the transcripts, a list of codes corresponding to the main themes will be determined. One transcript will then be coded by two researchers and revised to reach inter-rater agreement. Following this step, the list of codes will be revised and finalised. All transcripts will be coded by the same two raters. Following the coding, categories and themes will be identified and presented to the research team to discuss the interpretations of the results.

Phase 6.1. Integration of the results of the consultation exercise with the scoping review findings

In this convergent mixed-method design, the scoping review and consultation exercise will be conducted and analysed in tandem, and results will be integrated to understand how they converge or diverge.[9] Data

Table 3 Semi-structured interview guide for the consultation phase

Main thematic	Primary question	Secondary questions
Definitions	What does precision rehabilitation mean to you?	What are the key concepts? How does it differ from precision medicine or precision health? How does it differ from personalised rehabilitation?
	How would you describe precision rehabilitation in your context?	Can you give me an example in place right now? Do you have examples of how you are planning to implement precision rehabilitation now or in the future?
Obstacles and facilitators	When implementing precision rehabilitation, what are the difficulties that you encountered or anticipate encountering? What facilitated or will facilitate implementation?	What solutions did you find? What would you do differently next time?
Technologies and AI	What are your thoughts on the role of AI or technologies in the precision approach?	What are the barriers? What are the facilitators?

comparison will be used as the integration procedures; that is, the data will be examined for common concepts across both sets. Data will be presented in joint display tables or graphs that array the two results together.[17] Results will be discussed in what ways the results confirm, disconfirm or expand each other. The comparison of the scoping study results with the consultation phase findings will provide different but complementary data on precision rehabilitation and will allow for a more thorough understanding of the emergent research domain.[13]

ETHICS AND DISSEMINATION

The Research Ethics Board of Sainte-Justine UHC Research Centre approved the study (number 2024–6324). All stakeholders in the consultation phase signed informed consent to participate in the study. Results of this scoping study will be disseminated through professional networks, conference presentations and publication in scientific journals.

CONCLUSION

The proposed scoping review will be the first study to map the state of knowledge in precision rehabilitation. The convergent mixed-methods design will integrate quantitative data from the scoping review with qualitative insights from the consultation interviews, enabling a comprehensive understanding of precision rehabilitation and its potential facilitators and barriers.

Contributors Substantial contributions to the conception or design of the work: AP-L, DK and DEL. Data acquisition, analysis or interpretation of data for the work: AP-L, ED and DEL. Drafting the work or revising it critically for important intellectual content: AP-L, ED, DK and DEL. Final approval of the version to be published: AP-L, ED, DK and DEL. All authors agree to be responsible for all aspects of the work to ensure that questions about the accuracy or integrity of any part of the work are appropriately investigated and resolved. AP-L is the guarantor.

Funding This project is funded by the TransMedTech Institute and its main financial partner, the Apogee Canada First Research Excellence Fund, by "Ingénierie de technologie interactives en réadaptation" (INTER) (Fond de recherche du Québec-Nature et Technologie) and by the Canadian Institutes of Health Research (CIHR). Funders have no role in study design or conduct.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

ORCID iDs
Annie Pouliot-Laforte http://orcid.org/0000-0002-3759-2076
Dahlia Kairy http://orcid.org/0000-0001-6872-6607

REFERENCES

1 Viana JN, Edney S, Gondalia S, *et al*. Trends and gaps in precision health research: a scoping review. *BMJ Open* 2021;11:e056938.
2 Gambhir SS, Ge TJ, Vermesh O, *et al*. Toward achieving precision health. *Sci Transl Med* 2018;10:eaao3612.
3 Johnson KB, Wei W-Q, Weeraratne D, *et al*. Precision Medicine, AI, and the Future of Personalized Health Care. *Clin Transl Sci* 2021;14:86–93.
4 Schleidgen S, Klingler C, Bertram T, *et al*. What is personalized medicine: sharpening a vague term based on a systematic literature review. *BMC Med Ethics* 2013;14:55.
5 World health organization. Rehabilitation. 2023. Available: https://www.who.int/news-room/fact-sheets/detail/rehabilitation [Accessed 6 Feb 2024].
6 French MA, Roemmich RT, Daley K, *et al*. Precision Rehabilitation: Optimizing Function, Adding Value to Health Care. *Arch Phys Med Rehabil* 2022;103:1233–9.
7 Jette A. PTJ's Editor's Choice. *APTA Magazine* 2022;14:48–9.
8 Lin DJ, Stein J. Stepping Closer to Precision Rehabilitation. *JAMA Neurol* 2023;80:339–41.
9 Creswell JW, Clark VLP. *Designing and conducting mixed methods research*. SAGE, 2011.
10 Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol* 2005;8:19–32.
11 Levac D, Colquhoun H, O'Brien KK. Scoping studies: advancing the methodology. *Implement Sci* 2010;5:69.

12 Peters MDJ, Marnie C, Tricco AC, *et al*. Updated methodological guidance for the conduct of scoping reviews. *JBI Evid Synth* 2020;18:2119–26.
13 Buus N, Nygaard L, Berring LL, *et al*. Arksey and O'Malley's consultation exercise in scoping reviews: A critical review. *J Adv Nurs* 2022;78:2304–12.
14 Tricco AC, Lillie E, Zarin W, *et al*. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med* 2018;169:467–73.
15 Vaismoradi M, Turunen H, Bondas T. Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nurs Health Sci* 2013;15:398–405.
16 Hennink MM, Kaiser BN, Marconi VC. Code Saturation Versus Meaning Saturation: How Many Interviews Are Enough? *Qual Health Res* 2017;27:591–608.
17 Combs JP, Onwuegbuzie AJ. Describing and Illustrating Data Analysis in Mixed Research. *IJE* 2010;2.