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CLINICAL RESEARCH

Barriers to the implementation of point-of-care ultrasonography by physiotherapists in haemophilia treatment centres in Canada: a modified Delphi approach

Karen Strike, Anthony Chan, Monica R. Maly, Patricia Solomon

Background: In patients with haemophilia, evidence suggests that the physical examination alone is not sensitive enough to detect small amounts of blood within a joint. Attention has shifted to methods of improving the sensitivity of the physical examination through adding diagnostic modalities such as point-of-care ultrasonography (POC-US). Proficiency with the physical examination and understanding of the role of POC-US are important competencies for physiotherapists. Despite training, implementation of POC-US by physiotherapists in haemophilia treatment centres in Canada has been mixed. **Aim:** Using a theory-based approach, the aim of the current study is to achieve expert consensus regarding the barriers to physiotherapy performed POC-US in haemophilia treatment centres in Canada using a modified Delphi approach. **Materials and Methods:** Using the Knowledge-to-Action Framework and the Consolidated Framework for Implementation Research

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Physiotherapist-performed point-of-care ultrasonography (POC-US) can help to provide more sensitive physical examinations in haemophilia care; however, it is not yet routinely used for this purpose. Identifying barriers to its implementation is an important first step towards improving the physical examination of haemophilia patients.

KAREN STRIKE
Assistant Clinical Professor, School of Rehabilitation Science, Faculty of Health Science, McMaster University, Hamilton, Ontario, Canada. Email: christkl@mcmaster.ca

ANTHONY CHAN
Professor, Department of Pediatrics, McMaster University, Hamilton, Ontario, Canada

MONICA R. MALY
Associate Professor, School of Rehabilitation Science, Faculty of Health Science, McMaster University, Hamilton, Ontario, Canada; Department of Kinesiology, Faculty of Applied Health Sciences, University of Waterloo, Waterloo, Ontario, Canada

PATRICIA SOLOMON
Professor, School of Rehabilitation Science, Faculty of Health Science, McMaster University, Hamilton, Ontario, Canada

(CFIR), a modified Delphi approach was completed using the Modified BARRIERS Scale (MBS). Participants were blinded and consensus was reached over three rounds at the Canadian Hemophilia Society's annual three-day conference. **Results:** Twenty-two physiotherapists participated; 20 participants completed Round 1, and 21 completed Rounds 2 and 3. Four items of the MBS reached consensus: 1) The physiotherapist does not have time to read research related to POC-US; 2) The physiotherapist is isolated from knowledgeable colleagues with whom to discuss POC-US; 3) Administration will not allow POC-US implementation; 4) There is insufficient time on the job to implement new ideas. All four consensus items can be mapped to one domain of the CFIR: the inner setting. **Conclusion:** The haemophilia treatment centre within a healthcare organisation appears to be an important target for addressing barriers to the implementation of physiotherapy performed POC-US.

Keywords: *point-of-care systems, ultrasonography, haemophilia A, physiotherapy, implementation science, Delphi method*

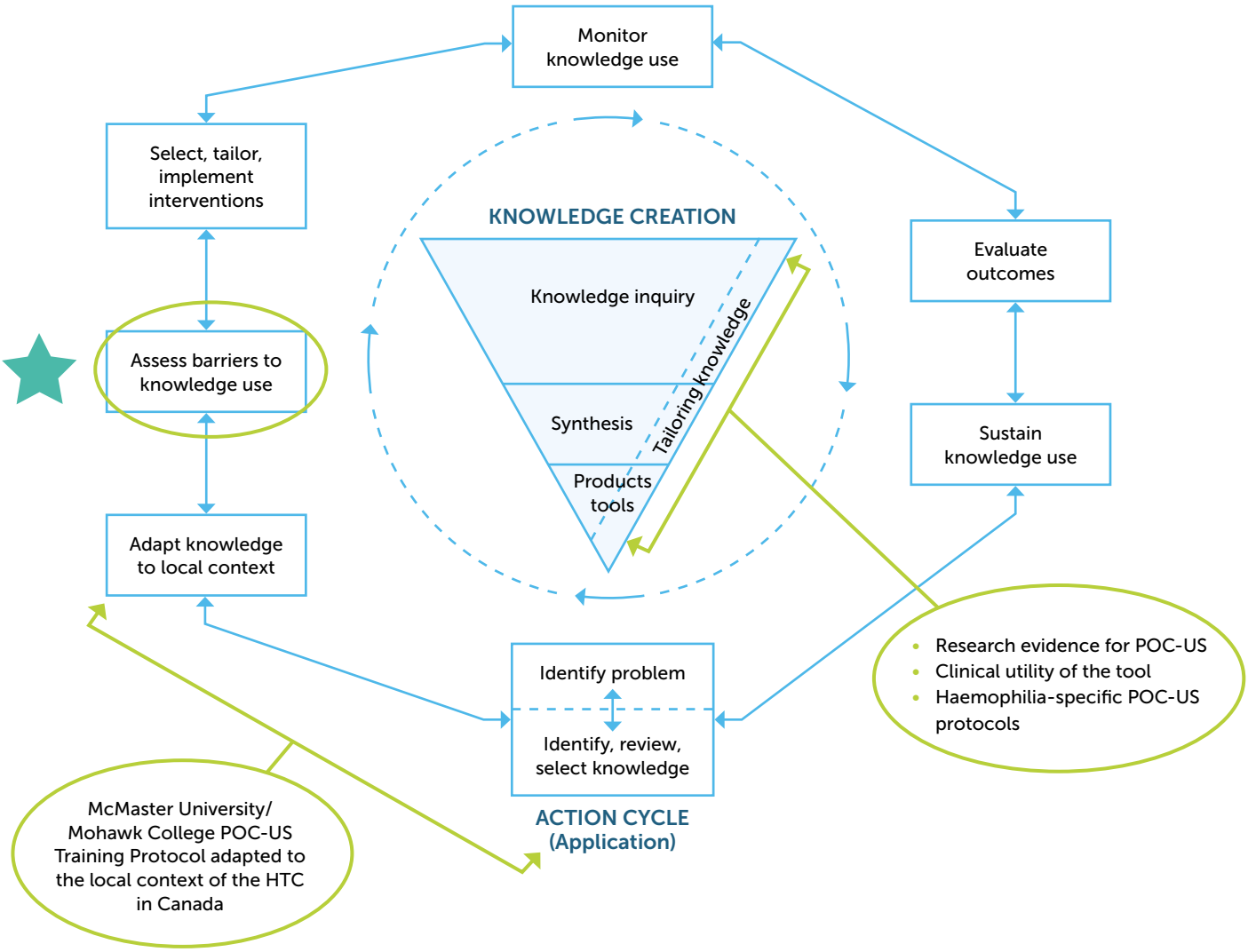
Joint disease affects 90% of patients with severe haemophilia [1,2]. Joint bleeding has serious consequences on the musculoskeletal system, functional health status and quality of life of patients with haemophilia (PWH) [3,4]. Acute joint bleeding is routinely assessed through a subjective history and a physical examination that is characterised by loss of joint range of motion, pain and swelling. Recent evidence suggests that the physical examination alone is not sensitive enough to detect small amounts of blood within the joint that may result in the development of joint disease [5,6]. Attention has therefore shifted to investigating methods of improving the sensitivity of the physical examination, including the addition of diagnostic modalities such as point-of-care ultrasonography (POC-US) [7]. POC-US is an ultrasound examination performed by a primary healthcare provider in combination with the physical examination in the clinic setting, and should be used to identify the presence or absence of a specific finding in clinicalsituations where time efficiency for diagnosis and treatment is crucial to patient care [8]. It is differentiated from the comprehensive diagnostic ultrasound examination, which is performed in the diagnostic imaging department with consultation from radiology.

POC-US is an emerging technology in the management of haemophilia [9,10], and haemophilia-specific ultrasound protocols for the assessment of disease activity such as joint bleeding and joint damage have been developed [11,12]. Querol *et al.* concluded that POC-US can supplement the clinical examination, and that it is particularly important in acute joint bleeding because it is an objective measure of the presence, location and amount of blood in the joint [13]. Additionally, it can be used to monitor the response to treatment and confirm complete resolution.

Healthcare professionals with appropriate training can perform POC-US within their area of expertise [7, 14]. POC-US can be performed in real time, is easily repeatable and may assist with improving diagnostic accuracy [14]. Proficiency with the clinical examination and an understanding of the role of POC-US are both important competencies for physiotherapists [15]. Boyles *et al.* reviewed physiotherapy practice and the role of diagnostic imaging and suggested that physiotherapists are the practitioners of choice for nonsurgical musculoskeletal injuries [16]. Studies by Brandon and Moss found that physiotherapy-led POC-US positively influenced decision-making and identified additional pathologies when performed in combination with the physical examination in patients with rheumatic disease [17-19]. However, POC-US is highly operator-dependent and the risk of misdiagnosis is high when POC-US is performed by inexperienced practitioners [20]. To address this issue, Strike *et al.* developed the POC-US in Hemophilia Training Program for physiotherapists in haemophilia care [7]. This training provides didactic and practical educational modules on the use of POC-US for the assessment and interpretation of joint and muscle bleeding, and is built on the Canadian Association of Radiology's position statement on POC-US and the core competencies for POC-US set out by Sonography Canada [7, 21].

As of May 2017, 20 physiotherapists from haemophilia treatment centres (HTCs) in Canada had successfully completed the POC-US in Hemophilia Training Program for Acute Hemarthrosis and Synovitis. However, despite training, implementation of POC-US by physiotherapists in HTCs in Canada has been mixed, with some fully implementing POC-US, some partially implementing POCUS, and others unsuccessful. Instances of partial implementation are marked by an inconsistent ability to perform POC-US due to time, resource or institutional constraints. This finding is not uncommon. Eccles *et al.* report that the transfer of research into clinical practice is "unpredictable and can be a slow, haphazard

Figure 1: Knowledge-to-Action (KTA) Framework [23]



The KTA Framework shown here has been modified to conceptualise the gap regarding the implementation of physiotherapy-performed POC-US. Text in the green ovals indicates current knowledge in the field of POC-US and the work to date on training and implementation of the tool. The turquoise star indicates the focus of this study at the level of barriers to knowledge use.

process," and suggest that this stems partly from a lack of consideration of relevant theory during the development and evaluation of a new process [22]. Use of theory in implementation science provides a framework to understand the characteristics of the intervention, healthcare professionals and environment that might influence the success of the implementation process. Further, it provides an increased understanding of the generalisability of findings and helps to define what works best for whom, where, why and at what cost.

AIM

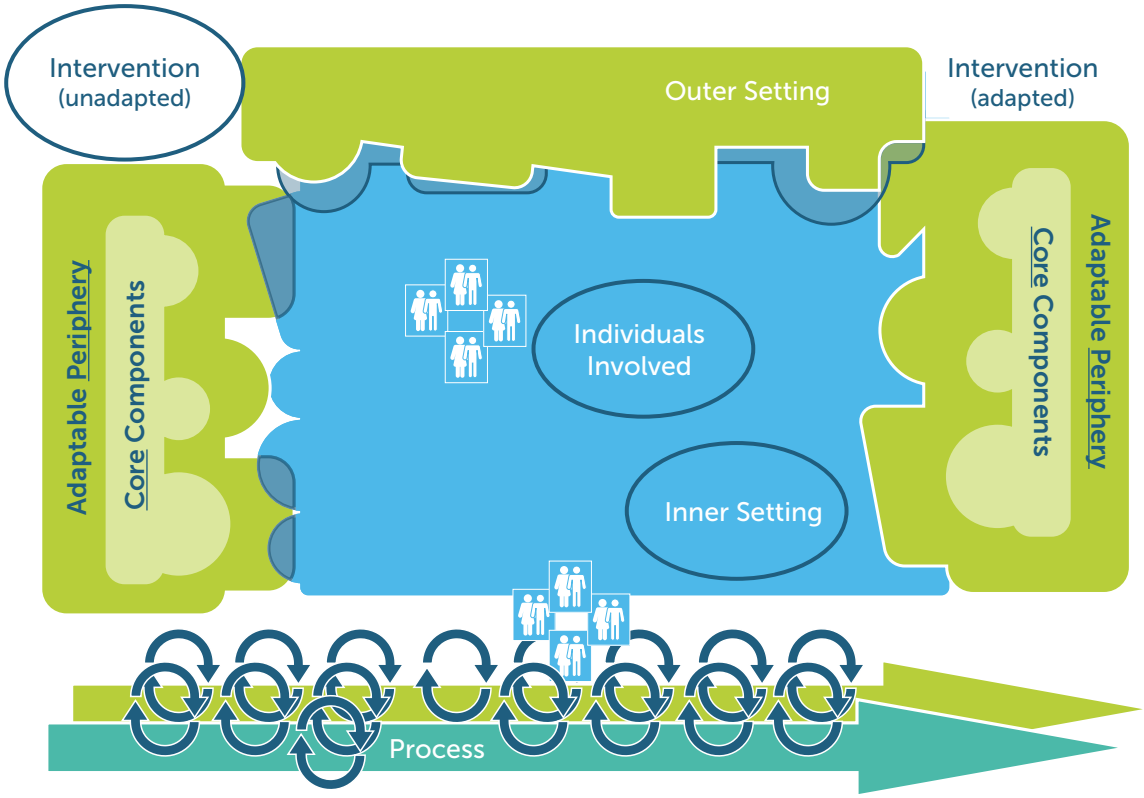
Using a theory-based approach, the aim of the current study is to achieve expert consensus regarding the barriers to physiotherapy performed POC-US in HTCs in Canada using a modified Delphi approach.

MATERIALS AND METHODS

The Knowledge-to-Action Framework

Knowledge translation (KT) addresses the gap between research and knowledge synthesis and the implementation of this work into clinical practice [23]. The Knowledge-to-Action (KTA) Framework is a conceptual framework for KT based on planned action theories and the knowledge creation process [23]. The KTA process is "iterative, dynamic, and complex", and takes into consideration the fluid boundaries between knowledge creation and the application (action cycle) of knowledge into practice [23]. The framework provides steps to guide the process of KT, and can be used to conceptualise the KT gap around the implementation of POC-US in haemophilia care (Figure 1). As research evidence, protocols and training programmes support

Figure 2: Consolidated Framework for Implementation Research (CFIR) [24,25]



The areas highlighted with blue ovals highlight the three constructs investigated in this study within the CFIR to identify and achieve a consensus on the barriers and facilitators to the implementation of physiotherapy-performed POC-US in haemophilia care.

the use of POC-US by physiotherapists, the ideal entry into the KTA framework to address the KT gap for implementation of physiotherapy performed POC-US is at the level of barriers to knowledge use in the action cycle.

The Consolidated Framework for Implementation Research

The Consolidated Framework for Implementation Research (CFIR) can also help to inform the discussion of POC-US implementation and the barriers to use by physiotherapists in HTCs in Canada [24]. As a determinants of implementation framework, it combines multiple implementation theories, such as the Diffusion of Innovation Theory, into a single framework, providing a foundation for development and verification around what works, where and why, across multiple contexts [24]. The CFIR includes five domains, each built on a menu of constructs that together provide a practical or theory-based approach to offer guidance on the factors associated with successful implementation of innovation. The five domains (visualised in Figure 2) are:

- Intervention characteristics
- Outer setting
- Inner setting
- Characteristics of the individuals involved
- Process of implementation.

The CFIR provides a pragmatic structure for investigating the complex, multi-level interactions around the barriers to POC-US implementation in haemophilia care [25]. It fits well with the national structure of haemophilia care in Canada as the framework allows for comparison between HTCs across the country. This study examined three CFIR domains: *intervention characteristics, the individual and the inner setting*. Constructs of these domains were investigated to identify and achieve a consensus on the barriers to the implementation of POC-US, and to provide guidance on strategies to overcome these barriers [26]. Focusing on these three CFIR domains allowed for the in-depth analysis of the strengths of POC-US, the features of the physiotherapist, and the position of the HTC within healthcare organisations in

Canada. Given the national structure of haemophilia care in Canada, it was anticipated that commonalities exist in the implementation process and outer setting.

The Delphi method

The Delphi method is a research technique that provides a flexible structure for group communication, with the aim of achieving a consensus of opinion on a common problem [27-29]. It uses a series of questionnaires delivered in multiple iterations to collect data from a selected group of experts, and is effective when the goal is to improve understanding of a problem, investigate barriers and/or look for solutions [27-29]. The recommended number of participants is variable and there is no set calculation for sample size, although it is generally agreed that the sample size should constitute a representative pooling of the opinions and experiences of the target audience/professional group across geographical regions [27]. Consensus is determined if a percentage of responses falls within a set range, historically set at ≥70% [27,30].

The classical Delphi technique uses an open-ended questionnaire designed to generate ideas and opinions on a topic from a panel of experts, and involves three or more rounds of consensus-building [30]. In a modified Delphi approach, the first round of the process is modified through replacing the first round of open-ended questionnaires with a face-to-face meeting, or using a validated and structured questionnaire that is supported by the literature [27,30]. This study used a modified Delphi approach that incorporated the BARRIERS Scale.

The BARRIERS Scale

The BARRIERS Scale is a self-report questionnaire designed to assess clinicians', researchers' or administrators' perceptions of barriers to the implementation of research findings into practice [31]. It is standardised and was considered a valid and reliable instrument to assess the barriers and/or facilitators to POC-US use in haemophilia care. The questionnaire consists of 29 items divided into four subscales:

- Characteristics of the adopter
- Characteristics of the organisation
- Characteristics of the innovation
- Characteristics of the communication.

Respondents rate the extent to which each item is a perceived barrier to the use of research in practice using a four-point Likert scale (1= "to no extent"; 2 = "to a little extent," 3 = "to a moderate extent," and 4 = "to a great extent"), and also have the option to record a "no opinion" response [31,32]. There is also a free text option, enabling respondents to introduce other possible barriers, to rank the three greatest barriers, and to list possible facilitators of research implementation. The BARRIERS Scale demonstrates acceptable internal consistency, with Cronbach's alpha for the subscales of 0.80, 0.80. 0.72 and 0.65 respectively, and acceptable test retest reliability (r=0.68 – 0.83) [31]. To enhance the Scale's validity, it is recommended that the barriers/facilitators under investigation are considered in the context of the implementation [31]. For the purposes of the current study, the BARRIERS Scale was therefore modified to specifically address physiotherapy-performed POC-US in haemophilia care (see Appendix 1). As all physiotherapists practice within the comprehensive care model of the HTC in Canada, following the same standards and guidelines, it was reasonable to assume that the context of implementation was similar across respondents.

Setting and participants

Physiotherapists involved in the treatment of patients with haemophilia within HTCs in Canada are formally organised into the Canadian Physiotherapists in Hemophilia Care (CPHC) group. Members of the CPHC are the musculoskeletal experts within the comprehensive care team, and have been the target of education, training and research initiatives in POC-US. There are 25 HTCs in Canada, each with a minimum of one physiotherapist who is a member of the CPHC. The CPHC maintains a network of physiotherapists in haemophilia care to provide a high level of physiotherapy management, education and research for people with haemophilia and related bleeding disorders [33]. In the current study, CPHC members formed the expert panel for the application of the Delphi approach. All CPHC members who attended the Canadian Hemophilia Society Annual Conference in 2017 were eligible to participate. This meeting was chosen for the purposes of the study to minimise attrition, to allow the research to be completed with minimal direct cost, and to reach a representative sample of physiotherapists in HTCs in Canada.

Procedure

The Modified BARRIERS Scale (MBS) was administered to physiotherapists daily over the course of the three-day meeting. Study participants were provided with the questionnaire upon arrival to the conference each day, and were asked to complete the questionnaire independently and not to discuss their responses, in order

to maintain blinding and anonymity. The researchers did not collect identifying information (e.g. name, address, email, HTC) on the questionnaire in an effort to maintain anonymity and to ensure that the project could not link individual questionnaires to the participants.

Following Round 1, a summary of the anonymous findings was collated, analysed and distributed back to participants. The summary consisted of a list of the top five items on the MBS rated as barriers, and a summary of the open text questions on the barriers, facilitators and future directions regarding physiotherapy-performed POC-US in haemophilia care.

On Round 2, the participants were provided with the Round 1 summary and the MBS; the summary from Round 2 was then collated. The summary comprised a list of the items on the MBS that achieved consensus as barriers to physiotherapy-performed POC-US.

On Round 3, the MBS was administered in an effort to confirm consensus on the barriers/facilitators to POC-US use. Items on the MBS that achieved consensus in Round 2 were not removed from the questionnaire for Round 3; however, these were not considered in data analysis for the final round.

Data analysis

To achieve consensus on each item of the MBS, two criteria had to be met:

1. A median of 3.25/4 or greater was required for each item; and
2. 70% of participants must rate the item as a moderate (score=3) or great (score =4) barrier [27].

This level of agreement is consistent with the literature [30].

Comments from participants in the free text questions on the barriers, facilitators and future directions around physiotherapy-performed POC-US in haemophilia care were collated and reported back to participants in the summary of findings for Round 1. The list of free text comments were completed only for Round 1 to provide participants with a broad context for physiotherapy-performed POC-US, as both physiotherapists who had completed the POC-US in Hemophilia Training Program and those who had not completed the training were included in the study.

Ethics

Permission for the modification and use of the BARRIERS Scale was provided by Dr Sandra Funk of the University of North Carolina at Chapel Hill, United States. Research ethics approval was obtained from the Hamilton Integrated Research Ethics Board.

Table 1: Results from Delphi Round 1

MBS ITEM	N	MEDIAN	25TH %ILE	75TH %ILE	SCORE 3 OR 4 ON MBS (%)
Q1	18	1.5	1.0	2.0	20
Q2	17	1.0	1.0	2.0	10
Q3	16	2.0	1.0	2.0	15
Q4	19	1.0	1.0	2.0	5
Q5	20	1.0	1.0	2.0	20
Q6	20	2.0	1.0	3.0	30
Q7	20	2.0	1.5	3.0	40
Q8	16	2.0	1.5	2.0	15
Q9	19	1.0	1.0	2.0	20
Q10	18	1.0	1.0	2.0	0
Q11	11	2.0	1.0	2.0	5
Q12	14	2.5	1.0	3.0	35
Q13	20	2.5	1.0	3.0	50
Q14	16	1.0	1.0	2.0	5
Q15	20	3.0	2.0	4.0	55
Q16	20	1.0	1.0	2.0	5
Q17	14	1.0	1.0	2.0	10
Q18	18	1.0	1.0	1.0	10
Q19	19	2.0	1.0	3.0	45
Q20	19	1.0	1.0	1.0	0
Q21	19	2.0	1.0	2.0	10
Q22	15	1.0	1.0	2.0	5
Q23	12	2.0	1.0	2.0	10
Q24	13	2.0	1.0	2.0	5
Q25	17	1.0	1.0	2.0	20
Q26	20	1.0	1.0	1.0	5
Q27	14	1.0	1.0	2.0	0
Q28	20	2.0	1.0	3.0	30
Q29	20	3.0	2.0	4.0	60

Table 2: Results from Delphi Round 2

MBS ITEM	N	MEDIAN	25TH %ILE	75TH %ILE	SCORE 3 OR 4 ON MBS (%)
Q1	21	1.0	1.0	2.0	10
Q2	21	1.0	1.0	2.0	15
Q3	20	2.0	1.0	2.0	10
Q4	19	1.0	1.0	1.0	0
Q5	21	1.0	1.0	2.0	19
Q6	21	2.0	2.0	3.0	48
Q7	21	3.0	2.0	4.0	71
Q8	18	1.0	1.0	2.0	10
Q9	20	1.0	1.0	2.0	10
Q10	18	1.0	1.0	1.0	0
Q11	16	1.0	1.0	2.0	5
Q12	18	2.0	1.0	2.0	10
Q13	21	3.0	2.0	4.0	62
Q14	18	1.0	1.0	2.0	0
Q15	21	4.0	3.0	4.0	76
Q16	20	1.0	1.0	1.5	10
Q17	19	1.0	1.0	2.0	10
Q18	20	1.0	1.0	2.0	10
Q19	21	3.0	3.0	4.0	76
Q20	21	1.0	1.0	1.0	0
Q21	20	1.0	1.0	2.0	0
Q22	19	1.0	1.0	1.0	5

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MBS ITEM	N	MEDIAN	25TH %ILE	75TH %ILE	SCORE 3 OR 4 ON MBS (%)
Q23	14	1.0	1.0	2.0	10
Q24	16	1.0	1.0	1.5	5
Q25	20	2.0	1.0	3.0	28
Q26	21	1.0	1.0	1.0	0
Q27	18	1.0	1.0	2.0	10
Q28	21	1.0	1.0	2.0	24
Q29	21	4.0	2.0	4.0	71

Table 3: Results from Delphi Round 3

MBS ITEM	N	MEDIAN	25TH %ILE	75TH %ILE	SCORE 3 OR 4 ON MBS (%)
Q1	20	1.0	1.0	2.0	5
Q2	20	1.0	1.0	2.0	14
Q3	20	1.0	1.0	2.0	10
Q4	20	1.0	1.0	1.0	0
Q5	21	1.0	1.0	2.0	19
Q6	21	2.0	1.0	3.0	34
Q7	21	4.0	3.0	4.0	81
Q8	16	1.0	1.0	2.0	0
Q9	20	1.0	1.0	2.0	14
Q10	19	1.0	1.0	1.0	0
Q11	16	1.0	1.0	2.0	0
Q12	18	2.0	1.0	2.0	10
Q13	21	2.0	1.0	3.0	43
Q14	17	1.0	1.0	1.0	0
Q15	Consensus achieved in Round #2				
Q16	21	1.0	1.0	1.0	0
Q17	17	1.0	1.0	2.0	5
Q18	20	1.0	1.0	2.0	10
Q19	20	4.0	3.0	4.0	86
Q20	21	1.0	1.0	1.0	0
Q21	20	1.0	1.0	2.0	10
Q22	18	1.0	1.0	1.0	0
Q23	17	1.0	1.0	2.0	5
Q24	19	1.0	1.0	2.0	0
Q25	20	1.0	1.0	2.0	19
Q26	21	1.0	1.0	1.0	5
Q27	18	1.0	1.0	2.0	10
Q28	21	2.0	1.0	2.0	15
Q29	Consensus achieved in Round #2				

RESULTS

Participants

Twenty-two physiotherapists attended the 2017 Canadian Hemophilia Society Annual Conference and agreed to participate in the study. The participants represented 18 different HTCs in Canada; 13 of the physiotherapists had successfully completed the POC-US in Hemophilia Training Program for Acute Hemarthrosis and Synovitis. Twenty participants completed the MBS in Round 1 and 21 participants completed Rounds 2 and 3. Given the anonymity of the process, it is unclear which participants declined to participate in each round.

Delphi Round 1

Table 1 presents the descriptive statistics and percentage of participants rating the items as a moderate or great barrier in Round 1. As none of the items in the MBS reached a median of 3.25 for consensus, the top five barriers were identified using the percentage of participants rating the item as a moderate (score 3) or great (score 4) barrier. The top five barriers in order of ranking were:

1. **Q29:** There is insufficient time on the job to implement new ideas
2. **Q15:** The physiotherapist is isolated from knowledgeable colleagues with whom to discuss POC-US
3. **Q13:** The physiotherapist does not feel he/she has enough authority to change patient care procedures
4. **Q19:** Administration will not allow POC-US implementation
5. **Q7:** The physiotherapist does not have time to read research related to POC-US.

Participants' free text reports of the barriers to physiotherapy-performed POC-US in haemophilia care included: lack of POC-US machines, lack of time and space in clinic, lack of support from administration, unknowns about college requirements, opportunities to take training, general comfort level with POC-US, insecurity regarding interpretation of POC-US findings, and clinic visits that are generally focused on annual reviews not acute bleeding episodes.

Participants' free text reports of the facilitators to physiotherapy-performed POC-US included: support from the HTC team, engagement of the radiologist from the initiation of the implementation process, development of medical directives, funding for POC-US education, support from physiotherapy colleagues, patient advocacy and support for POC-US, support of administration, support from industry for machine/training/competency evaluation, observing changes in clinical practice such as changing weight-bearing recommendations following a bleed, and increased patient adherence.

Future ideas for consideration to assist with the implementation of physiotherapy-performed POC-US included the development of a discussion board or forum within the CPHC website, and the formation of POC-US "rounds" or webinars to ensure appropriate skills.

Delphi Round 2

Table 2 presents the descriptive statistics and percentage of participants rating the items as a moderate (score 3) or great (score 4) barrier in Round 2. Two items on the MBS achieved consensus:

1. **Q15:** The physiotherapist is isolated from knowledgeable colleagues with whom to discuss POC-US
2. **Q29:** There is insufficient time on the job to implement new ideas.

Items that did not achieve a median of 3.25, but which approached consensus on analysis of the percentage of participants rating the items as a moderate or great barrier, were communicated back to the participants in Round 3. These included:

1. **Q7:** The physiotherapist does not have time to read research related to POC-US
2. **Q19:** Administration will not allow POC-US implementation.

Delphi Round 3

Table 3 presents the descriptive statistics and percentage of participants rating the items as a moderate (score 3) or great (score 4) barrier. Following this final round, the following items achieved consensus with both methods of analysis:

1. **Q7:** The physiotherapist does not have time to read research related to POC-US
2. **Q19:** Administration will not allow POC-US implementation.

No additional items approached the 70% rating, thus expert consensus was achieved following the three rounds of the Delphi approach. The four items of the MBS that reached consensus were then analysed to reflect the three domains of the CFIR under consideration: intervention characteristics, inner setting, and characteristics of the individual involved.

DISCUSSION

Building on the theoretical frameworks provided by the KTA Framework and CFIR, the aim of the current study was to use a modified Delphi approach with an objective questionnaire to achieve expert consensus from physiotherapists in haemophilia care on the barriers and facilitators to the implementation of physiotherapy performed POC-US within HTCs in Canada. Four items of the MBS reached consensus:

1. **Q7:** The physiotherapist does not have time to read research related to POC-US
2. **Q15:** The physiotherapist is isolated from knowledgeable colleagues with whom to discuss POC-US
3. **Q19:** Administration will not allow POC-US implementation
4. **Q29:** There is insufficient time on the job to implement new ideas.

All four consensus items can be mapped to one domain of the CFIR: the inner setting.

Using the CFIR is a strength of the current study. The CFIR is a model that can be used to influence and tailor implementation strategies [25]. As all consensus items mapped to the inner setting of the CFIR, the HTC within a healthcare organisation appears to be most important to target for addressing barriers to the implementation of physiotherapy-performed POC-US. In this context, administrative support and the organisation's readiness for change are important features to consider within the KTA Framework. Further, comprehensive care in the HTCs has consolidated expertise to a small number of healthcare facilities in each province: this may contribute to feelings of isolation from physiotherapy colleagues. This is especially problematic when trying to implement a novel tool such as POC-US, as it may indicate a lack of professional support and mentoring.

Two of the consensus items relate to insufficient time to implement POC-US; specifically, time to read research related to POC-US, and time to implement new ideas into the physiotherapists' current job. This finding is particularly intriguing: many members of the CPHC do not have funded hours within the HTC, and provide physiotherapy care on a consultation or as-needed basis. The full-time equivalent (FTE) of the CPHC members is assessed annually; at the 2017 annual meeting, FTE ranged from 0 (no hours) to 1.0 (full time) (Minutes of the CPHC Annual General Meeting of , Toronto, Canada, 2017). Therefore, many CPHC members have responsibilities to other clinical areas and may perceive a lack of flexibility in their roles, which in turn may place limits on their ability to keep up to date on the evolving evidence for POC-US in haemophilia care, and issues around the implementation process.

Time, defined as both a financial and personnel resource, has been consistently reported as a barrier to the knowledge translation process for physiotherapists in other countries [34-36]. The ability to integrate evidence requires time and energy to critically appraise literature, learn new skills and apply them to clinical practice [37].

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Access to adequate time and funding to participate in these activities is often directly determined by management or the organisational structure within which physiotherapy care is provided. It is within this structure that a conflict of ideals arises, with pressure to provide a greater amount of clinical care while also participating in research and implementing innovation into practice [37]. The importance of and interdependence between time and management support has previously been shown in studies regarding implementation of research by physiotherapists [34,35,37]. Specifically, a qualitative study by Dannapfel *et al*. investigated the facilitators to research use in clinical practice by physiotherapists in Sweden [35]. Nine facilitators to the use of research were reported over three system levels, and although the study did not use the CFIR, four facilitators can be mapped to the inner setting: organisational culture, research-related resources (including adequate time), leadership support and knowledge exchange were identified as important facilitators at a workplace level [35]. Similar findings were found in studies involving physiotherapists in Australia and the United Kingdom, who identified lack of time, management support, difficulty accessing and reading scholarly papers, and isolation from colleagues as important barriers to the integration of research into clinical practice [36,37].

The use of theory to interpret the study findings and provide a foundation on which to build evidence-based KT intervention strategies is a strength of the current study. The active involvement of POC-US users in the identification of barriers to implementation is crucial to the success of any potential intervention or change in service/treatment model [30]. This is a major advantage of using a modified Delphi approach. Additionally, the anonymity of the Delphi process and the consideration of each opinion equally in the analysis can reduce subject and response bias [30]. Using members of the CPHC as the expert panel provided the study with direct knowledge, skills and expertise. As participants may also be affected by the outcome of the study, they also had a vested interest in providing insightful feedback and opinions, and to stay involved.

A potential limitation of the study is the exclusion of physiotherapists who are members of CPHC but who did not attend the annual conference. However, 18 of 25 HTCs were represented. With the exception of one of the authors, all physiotherapists at the conference were included, even those who had not trained in POC-US, to ensure a broad spectrum of opinion. The Delphi method has been criticised for the potential for a declining response rate with each round of the process, given the time-consuming nature of multiple rounds of assessment [30]. However, the high response rate (91% in Round 1 and 95% in Rounds 2 and 3) suggests this was not a concern, and using Delphi over the course of a three-day conference appears to have minimised the amount of time required to complete the process.

The selection of experts in the Delphi method is not without criticism: there is a belief that having knowledge in a particular area does not necessarily make an individual an expert, and this may impact on the validity of the results [30]. To minimise this potential bias, it was important to include a heterogeneous sample of physiotherapists with varying levels of experience in haemophilia care [27]. Blinding and efforts to maintain anonymity were also important in ensuring that the respondents remained impartial, so that the information obtained reflected current knowledge or perceptions [30]. Despite instructions to complete the questionnaire independently, all participants were known to each other and interacted during the course of the conference, and it was therefore not possible to ensure that participants did not discuss POC-US. This may be a potential limitation of the study.

Future directions

This study was a first step in investigating the perceived barriers to the implementation and use of physiotherapy-performed POC-US from the practitioner perspective. In addition to providing a basis for future studies that involve patient groups and hospital administrators, the findings can be used to provide direction for the next step in the KT cycle to select, tailor and implement interventions [23]. In the context of the HTCs, possible interventions could include written fact sheets and a knowledge broker [38,39]. As printed education material, fact sheets are one of the most commonly used forms of KT, and enable the passive dissemination of research, skills and attitudes directly to the healthcare professional, thereby helping to translate research findings into clinical practice, with resulting enhanced patient outcomes [38]. They are a low-cost KT intervention and a convenient medium for information transfer, especially for a comprehensive topic targeted at a specific audience. A knowledge broker can be an individual or organisation that strives to provide a link between researchers and the end user. Given that the barriers identified in the current study represent constructs from the inner setting domain of the

CFIR, using a knowledge broker is a preferred KT intervention, as the knowledge broker has the skills and capacity to facilitate the transfer of knowledge into local practice and policy [40]. Knowledge brokers are perhaps an ideal medium for addressing the barrier related to the isolation of physiotherapists in haemophilia care, as they have been shown to be effective in creating networks of people, and can facilitate a community of practice and provide opportunities for increased information sharing among the target audience [39].

CONCLUSION

Using a modified Delphi method, this study achieved expert consensus on four barriers to physiotherapy-performed POC-US in HTCs in Canada. The barriers identified mapped to the inner setting domain of the CFIR. Therefore, the HTC within a health care organisation appears to play an important role in the implementation of physiotherapy-performed POC-US. An important caution when using a Delphi approach is to be aware that, although consensus has been reached, it does not necessarily mean that the correct answer has been found. However, the results from this Delphi process represent a good starting point to inform the discussion on the use of POC-US. While not a replacement for scientific reviews of the literature, the theoretical basis from which this study was formed and the results from the Delphi process can provide a foundation to guide future knowledge translation initiatives to integrate physiotherapy-performed POC-US into clinical practice in HTCs in Canada.

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ORCID

Karen Strike https://orcid.org/0000-0002-5598-2051
Anthony Chan https://orcid.org/0000-0003-1551-3995
Monica R. Maly https://orcid.org/0000-0001-5414-3777
Patricia Solomon https://orcid.org/0000-0002-5014-0795

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Appendix 1: Modified Barriers Scale [31,32]

Modified Barriers Scale

Barriers and Facilitators to Using Point-of-Care Ultrasonography (POC-US) within Hemophilia Treatment Centres (HTC) in Canada

Instructions: We would like to know the extent to which you think each of the following situations is a barrier to physiotherapists' (PT) use of research related to Point-of-Care Ultrasonography and the ability to use this research in support of implementation of the tool (POC-US) to alter/enhance clinical practice. For each item, circle the number of the response that best represents your view. Thank you for sharing your views with us.

	THIS IS A BARRIER				
	TO NO EXTENT	TO A LITTLE EXTENT	TO A MODERATE EXTENT	TO A GREAT EXTENT	NO OPINION
1. Research reports/articles are not readily available at my HTC	1	2	3	4	5
2. Implications for practice are not made clear	1	2	3	4	5
3. Statistical analyses are not understandable	1	2	3	4	5
4. The research is not relevant to the PT's practice in the HTC	1	2	3	4	5
5. The PT is unaware of the research	1	2	3	4	5
6. The HTC facilities are inadequate for implementation	1	2	3	4	5
7. The PT does not have time to read research related to POC-US	1	2	3	4	5
8. The research in POC-US has not been replicated	1	2	3	4	5
9. The PT feels the benefits of changing practice will be minimal	1	2	3	4	5
10. The PT is uncertain whether to believe the results of the research	1	2	3	4	5
11. The research in POC-US has methodological inadequacies	1	2	3	4	5
12. The relevant literature is not compiled in one place	1	2	3	4	5
13. The PT does not feel he/she has enough authority to change patient care procedures	1	2	3	4	5
14. The PT feels the literature is not generalizable to their HTC	1	2	3	4	5
15. The PT is isolated from knowledgeable colleagues with whom to discuss POC-US	1	2	3	4	5
16. The PT sees little benefit for self	1	2	3	4	5
17. Research reports/articles in POC-US are not published fast enough	1	2	3	4	5
18. Hematologists will not cooperate with POC-US implementation	1	2	3	4	5
19. Administration will not allow POC-US implementation	1	2	3	4	5
20. The PT does not see the value of research and POC-US in the HTC	1	2	3	4	5
21. There is not a documented need to change practice	1	2	3	4	5
22. The conclusions drawn from the research are not justified	1	2	3	4	5
23. The literature in POC-US reports conflicting results	1	2	3	4	5
24. The research in POC-US is not reported clearly and readably	1	2	3	4	5
25. Other staff are not supportive of POC-US implementation	1	2	3	4	5
26. The PT is unwilling to change/try new ideas	1	2	3	4	5
27. The amount of research in POC-US is overwhelming	1	2	3	4	5
28. The PT does not feel capable of evaluating the quality of the research in POC-US	1	2	3	4	5
29. There is insufficient time on the job to implement new ideas	1	2	3	4	5

Modified Barriers Scale
Barriers and Facilitators to Using POC-US in HTCs in Canada
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Are there any other things you think are barriers to POC-US implementation into your HTC?
If so, please list and rate each on the scale:

	TO NO EXTENT	TO A LITTLE EXTENT	TO A MODERATE EXTENT	TO A GREAT EXTENT	NO OPINION
30.					
31.					
32.					
33.					
34.					

Which of the above items do you feel are the three greatest barriers to POC-US implementation at your HTC?

Greatest Barrier: _____ Item #: _____

Second Greatest Barrier: _____ Item #: _____

Third Greatest Barrier: _____ Item #: _____

What are the things you think facilitate POC-US use at your HTC?

_____

_____

_____

_____