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PHYSIOTHERAPY Practice

Strategic Research Committee

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Measures

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A Few Thoughts on Standardized Outcome Measures and Their Successful Application



A Bit of History

In 1979 the Canadian Physiotherapy Association (CPA) became one of the first health care professional associations to provide direction for Quality Assurance. The initial report titled “Toward Assessment of Quality of Care in Physiotherapy”¹ stated that the model for measuring quality of care should be based on outcome measures. A follow-up report provided an account of the development and testing of outcome measures relevant to physiotherapy care. Subsequently, two intrepid groups—the first led by Beverly Cole and the second by Elspeth Finch—produced the first and second editions of Physical Rehabilitation Outcome Measures—which popularly became known as the “Red Book”. The past four decades have seen an exponential growth in the number of outcome measures and the level of sophistication applied to the validation of these measures. Today, the challenge for many clinicians is identifying the measure from a pool of competing measures that best serves their patients’ needs. In this article I briefly review the characteristics of an outcome measure, comment on the value of standardized outcome measures (SOMs), acknowledge recurring barriers to the successful implementation of SOMs, and suggest criteria for selecting measures that best align with your practice and patients’ requirements.

Characteristics of an Outcome Measure

Outcome measures exist in many forms and are routinely used by physiotherapists to assess impairments, activity limitations, and participation restrictions. They include performance measures (e.g., Timed-up-and-go, Berg Balance Test), condition or region-specific self-report measures (e.g., Roland-Morris Questionnaire, Neck Disability Index), patient specific measures (e.g., Patient Generated Index, Patient Specific Functional Scale), and long-standing therapist acquired physical examination measures (e.g., range-of-motion, strength). Even asking a patient “How are you doing today?” or, “Have you noticed a change over the past week?” could be considered an outcome assessment, albeit not standardized. Unlike less formal assessments, SOMs have descriptions of their conceptual framework, development, application, and scoring. Furthermore, the validity and usefulness of SOMs can be defended to the extent that their context specific measurement properties have been critiqued and substantiated in peer-reviewed forums. To be

clinically useful an outcome measure must be proficient at differentiating among patients at a point in time and in assessing change over time. Broadly speaking the interpretation of an outcome measure’s score should inform the following two questions: (1) Does this patient have a limitation in the outcome of interest, and to what extent? (2) Has this patient made a true and meaningful change?

Value of Standardized Outcome Measures

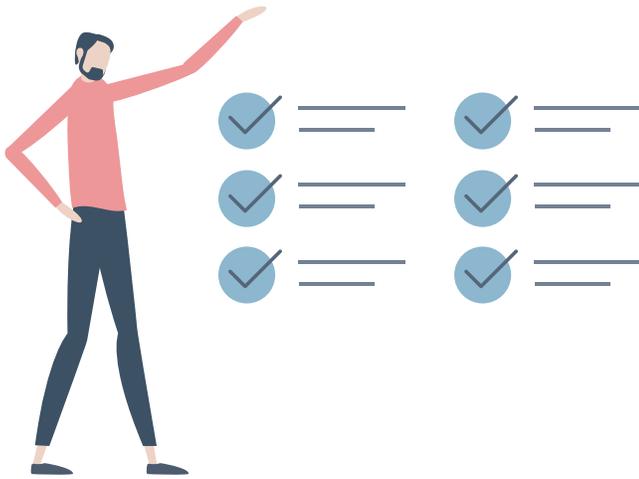
SOMs provide the foundation for constructing measurable goals and determining the extent to which the goals have been met. This information can be used not only to inform clinical decision-making, but also to communicate and justify the value of physiotherapy to payers and other health professionals. SOMs are not intended to replace less formal assessment methods or conversations with patients, but rather to add clarity and confidence to the interpretation of a patient’s response.

Assessing Patient Outcome is a Clinical Skill

Assessing patient outcome is a multi-faceted clinical skill that requires a conceptual framework and specific body of knowledge.² When considering the decisions made by physiotherapists each day, a potential framework could be shaped around the following five questions. The body of knowledge is the context specific answers to these questions.

1. How confident can I be in the location of this patient’s measured value?
2. To what extent can I draw an appropriate inference from this patient’s measured value?
3. To what extent can I draw an appropriate inference from this patient’s change score?
4. What is the target value for this patient?
5. What is the optimal reassessment interval for this specific outcome applied to this specific patient at this point in the patient’s clinical history?

Question 1 draws on the results of reliability studies; Question 2 is informed by validity and interpretability studies; Question 3 is answered by sensitivity to change studies; Question 4 considers information from prognostic studies; and Question 5 is answered by combining information from questions 3 and 4.



Consider following six steps when seeking out a measure that best serves your patients' needs.

Barriers and Barrier Busting Steps

Several studies have identified barriers that impede the successful implementation of SOMs.³⁻⁶ These barriers impact the physiotherapist, the patient-therapist encounter, and clinic operation. Often barriers arise because those selecting measures have not identified the best measures that serve their clinic's unique needs. To mitigate these barriers, consider the following six steps when seeking out a measure that best serves your patients' needs.

1. Start by clearly declaring what you want to assess with the measure.

Example: I want to assess my patients' perceptions of their lower extremity ability to move around. Because clinic space is limited, I'm looking for a patient reported outcome measure.

2. State important patient-related constraints.

Example: Many patients seen in my clinic speak either French or English. Accordingly, I require a measure that is validated in both these languages.

3. State important constraints that apply to your clinical setting.

Example: I wish to use a measure that is free of charge and that most patients can complete unassisted in about 3-minutes. Also, I should be able to score the measure without the use of computational aids in less than 30-seconds.

4. Search effectively and efficiently for a relevant measure.

Example: An excellent starting point is Physiopedia's outcome measure website (physio-pedia.com). This site provides information on existing measures and criteria for appraising measures. Additional resources include CPA's website (Quality Toolkit - Effective option), Stroke Engine (strokengine.ca), and of course there's always the "Red Book" albeit outdated with respect to recent information.

5. Seek out a measure that provides information on the interpretation of score values.

Example: I'm looking for a measure that has answers to the five questions posed previously in the Clinical Skills section.

6. Scrutinize the extent to which the measure's reliability, validity, and sensitivity to change have been assessed and supported in patients like those seen in your practice.

Example: If you work in a specialized practice area (e.g., joint-replace or sports injuries), you are looking for measurement properties specific to that practice area. If your practice sees patients with a variety of conditions, you are looking for a measure validated across a spectrum of conditions such as a region (not condition) or patient specific measure.

With a clear vision of what you want to assess and the constraints imposed in your unique setting, you are more likely to identify and maintain the use of a measure that adds clarity and confidence to your clinical decision-making about a patient's progress and eventual outcome.

What Researchers Can Do Better

If high quality outcome measurement study results are to be transformed into clinical actions that best serve individual patients, the results must be conveyed in a manner that makes clinical application obvious. For example, in a recent survey of clinicians Walton identified the following barrier: "A further issue was that research describes complex statistical analyses in a way that non-academics can rarely interpret."⁷ How then can the rigour of research reporting be preserved, but also translated into clinically relevant information? One approach would be to complement the requisite statistical findings reported in the Results section of a manuscript with a clinical vignette imbedded in the Discussion or an appendix. The following is a brief example of a vignette that has transformed reliability, sensitivity to change, and prognosis coefficients into a simple clinical scenario.

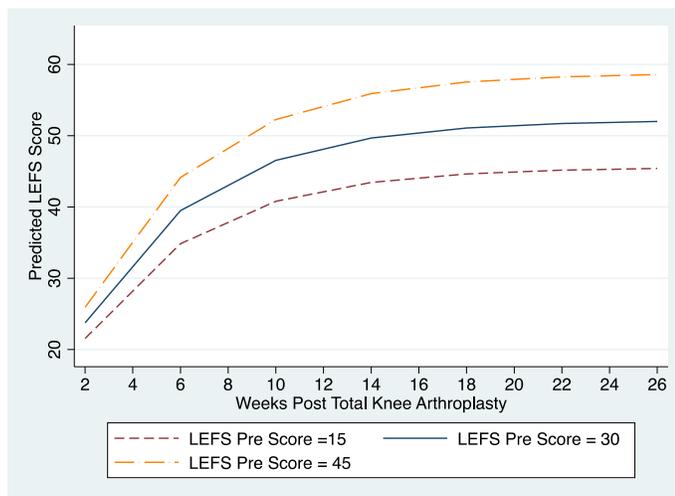
The development, evaluation, and use of standardized outcome measures have come a long way

A Clinical Vignette

In this illustration the measure of interest is the Lower Extremity Functional Scale (LEFS).⁸ This measure has 20-items, each scored 0-4, which are summed to yield a total score of 80. Higher scores represent greater lower extremity functional status.

You are seeing a woman 2-weeks post total knee replacement and her LEFS score is 23. Her pre-operative LEFS score was 33. A brief literature search reveals that a true and important improvement is 9-LEFS points, and the expected rate of improvement for the typical female patient is shown in the figure.⁹ You see that the solid line best represents this patient's pre LEFS score of 33. Applying this information, you form the following short- and long-term measurable goals respectively: (1) To increase this patient's LEFS score by 9 or more points in 3-weeks. (2) To achieve a LEFS score of 50 or more in 12-weeks. You reassess her in 3-weeks (i.e., at week 5) and find that her LEFS score is now 37. You report in the medical record that she has improved an important amount and that she is "on target".

Growth trajectories for women post total knee arthroplasty



Clinicians and Researchers Can Work Together

A second topic identified in Walton's survey was that clinicians believed research is not congruent with clinicians' priorities.⁷ In the early 1990's Jill Binkley conceived and championed the North American Orthopaedic Rehabilitation Research Network (NAORRN).⁸ This volunteer group consisted of approximately 30 likeminded clinicians and researchers from 4 provinces and 7 states. The group's initial goal was to develop and assess clinically relevant outcome measures. Partnership with this group led not only to the development and evaluation of measures such as the Lower Extremity Functional Scale, Upper Extremity Functional Index, Patient Specific Functional Scale and P4, but also to valuable real-time insights from clinicians. These insights resulted in the developers making "on-the-fly" modifications to measure development, scoring, and communication which were informed by clinician feedback. For example, the clinical vignette was born out of the need to better communicate the results from our "impulse" reporting of coefficients. Clinician feedback guided the end products and ensured that the context of clinical reality was inserted into the structure and complexity of measures.

In Summary

The development, evaluation, and use of standardized outcome measures have come a long way since the publication of "Towards the Assessment of Quality of Care in Physiotherapy" over four decades ago. However, barriers to their use persist. Perhaps collegial interactions like those of the NAORRN can provide a direction for stemming barriers and supporting actions that best serve our patients as we move into the second century of physiotherapy practice in Canada. 🇨🇦

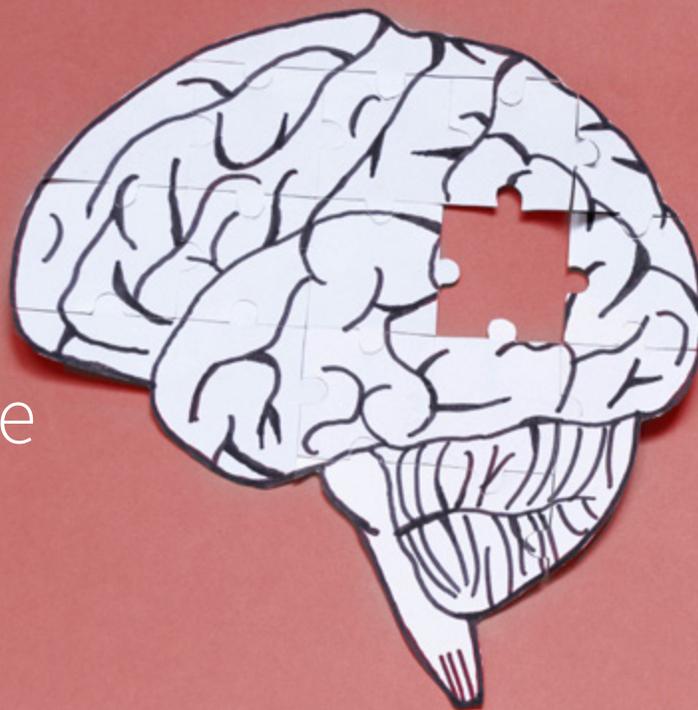


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Canadian Physiotherapists Develop and Advance Clinical Outcome Measures for Adult Neurological Rehabilitation



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Neurological clinical practice has changed dramatically with advancements in medicine and the growth of specialized acute and rehabilitation hospital units. Neurological physiotherapy inpatient and outpatient services are increasingly becoming highly specialized and are provided by clinicians with advanced training in focused areas of care.

- Clinicians have been enhancing their knowledge through continuing education about movement, posture, mobility, and function to deliver high-quality physiotherapy.
- Academics have developed theoretical frameworks such as the Movement Continuum⁽¹⁾ to educate their students, clinicians, and other health professionals.
- University Physiotherapy Programs have moved to Master's Entry to Practice and increased their collaborations with the clinical community to inform and integrate science into clinical practices.
- Physiotherapy scientists, along with graduate students and postdoctoral fellows, have worked collaboratively with other scientists in neuro-rehabilitation and biomedical laboratories across the country and abroad, to develop new neuro-restorative therapeutic approaches customized for many neurological conditions.

With the exponential growth of evidence-based practice and the acknowledgement of the existence of neuroplasticity, there has been a major increase in the development of neurotherapeutic approaches over the past three decades. Currently, the practice of neurological physiotherapy combines the neurosciences, biotechnologies, and neuro-therapeutics along with clinical outcomes to advance both the understanding and delivery of neuro-rehabilitation.

There is a long history of initiatives led by Canadian physiotherapists to set standards for improving quality of care to improve patient care.⁽²⁾ (See Stratford P. this edition of Physiotherapy Practice for details, P. 5)

Physiotherapy was one of the first disciplines to recognize the need to develop clinical outcome measures that would assist in documenting therapy effectiveness. Many neurological clinical outcome measures are included in the 2002 edition of the *Physical Rehabilitation Outcome Measures: A Guide to Enhanced Clinical Decision Making*.⁽³⁾ Authored by physiotherapy leaders Elspeth Finch, Dina Brooks, Paul Stratford, and Nancy Mayo, the book was produced to guide clinicians, students, academics, and research scientists about the constructs of the measures based on the International Classification of Functioning, Disability and Health, proposed by the World Health Organization. As well, it includes the properties, applicability, and selection of specific outcome measures essential to conduct clinical research designed to advance evidenced-based rehabilitation practice for selected patient populations.

In this article, we are highlighting six clinical outcome measures originally developed by Canadian physiotherapists for assessing adult neurological conditions. These six measures are used in clinical practice settings to evaluate patient outcomes and in research studies to evaluate existing and new therapeutic approaches, all with the goal of evolving clinical practice and enhancing patient care.

Chedoke McMaster Stroke Assessment (CMSA) ⁽³⁾ The CMSA (<https://cnfs.ca/stroke>) is a performance-based measure that is used internationally. It was developed at the Chedoke Rehabilitation Hospital, in collaboration with McMaster University in the 1970's, by a group of physiotherapists under the leadership of Carolyn (Kelley) Gowland.⁽⁴⁾ The measure was developed for rehabilitation clinicians to guide clinical decision-making using predictive equations and to evaluate change in both clinical and research contexts.

The CMSA has two parts: the Impairment Inventory (CMSA-II), which quantifies motor recovery of the arm, hand, leg, foot, and postural control dimensions, and the Activity Inventory (CMSA-AI), which evaluates change in functional mobility (i.e., gross motor function and walking). The CMSA-AI is now validated for assessing patients with acute brain injury, multiple sclerosis, and for inpatient geriatric care. A telephone version of the CMSA-AI enables remote assessment of functional mobility.⁽⁵⁾ The CMSA-II is recognized as a measure of motor function within the Heart and Stroke Foundation's Canadian Stroke Best Practice Recommendations. The CMSA-II can be used to identify study participants for clinical rehabilitation trials⁽⁶⁾ and recent studies demonstrate the possibilities of using CMSA-II scores, paired with neuroimaging, as a biomarker to predict functional recovery of the hand.⁽⁷⁾ Developers of the CMSA subsequently developed the **Chedoke Arm and Hand Activity Inventory (CAHAI)** (<https://www.cahai.ca/>) to evaluate change in upper extremity function through the performance of bi-manual tasks that were meaningful to clients with stroke. The CAHAI has strong clinical utility and is available in a number of versions.^(8,9) A change of 6 points on the 13-item CAHAI indicates a true change has occurred.^(9,10)

Both inventories of the CMSA provide PTs with a common language to describe patient status and monitor impact of treatment by estimating the threshold value for change, giving them the confidence in labelling a person as having improved or not. A change of 1 impairment stage indicates a true change in five of the six dimensions of the CMSA-AI⁽¹⁰⁾, and a change of 8 points indicates a meaningful change in the CMSA-AI.⁽¹¹⁾



Berg Balance Scale (BBS) The Berg Balance Scale ⁽³⁾ was developed by Katherine Berg in the late 1980's, a PT with more than 10 years of clinical experience with inpatient neurology and geriatrics, while doing her PhD studies at McGill University with Drs. Sharon Wood-Dauphine, PT and Jack Williams, both measurement methodologists. The purpose of the scale was to monitor functional balance over time and to evaluate a client's response to treatment. Its development and implementation has served as an exemplar for the development of subsequent measures.⁽¹²⁾ Active clinicians (PTs, occupational therapists (OTs) and physicians) from diverse settings were involved in each stage of the content development. Clinicians were asked open-ended questions as to how they evaluated balance in their patients. Their responses were quite consistent in that they evaluated patients by observing their performance during functional activities. Two subsequent stages required different groups of practicing clinicians to rank potential items in terms of relevance. Clinicians were also involved in assessing the reliability of items. Multiple validation strategies were used including comparisons with biomechanical measures at the balance laboratory of Dr. Brian Maki, a biomedical engineer at Sunnybrook Hospital in Toronto.

The BBS has enabled PTs to collect and interpret objective data, and provided a basis for exchange of practice ideas. BBS has been used in clinical trials with stroke for detecting change, spinal cord injury, Parkinson's disease and individuals with vestibular dysfunction, spinal cerebellar ataxia and hereditary peripheral neuropathies. The BBS is arguably one of the best-known outcome measures used in adult neurological physiotherapy practice for balance. It has been translated, culturally adapted, validated, and implemented in other countries. For example, the Brazilian-Portuguese version of the BBS has been determined as a reliable instrument for assessment of elderly Brazilian patients.⁽¹³⁾ The BBS is recommended for use in clinical practice guidelines (e.g. core set of measures for neurological PT- American Physical Therapy Association) and toolkits (see the Standing Walking Assessment Tool section). The BBS is also aligned with electronic records of several large health data systems.

The BBS is used nationally and internationally to evaluate fall risk by many different health professionals in institutional and community settings, and to inform policy decisions such as deciding who is eligible for funding for walking aids and accessible transportation.

Community Balance & Mobility Scale (CB&M) The CB&M addresses the clinical need to identify balance impairments and evaluate change in higher-functioning, ambulatory individuals with residual balance deficits.⁽¹⁴⁾ It was designed to include sufficiently challenging dynamic balance items to capture limitations that may, otherwise, not be identified by balance assessments designed for more severe impairment. For example, patients who score near the maximum of the BBS may still exhibit a wide distribution of scores on the CB&M.⁽¹⁵⁾ The Toronto research team was a clinical-research partnership including methodologists, physiotherapy scientists and clinicians, and kinesiologists. The scale was developed with input from physiotherapists and occupational therapists with extensive neuro-rehabilitation expertise and the inclusion of community-dwelling adults with traumatic brain injury. The items included within the scale reflect functional tasks or task components identified by the therapists and patients as chal-

drive funding decisions and best practices for optimizing mobility for persons following SCI.

Toronto Rehabilitation Institute – Hand Function Test (TRI-HFT) The TRI-HFT is a unilateral upper extremity outcome measurement tool developed by an inter-professional team of physiotherapists, occupational therapists, and biomedical engineers with expertise in SCI rehabilitation.⁽²⁸⁾ The measure is applicable for use in individuals with both sub-acute and chronic SCI, as well as for those with chronic stroke. TRI-HFT measures upper extremity motor capacity by requiring patients to use specific pre-determined grasps to manipulate “real-world” universal objects and by grading their ability to reach, grasp, and manipulate these objects. TRI-HFT is intended to be administered in the clinical setting by physiotherapists and/or occupational therapists who are self-trained in the use of the measure.

TRI-HFT was developed for clinical assessment and to test the applicability, efficacy, and effectiveness of emerging rehabilitation technologies. The new 3D printed version of the TRI-HFT has been tested and shown to be valid, reliable, and responsive for measuring hand function in individuals with stroke⁽²⁹⁾ providing an additional hand assessment measure to consider for the stroke population. The 3D printed version changes the approach to the use of standardized assessments in practice. 3D printing standardizes the dimension of objects. With the 3D design files becoming freely available, in the future, clinicians in different practice settings will be able to manufacture the assessment materials for the TRI-HFT themselves. They will be able to acquire a quantitative standardized assessment without the delay, expense of training typical of other upper extremity outcome measure assessments for SCI.

Having an outcome measure where therapists can self-train in their own clinical setting, be it inpatient or outpatient, profit or not for profit, with access to 3D printing of “real world” standardized assessment materials, provides the clinical environment with an accessible

approach for daily practice with little resource use. Testing outcomes of patient specific emerging therapeutic paradigms for enhancing functional reaching and grasping has the potential to become an acceptable standard practice in the future and the TRI-HF will be the first.

How should we use the Clinical Outcome Measures? With our understanding of movement, mobility, physical activity and function, and knowledge and use of clinical outcome measures, Canadian physiotherapists can have a substantial impact to shape better patient care. It is our business to use outcome data for clinical decision making, to calculate and predict the type, intensity, and duration of therapies required to attain best outcomes, and to determine length of stays or number of physiotherapy sessions required for optimal outcomes. In addition, having our outcome data collected longitudinally can inform the “payers’ of services” what resources are required for best outcomes or for appropriate discharge destinations. It is our social responsibility to do something productive with our data and inform the Canadian health care system how to deliver best practices. With the fast-paced introduction of electronic “big data” systems, the inclusion of artificial intelligence for data mining, growth of medical genetics, explosion of emerging biomedical technologies, and delivery of precision medicine all informing health systems, physiotherapists must “get in the game”. We have outcome data! We must learn how to use it to advance our practice.

Modernizing and scaling up how we, collectively collect, house, and more importantly, utilize the data generated from our clinical outcome measures in concert with our provincial and federal health care systems is paramount for our future. As Clinicians, Academics, University Programs and Physiotherapy Scientists, we must empower ourselves to take up a united challenge to ensure that we are advancing strategically. Moving forward with our strategic research plan is a good place to start! 📊

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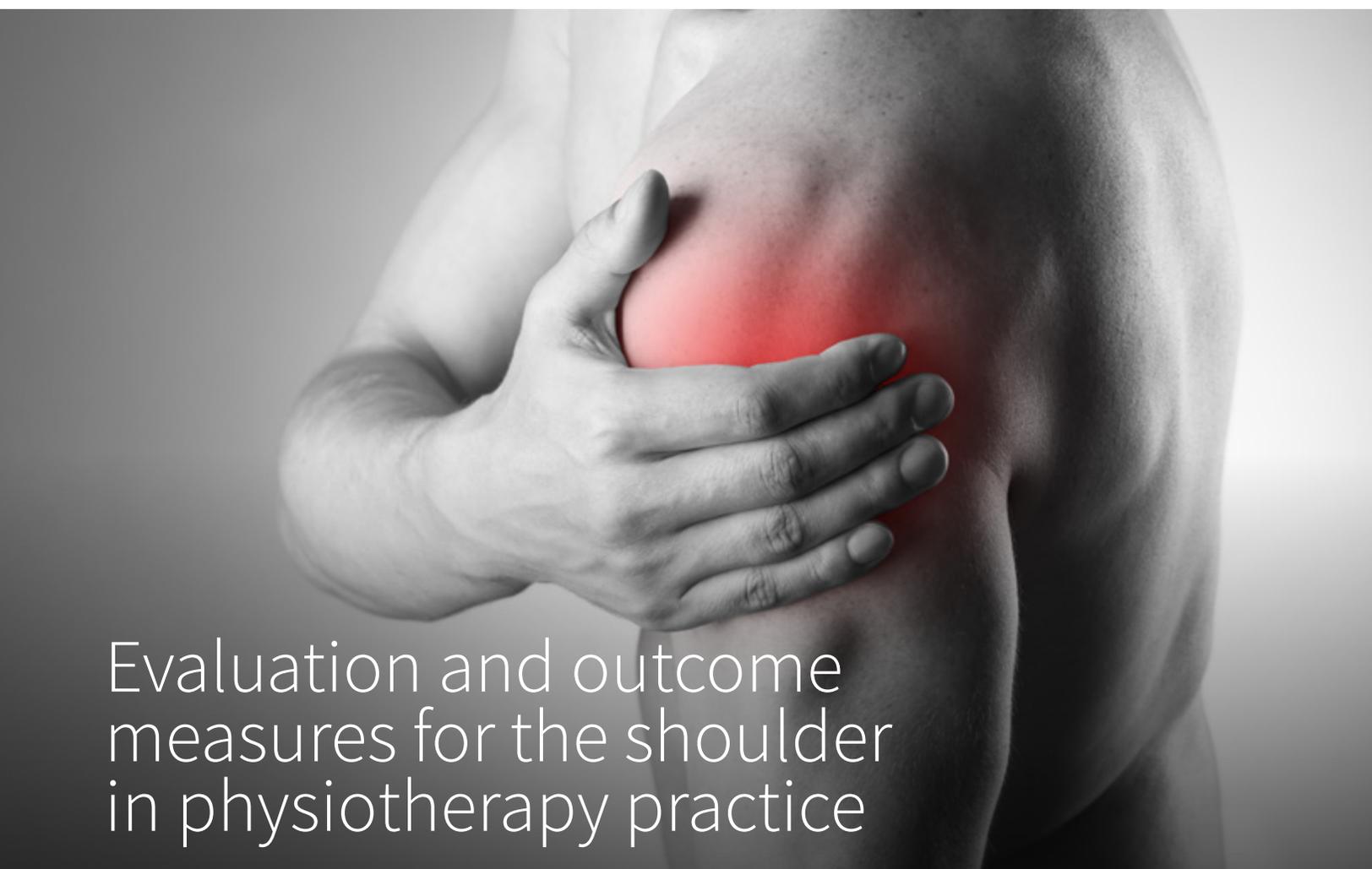
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Evaluation and outcome measures for the shoulder in physiotherapy practice

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Shoulder pain is a common and disabling condition that affects up to 67 per cent of adults during their lifetime.¹ The most frequently encountered pathoanatomic diagnoses of shoulder pain are rotator cuff-related shoulder pain, which includes rotator cuff (RC) tendinopathy and full-thickness RC tear,² adhesive capsulitis, acromioclavicular joint (ACJ) disorders, glenohumeral osteoarthritis, and glenohumeral instability.^{3,4} The differential diagnosis of shoulder pain is complex and requires a complete assessment process including the history of the patient, a subjective examination, and a physical examination.

Various outcome measures (OMs) such as objective measures, patient-reported outcome measures (PROMs), clinician-based OMs, and performance-based tests are also used to diagnose and evaluate patients suffering from shoulder pain.⁵ These OMs are commonly used afterwards to measure changes related to treatment, disease progression, or natural recovery.⁵ The appropriate OMs need to be selected based on the patient's clinical profile. Clinicians must, therefore, determine a diagnosis and evaluate body structures impairments, function, and disability before selecting OMs.⁶

The objective of this article is to describe the evaluation process and the combination of physical tests that can be used to make a diagnosis in people with shoulder pain, and to describe the recommended OMs according to the diagnosis and patients' condition.

Evaluation

The complete assessment of an individual suffering from shoulder pain starts with a thorough medical history, which allows the physiotherapist to identify potential red or yellow flags. Red flags include symptoms such as persistent pain at night, fatigue, unexplained weight loss, fever, night sweats, shortness of breath, or chest pain which may radiate to the shoulder region.⁷ These symptoms might indicate more serious illnesses such as hepatobiliary diseases, pneumonia, lung tumour, metastases, or myocardial ischemia.⁴ Yellow flags may include psycho-social symptoms or work-related factors that might increase the risk to develop chronic pain and should be identified as early as possible.⁸

Table 1: Interpretation of positive and negative likelihood ratios¹⁹

LR+	LR-	Interpretation of the effect
>10	<0.1	Large and conclusive change in probability for confirming or infirming the diagnosis
5.0-10.0	0.1-0.2	Moderate change in probability for confirming or infirming the diagnosis
2.0-5.0	0.2-0.5	Small but sometimes important change in probability for confirming or infirming the diagnosis
1.0-2.0	>0.5	Negligible change in probability for confirming or infirming the diagnosis
LR+: Positive likelihood ratio LR-: Negative likelihood ratio		

Then, the history of the current shoulder pain episode and the subjective examination should provide information to determine the characteristics, including most likely drivers or sub-categories, of the patient’s pain.^{7,9} The physiotherapist should question the patient on the mechanism of onset of symptoms, the evolution of pain, and the presence of other complaints.^{4,7} The subjective examination should collect information on the localization, intensity, type, and duration of shoulder pain, as well as factors that increase or decrease pain.^{4,7} This information will help the clinician to plan the physical examination required to establish a valid diagnosis.¹⁰

Physical examination of the patient commonly includes observation, palpation, evaluation of range of motion (ROM), scapular movement, as well as muscle strength and endurance.^{7,9} Specific physical tests are also used to identify the pathoanatomic cause of shoulder pain.^{3,11} However, the diagnostic value of using specific physical tests to identify the pathoanatomic cause of pain is questioned.² The complex anatomy of the shoulder region and the interrelation between muscles, tendons, ligaments, and capsular structures tend to invalidate the hypothesis that a test can be entirely specific to one structure.^{2,12} Moreover, studies aiming at evaluating the validity of diagnostic physical tests often suffer from methodological bias and the intra- and inter-rater reliability of the tests are quite variable.^{11,13,14} Despite some weaknesses of specific physical tests, diagnostic clusters including patient’s characteristics and results of specific tests have been found to have relatively good diagnostic values and may guide the clinician in making a valid diagnosis.¹³ For the diagnosis of non-traumatic rotator cuff tendinopathy, a painful arc¹⁵ with positive Hawkins-Kennedy¹⁶ and infraspinatus tests¹⁷ have a positive likelihood ratio (LR+) of 10.56 and when not identified provide a negative likelihood ratio (LR-) of 0.17.^{13,18} A higher LR+ represents a higher probability that the pathology is present and, therefore, helps to confirm a diagnosis. A LR- that is closer to zero represents a higher probability that the pathology is absent and helps to reject a diagnosis (Table 1).¹⁹

To diagnose a full-thickness rotator cuff tear, results from high methodological quality studies¹³ suggest that combining a

positive painful arc¹⁵, drop arm test²⁰ and infraspinatus test¹⁷ in a patient older than 60 will yield a LR+ of 28.0 and a LR- of 0.09.¹⁸ Combining weakness in external rotation and night pain for a patient older than 65 may also help to diagnose a full-thickness rotator cuff tear with a LR+ of 9.84, but does not confidently rule out the pathology with a LR- of only 0.54.²¹ Similarly, the combination of a positive empty can test (Jobe test)²², a full can test,²³ and an external rotation lag sign test²⁴ can confirm the presence of a supraspinatus full-thickness cuff tear with a LR+ of 15.09, but the combination of these three tests being negative only yield a LR- of 0.82.²⁵ To confirm the presence of a subscapularis full-thickness tear, the combination of a positive lift-off test (Gerbers test)²⁶ and a positive belly press test²⁷ has a LR+ of 8.48.²⁸

For traumatic anterior glenohumeral instability, the combination of a positive apprehension²⁹ and a relocation test³⁰ (LR+ of 39.68) can be used to confirm this diagnosis.³¹ The combination of these tests being negative can also be used to reject the diagnosis (LR- of 0.19).³¹

ACJ disorders can be either traumatic or degenerative. In patients with isolated chronic acromioclavicular lesion, combining positive cross body adduction (Scarf test)³², acromioclavicular resisted extension,³³ and active compression (O’Briens test)³⁴ tests yield a LR+ of 8.33 and a LR- of 0.77, which indicates that the diagnostic cluster is adequate to rule in the pathology. However, the combination of these negative tests does confidently rule out an ACJ disorder.³⁵

To our knowledge, no diagnostic clusters have been developed or validated for adhesive capsulitis. Still, adhesive capsulitis diagnosis is possible based on the patient’s history and clinical examination. Patients aged between 40 and 65 years old, presenting a progressive onset of pain and stiffness that limits sleep and activities of daily living and presenting limited glenohumeral passive range of motion in multiple direction are likely to be diagnosed with adhesive capsulitis.³⁶ Adhesive capsulitis can be ruled out if there is radiographic evidence of glenohumeral osteoarthritis, one of the most common differential diagnosis to consider with adhesive capsulitis.³⁶

Table 2: Psychometric properties of diagnostic clusters for common shoulder pathologies

Pathology	Tests	LR +	LR -
Rotator cuff tendinopathy	Painful arc ⁺¹⁵ Hawkins-Kennedy ⁺¹⁶ Infraspinatus test ⁺¹⁷	10.56	0.17
Full-thickness rotator cuff tear	Age > 60 years old Painful arc ⁺¹⁵ Drop arm test ⁺²⁰ Infraspinatus test ⁺²⁰	28.0	0.09
Full-thickness rotator cuff tear	Age > 65 years old Night pain + Weakness in external rotation +	9.84	0.54
Full-thickness supraspinatus tear	Empty can test (Jobe test) ⁺²² Full can test ⁺²³ External rotation lag sign test ⁺²⁴	15.09	0.82
Full-thickness subscapularis tear	Lift off test (Gerbers test) ⁺²⁶ Belly press test ⁺²⁷	8.48	-
Traumatic anterior instability	Apprehension test ⁺²⁹ Relocalisation test ⁺³⁰	39.68	0.19
Chronic acromioclavicular disorder	Cross body adduction test (Scarf test) ⁺³² Acromioclavicular resisted extension test ⁺³³ Active compression test (O'Briens test) ⁺³⁴	8.33	0.77
LR+: Positive likelihood ratio LR-: Negative likelihood ratio			

In addition to the specific physical tests to determine the diagnosis, the physiotherapist will also evaluate some OMs during the physical examination to characterize the current status, and to be able to monitor the evolution of the condition over time. These OMs will, therefore, guide clinical decision making. To achieve this, clinicians must use valid, reliable, and sensitive tools. Below, we summarize some of the common OMs for use in shoulder pain conditions.

Shoulder Impairment Outcomes

Joint Mobility

A high level of shoulder mobility is required to perform activities of daily living, work tasks and specific sport gestures. The measurement of shoulder mobility is, therefore, a critical component of the physical examination. Movements such as shoulder flexion, extension, abduction, external rotation, and internal rotation, as well as cross-body adduction and hand behind the back are usually part of this evaluation. Passive and active mobility can be assessed in different positions (lying, standing, sitting) with a specific attention given on possible compensations (usually from the trunk and shoulder girdle). During the evaluation of passive mobility, clinicians should look for the reproduction of pain, as well as end feel sensation. During the evaluation of active mobility, they should look for the reproduction of pain and how the movement is controlled. Goniometers and inclinometers are both valid and reliable tools to measure shoulder range of motion (Table 3).^{37,38}

Strength and Endurance

Due to its great mobility, the shoulder is inherently an unstable joint. Scapulohumeral and scapulothoracic muscle strength and endurance are therefore very important for shoulder stability and their assessment should be part of the physical evaluation. The

main muscles to consider when evaluating strength include humeral flexors, extensors, abductors, external rotators, and internal rotators, as well as scapular depressors, elevators, protractors, and retractors. Strength evaluation can be conducted using manual muscle testing, handheld dynamometers or isokinetic dynamometers. Manual muscle testing has been shown to lack precision compared to the other two methods (Table 3).³⁹ In some cases (e.g. manual workers, athletes), it can be relevant to evaluate trunk and lower limb muscle strength as they contribute to more than 50 per cent of strength during more complex kinetic chain movements.⁴⁰ Endurance of the scapulohumeral and scapulothoracic muscles can be estimated through validated functional tests (Table 3), such as the Simple Shoulder Endurance Test (SSET)⁴¹ and Functional Impairment Test - Head, Neck/Shoulder/Arm (Fit-HaNSA)⁴², since literature on endurance tests is still limited.

Scapular Position and Control

The scapula is an integral part of shoulder function as it contributes to nearly 35 per cent of shoulder mobility and gives a stable base on which the rotator cuff and other scapulohumeral muscles can act on.⁴⁰ Scapular position and control are, therefore, fundamental for normal shoulder function.

Scapular position can be assessed with linear and angular measures (Table 3). Linear measures refer to the position of the scapula relative to the spine while angular measures most commonly refer to scapular position and movement in upward rotation or tilting. Examples of linear measures include the Lateral Scapular Slide Test (LSST), which measures the distance between the scapula and the spine during protraction or depression.⁴³ Angular measures are usually obtained with an inclinometer placed on the scapular spine or using mathematic formulas based on distance between bony landmarks.⁴³

A thorough patient's history and subjective examination, as well as the use of appropriate diagnostic clusters to complement physical examination, should be part of the shoulder assessment to identify a diagnosis and impairments in body structures, function, and disability.

Different tests have been suggested to qualitatively evaluate scapular control. Kibler et al. suggested to characterize abnormal patterns during arm elevation by qualitatively assessing for prominence of the inferomedial angle, medial border, or superior scapular border.^{44,45} Others also put forth the Scapular Dyskinesis Test where patients perform arm elevation with a dumbbell in their hand while the clinician qualitatively rates the quality of movement (normal, slightly abnormal, abnormal).^{46,47}

It has been hypothesized that some scapular measures could be used to discriminate between those injured and those who are not. However, literature has shown that they should only be used to characterize scapular position and control, and monitor changes over time as there is no clear correlations between scapular dyskinesis and shoulder pathology.^{48,49} These tests have also been shown to present low to moderate levels of reliability (Table 3).

Patient-Reported Outcome Measures (PROMs)

PROMs, commonly referred to as self-administered questionnaires, are currently the OMs that are the most sensitive to change for shoulder pain and are, therefore, recommended tools to objectify change over time.⁵⁰ Several questionnaires have been developed for shoulder pain and there is currently no gold-standard as most of the proposed questionnaires have been shown to be valid, reliable, and sensitive (Table 3). The questionnaire should, therefore, be chosen based on the constructs that the physiotherapist wishes to evaluate and the availability of clinically relevant indices such as minimal detectable change (MDC) and minimal clinically important difference (MCID).⁵¹

First, there are upper-limb and shoulder-specific questionnaires, aimed at measuring symptoms and functional limitations, including: the American Shoulder and Elbow Surgeons Standardized Assessment (ASES)⁵², the Disabilities of the Arm, Shoulder and Hand questionnaire (DASH)⁵³ or its shorter version the QuickDASH⁵⁴, the Shoulder Pain and Disability Index (SPADI)⁵³, the Oxford Shoulder Score (OSS)⁵⁵, and the Simple Shoulder Test (SST)⁵³.

There are also condition-specific questionnaires aimed at measuring the impact of a specific condition. Here are some examples: the Western Ontario Rotator Cuff Index (WORC)⁵⁵ and the Rotator Cuff Quality of Life (RC-QoL)⁵⁶ which are specific for rotator cuff-related shoulder pain, and the Melbourne Instability Shoulder Scale (MISS)⁵⁷, and the Western Ontario Shoulder Instability Index (WOSI)⁵⁷ which are specific for instability.

Pain represents another important construct to measure with patients presenting with shoulder disorders. PROMs such as the Numerical Pain Rating Scale (NPRS)⁵⁸, the Visual Analog Scale (VAS)⁵⁹, and the Brief Pain Inventory (BPI)⁶⁰ represent valid tools with low administration burden to use with patients.

Literature also demonstrates the importance of considering yellow flags or psychosocial factors as barriers or facilitators in

the rehabilitation of shoulder disorders.^{61,62} Hence, more cognitive or belief-oriented OMs may provide useful information about the full breadth of the patient's pain experience. Common questionnaires (Table 3) in this area include: the Patient Health Questionnaire (PHQ)⁶³, the Hospital Anxiety and Depression Scale (HADS)⁶⁴, the Fear-Avoidance Beliefs Questionnaire (FABQ)⁶⁵, the Tampa Scale of Kinesiophobia (TSK-11 or 17)⁶⁵, the Pain Self Efficacy Questionnaire (PSEQ)⁶⁶, and the Pain Catastrophizing Scale (PCS)⁶⁷.

Conclusion

A thorough patient's history and subjective examination, as well as the use of appropriate diagnostic clusters to complement physical examination, should be part of the shoulder assessment to identify a diagnosis and impairments in body structures, function, and disability. Clinicians must also ensure that they include adequately valid, reliable, and sensitive outcome measures in their practice in order to assess their patients' condition and measure the change over time to guide clinical decision making. 📌



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Table 3: Psychometric properties of relevant outcome measures^a

Outcome measure	Psychometric properties
Joint mobility	
Goniometer ³⁷	Intrarater reliability: ICC = 0.94-0.95 Inter-rater reliability: ICC = 0.67-0.95 MDC: 8-23° MCID: 3-12°
Inclinometer ³⁷	Intrarater reliability: ICC = 0.95-0.98 Inter-rater reliability: ICC = 0.58-0.95 MDC = 4-9° MCID: 3-12°
Strength	
Handheld dynamometer ³⁸	Intrarater reliability: ICC = 0.85-0.96 Inter-rater reliability: ICC = 0.82-0.92 MDC = 29-40 N
Isokinetic dynamometer ³⁸	Relative reliability: ICC = 0.69-0.92 MDC = 21-57
Manual muscle testing ³⁹	Intrarater reliability: ICC = 0.79-0.99 Inter-rater reliability: ICC = 0.55-0.72
Functionnal tests	
Simple Shoulder Endurance Test (SSET) ⁴¹	Test-retest reliability: r = 0.59-0.60
Functional Impairment Test - Head, Neck/Shoulder/Arm (Fit-HaNSA) ⁴²	Test-retest reliability: ICC = 0.98
Scapular position and control	
Lateral Scapular Slide Test (LSST) ⁴³	Intrarater reliability: ICC = 0.87-0.96 Inter-rater reliability: ICC = 0.63-0.86
Angular measures of scapular position (inclinometer) ⁴³	Intrarater reliability: ICC = 0.61-0.95 Inter-rater reliability: ICC = 0.50-0.92
Kibler Method to assess scapular movement ^{44,45}	Inter-rater agreement: 61%; kappa = 0.44
Scapular Dyskinesis Test (SDT) ^{46,47}	Inter-rater agreement: Kappa = 0.48-0.61
Upper-limb and shoulder-specific questionnaires	
American Shoulder and Elbow Surgeons Standardized Assessment (ASES) ⁵²	ICC = 0.84-0.93 MDC ₉₀ = 10.5 MCID = 15.5
Disabilities of the Arm, Shoulder and Hand questionnaire (DASH) ⁵³	ICC = 0.88 MDC ₉₀ = 10.7 MCID = 10.2
Abbreviated version of the DASH (QuickDASH) ⁵⁴	ICC = 0.91-0.94 MDC ₉₀ = 14.0; MDC ₉₅ = 17.1 MCID = 8.0-12.4
Shoulder Pain and Disability Index (SPADI) ⁵³	ICC = 0.91 MDC ₉₀ = 18.2 MCID = 14-21

Oxford Shoulder Score (OSS) ⁵⁵	ICC = 0.80 MCID =6 (13%)
Simple Shoulder Test (SST) ⁵³	ICC = 0.89-0.98 MDC ₉₅ = 32.3 MCID = 2.4-9.7
Condition-specific questionnaires	
Western Ontario Rotator Cuff Index (WORC) ⁵⁵	ICC = 0.91 MDC ₉₀ = 16.7 MCID =12.8%
Rotator Cuff Quality of Life (RC-QoL) ⁵⁶	ICC = 0.91 MDC = 3 MCID = 7-14
Melbourne Instability Shoulder Scale (MISS) ⁵⁷	ICC = 0.98 MDC = 5.5
Western Ontario Shoulder Instability Index (WOSI) ⁵⁷	ICC = 0.87-0.98 MDC = 16.1% MCID =10
Pain	
Numerical Pain Rating Scale (NPRS) ⁵⁸	ICC = 0.92 MDC = 2 MCID = 1
Visual Analog Scale (VAS) ⁵⁹	ICC = 0.89 MCID = 1.37/10
Brief Pain Inventory (BPI) ⁶⁰	ICC = 0.95 MDC = 2 MCID = 2.2
Psychological constructs	
Patient Health Questionnaire (PHQ) ⁶³	ICC = 0.84-0.94
Hospital Anxiety and Depression Scale (HADS) ⁶⁴	ICC = 0.84-0.85
Fear-Avoidance Beliefs Questionnaire (FABQ) ⁶⁵	ICC = 0.88 MDC = 30-33%
Tampa Scale of Kinesiophobia (TSK-11 or 17) ⁶⁵	ICC = 0.82
Pain Self Efficacy Questionnaire (PSEQ)	ICC = 0.86 MDC ₉₅ = 11.52
Pain Catastrophizing Scale (PCS) ⁶⁷	ICC = 0.83-0.93 MDC = 8
ICC: Intraclass correlation coefficient MDC: Minimal detectable change (with 90 and/or 95% confidence interval) MCID: Minimal clinically important difference Green represents good to excellent levels of reliability (ICC > 0.80) Orange represents low to moderate levels of reliability (0.60 < ICC < 0.79)	

a: These values are taken from the literature but are not derived from a structured critical or systematic review.

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A MAP for navigating the paradox of pain

Timothy Wideman and David Walton

Ludwig Wittgenstein was a 20th century philosopher who developed a clever thought experiment on the enigmatic nature of pain. The experiment goes like this: imagine that you and everyone you know has a special box. What makes this box special is that you can open it whenever you'd like and survey its contents. However, the one catch is that you can never look inside someone else's box and they cannot look in yours. Now, imagine that you and everyone you know called the contents of this special box a beetle. How would you ever know whether your beetle even remotely resembles someone else's? If we replace the word beetle with pain, we're left with the same conundrum. We all use the word pain and relate this word to our own intimate, personal experiences of pain and, yet, we have no way of knowing how these personal experiences of pain may or may not relate to the pain experiences of others. For us clinicians, this creates a challenging paradox—we have no way of directly observing or measuring the pain that our patients report and, yet, we are dependent on such observations and measures to effectively manage their pain and justify our treatments. What are we to do?

Working with a team of researchers and clinicians, we created the Multi-modal Assessment of Pain model (MAP) to help navigate these challenges (Wideman et al, 2019). MAP aims to help us more clearly consider pain from our “outsider” clinical perspective. It tries to illustrate how this is a fundamentally different perspective from that of our patients who are actually experiencing the pain. In effect, MAP tries to help us think about pain as the beetle in Wittgenstein's box and then offers some pragmatic strategies on how we might cope with these inherent limitations.

First and foremost, MAP invites clinicians to exercise humility when confronted by a patient reporting pain. MAP aims to reinforce that we can never generate or acquire direct evidence to validate or invalidate a patient's reported pain. This leaves clinicians with a fundamental choice—to believe or not to believe our patients. And the only logical approach here is to be consistent across all patients—either we should take all patients at their word or none of them, as there is no reliable evidence that could be used to meaningfully distinguish between the two options for any given patient. MAP invites us to honour all patients' reports of pain as legitimate and true. The rationale for this position is that it is aligned with our core principles of medical ethics, which aim to empower patient autonomy, and it

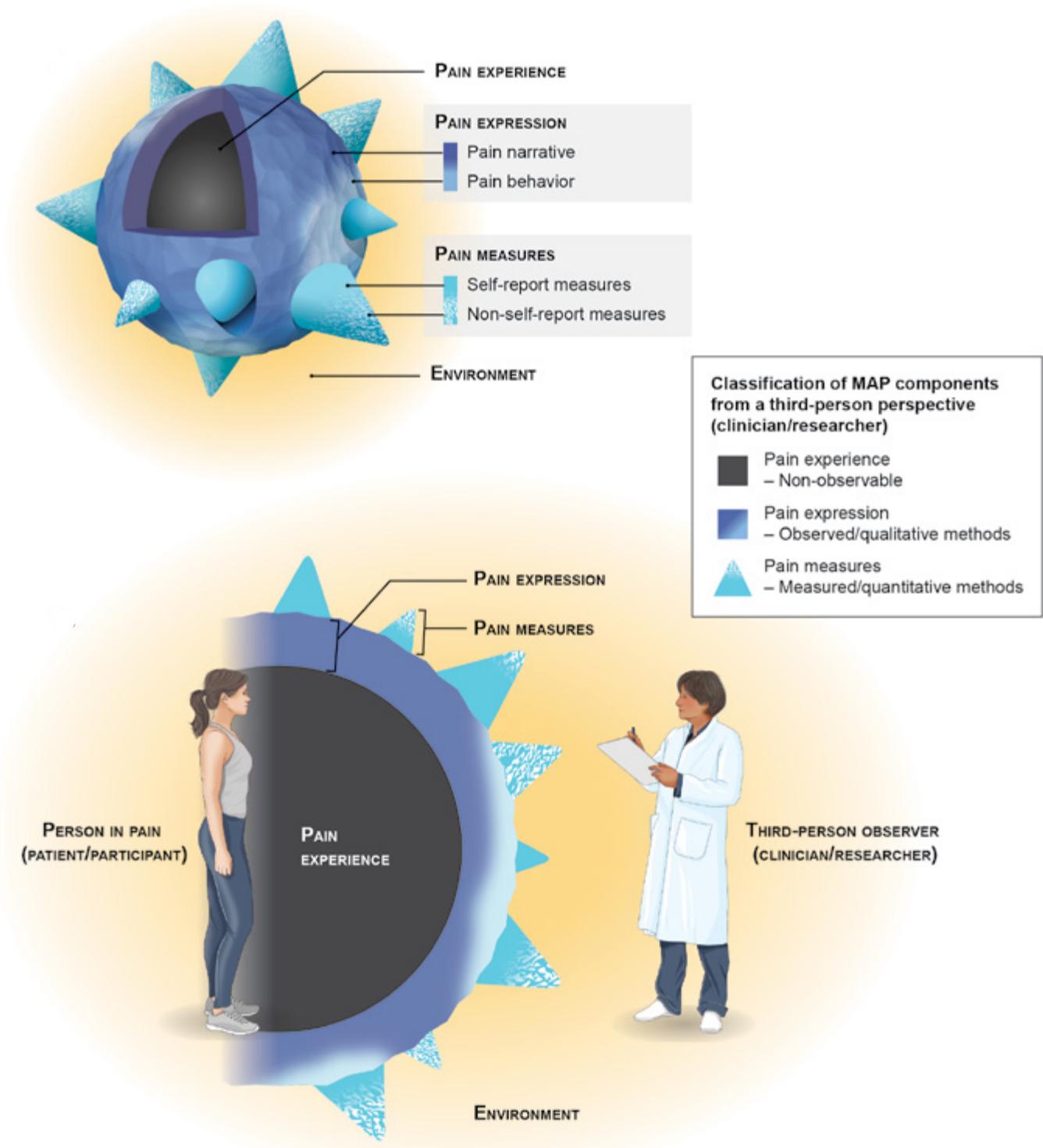
recognizes that we could never generate definitive evidence to invalidate a patient's report about their own personal experience. In effect, MAP subscribes to the old adage that pain is what the person says it is and occurs when he or she says it does (McCaffery, 1968).

By validating all reports of pain as legitimate, MAP aims to offer some basic first principles for approaching clinical care. However, this doesn't really provide us with clear direction for how to actually manage pain. To treat pain, we need to develop a comprehensive understanding of what might be causing our patient to report pain. To answer this question, MAP emphasizes the importance and value of using a multi-modal approach to assessment. In the context of pain assessment, multi-modal means strategically gathering and using both qualitative and quantitative information about our patient.

Quantitative information (or clinical data) is generated by using standardized measures within our pain assessment. These might include, for instance, a 0 to 10 numeric rating of pain, a questionnaire about painful activities, or a clinical measure of pain sensitivity. The common feature of these quantitative forms of assessment is that we are left with a number to represent some aspect of the pain experience. On the other hand, qualitative pain assessment focuses on encouraging the patient to use their own words to provide a narrative description of their pain and how it has affected their life. MAP assigns unique value to each form of assessment. Quantitative assessments help us diagnose pain conditions, delineate some of the underlying mechanisms, and benchmark treatment responses. On the other hand, qualitative forms of assessment typically involve using open-ended questions and listening strategies that help empower patients to use their own words to tell us what might be most important to them. This form of assessment helps us get at the personal meaning and context that are essential for understanding how a particular patient might be experiencing pain.

A key tenet of the MAP model is that the patient's words about their pain (i.e. their qualitative pain narrative) need to be prioritized over the numbers used to quantify their pain (i.e. the quantitative pain measures). This tenet can be understood as an extension of McCaffery's *pain is what the person says it is* adage, as it wouldn't quite make sense to hold the pain measures that we collect as potential evidence to challenge a patient's narrative report of pain.

Figure 1: The Multi-Modal Assessment Model of Pain
 (Source: Wideman et al, *The Clinical Journal of Pain*, 2019; 35(3): 212-221. DOI: 10.1097/AJP.0000000000000670")



Another important reason for this prioritization is that the patient's narrative descriptions of pain have so much more potential for richness when compared to quantitative measures of pain. We're assuming that most of our readers are not living with chronic pain. So, to help us appreciate the richness of personal narrative, let's try another thought experiment; this time, let's take a moment for a brief meditation on love.

Think of a time when you experienced love. Think about how this experience made you feel. How did it affect your thoughts? How did it affect your day-to-day activities? How did it affect your relationship with others? How did it affect your outlook on the future? As you conjure the sense of this love experience and all its permutations, rate its intensity on a 0 (no love) to 10 (most love you could imagine) scale. What number best captures your experience of love? Now, with this number in mind, imagine that you've just survived a global pandemic. You've been living off the grid, disconnected from your friends and family. Yet, incredibly, you met someone just before lockdown and have since fallen head over heels in love. You're overjoyed and are so excited to start reconnecting with your community. You finally sit down with one of your oldest friends to chat over coffee and quickly blurt out that you've fallen in love. Just as you're gearing up to provide all the details, your oldest friend holds up their hand and says "Hold on, what's your number? How do you rate this love experience of yours?" Now imagine after hearing only your numeric rating, your friend stands up and walks away. With just this number in mind, how well do you think your friend would understand your experience of love? What if they asked for four additional numbers that corresponded to each of the initial questions you were asked (thoughts, activities, relationships, outlook)—would this be enough data to feel confident that they understood what you were living? And what would be your reaction if your friend said they don't believe your number because you aren't acting the way they would act if *they were that* in love. For many people living with persistent pain, this starts to get at the feeling that they can be left with when their healthcare provider only uses measures to understand their pain or, worse yet, uses these measures to undermine their reported experience of pain.

Empowering our patients to use their own words to tell us about their pain is an essential way to start understanding their lived experiences. This, in turn, can help build trust and partnership and creates the potential for more personalized care.

So, how can we strategically integrate qualitative forms of assessment within our pain management plans? We would like to suggest that it starts by developing a series of open-ended questions that can help you gain a richer understanding of your patient's pain experience, its impact on their life and, ultimately, the relevant impact of your treatment. There is no one way to approach this. Indeed, the best strategy is likely to tailor your questions and your approach to individual patients. That said, here are some suggestions to help get you inspired:

- Can you please tell me about how your pain first started and how it has progressed since then?
- Can you please tell me about the ways in which pain has been most disruptive to your life?
- What do you think would help you feel less pain and be able to do what's most important to you?
- Can you please tell me about how our work together has influenced your pain and the impact of pain on your life?

Making more space for narrative within your pain assessment can be an exciting process—you really never know what your patient might bring to the table. At the same time, it can also be stressful for the clinician. Some patient narratives might evoke strong emotions (*I would never respond that way!*), disbelief (*How could they function if they're in that much pain?*), confusion (*I have no idea what's going on here. What should I do?*), or a range of other reactions. For the adventuresome, these encounters can actually provide some great opportunities to reflect on how you think about pain (*Hmm...I wonder why I had such a strong reaction to that?*) and your role in its management (*Healer? Forensic detective? Partner?*).

Our hope from a research perspective is that the MAP model will inspire new approaches to the study of pain that further integrate qualitative methods within our predominantly quantitative field. With time, and a little luck, we hope that MAP will help us be a little more comprehensive and compassionate in how we approach pain assessment and, hopefully, help us to further alleviate some of the widespread suffering that is too commonly experienced by Canadians living with pain. ❄️



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The Power of Exercise

Marilyn MacKay-Lyons, PT, PhD and Alison McDonald, BSc (PT)

“If we could give every individual the right amount of nourishment, and exercise, not too little and not too much, we would have found the safest way to health.” Hippocrates, ~380 BCE [before common era] was allegedly the first physician in recorded history to provide a written prescription for exercise.¹ Exercise is definitely not a new intervention but it has certainly withstood the test of time with over 40,000 exercise-related, peer-reviewed articles cited in Medline in 2020 alone. Ongoing innovations in the delivery of exercise, and the assessment of its effects, will continue to catalyze scientific and clinical excitement. We, as physiotherapists, are in the privileged position of having exercise as the main tool in our clinical armamentarium. It behooves us to keep abreast of the latest literature and prescribe this prized physiological agent with precision, guided by the principles of exercise science. Only then, will we optimize its effects on every patient.

Overwhelming evidence now exists that exercise and physical activity are associated with enhanced physical and mental health, better control of chronic diseases, higher quality of life, and a longer lifespan. Conversely, lack of exercise and physical inactivity lead to the elevated probability of developing chronic disease risk factors (e.g. systemic inflammation,

obesity, hypertension) as well as premature mortality.² Again, this duality is not exactly a new concept—in ~350 BCE Plato asserted, “Lack of activity destroys the good condition of every human being, while movement and methodical physical exercise save it and preserve it.” Indeed, the escalating incidence of sedentary behaviors in both developing and developed countries is “the greatest public health challenge of the 21st century”.³ This crisis deserves the immediate attention of physiotherapists—recognized movement experts on health-care teams.

Exercise is a multi-potent physiological agent which has complex consequences including anti-inflammatory and antioxidant effects⁴ on all body systems⁵ (Fig 1). A specific intervention tends to provoke the most profound changes on those body systems most closely targeted by the intervention. Exercise is no exception—aerobic exercise bestows the most benefit on the cardiorespiratory system, whereas the principal beneficiary of resistance training is the muscular system, and of flexibility exercise, the skeletal system. Nonetheless, multi-system effects of exercise are common, yielding a host of positive functional outcomes. Importantly, the largest benefits are conferred on people at the lower end of the physical activity continuum.⁶ Below

As physiotherapists we have a duty to advocate for a healthcare model that embraces both primary and secondary prevention.

we briefly address only a small fraction of these outcomes, with a particular focus on the four main chronic diseases identified by the World Health Organization (vascular diseases [e.g., heart and stroke], diabetes, cancers, and chronic respiratory diseases [e.g., chronic obstructive pulmonary disease, asthma]).⁷

Benefits of aerobic exercise and physical activity compelling

The benefits of aerobic exercise and physical activity on cardiovascular and metabolic functioning are compelling. In 1989, Steven Blair, a leading exercise science expert, asserted that cardiorespiratory fitness is the single most useful measure of health,⁸ due to multiple effects, including antioxidant effects.⁴ Around the same time, another recognized exercise physiologist, Jonathan Myers, proclaimed supremacy of exercise capacity, measured by maximal oxygen consumption, over other established cardiovascular risk factors (including hypertension) as a predictor of mortality.⁹ Data support these claims—the risk of heart disease is reduced by more than a third in physically active versus inactive adults,¹⁰ and eight-year mortality risk may be cut in half by transitioning from low to high cardiorespiratory fitness.¹¹

A chronic condition closely related to cardiovascular disease is stroke—the most common neurological condition treated by physiotherapists. Stroke is a good example of the multi-potency of exercise and physical activity on numerous body systems, particularly the nervous system (e.g. motor control, cognition, emotional well-being, sensation, postural control, sleep); circulatory and respiratory systems (e.g. exercise capacity, fatigue resistance); and, muscular and skeletal systems (e.g. strength, movement, bone mineral density). In 2013, the prestigious British Medical Journal published meta-analytical data demonstrating the superiority of physical activity interventions over drug treatment in reducing mortality after stroke.¹²

Lack of cardiorespiratory fitness is a well-established independent risk factor of heart disease,⁵ stroke,¹³ and type 2 diabetes.⁵ Control of type 2 diabetes is modulated by behavior change, with exercise as the most powerful lifestyle factor due to its reduction in dampening the inflammatory state induced by insulin resistance.⁵ Anti-inflammatory effects of exercise also play a key role in primary/secondary prevention and mortality of some forms of cancer, especially among patients who have neoplastic disease and type 2 diabetes as a co-morbidity.¹⁴

Despite the multiple benefits of exercise and its relative safety,¹⁵ caution must be taken in prescribing exercise. Dose must be carefully titrated for maximal effects, with due consideration given to the potential for adverse interactions between exercise and medications, particularly exercise—elicited alterations in plasma concentrations of drugs.¹⁶ Further, condition-specific precautions must be borne in mind, such as risk of hypo-glycaemia in individuals with type 1 diabetes, falls in adults who are frail or have poor postural control, and paradoxical weakness due to excessive resistance training in people with Guillain Barre Syndrome.

Figure 1: As we necessarily move to a proactive, preventive healthcare model physical inactivity is an actual cause of type 2 diabetes, cardiovascular disease, and tens of other chronic conditions via interaction with other factors (e.g. age, diet, gender, and genetics) to increase disease risk factors. This leads to chronic disease, reduced quality of life, and premature death. However, physical activity can prevent and, in some cases, treat disease progression associated with physical inactivity and other genetic and environmental factors.



Exercise and physical activity exert powerful effects on all body systems and multiple conditions in which physiotherapists intervene to prevent or reduce detrimental consequences.

In summary, exercise and physical activity exert powerful effects on all body systems and multiple conditions in which physiotherapists intervene to prevent or reduce detrimental consequences. The health-promoting nature of exercise is attracting growing attention by those interested in evidence-based, noninvasive alternatives to traditional medical approaches. In this short commentary, we barely skimmed the surface of exercise-induced outcomes in a smattering of chronic conditions. Many conditions worthy of note have not been mentioned, including arthritis, mental health, cognition, and frailty of ageing persons.

As physiotherapists we have a duty to advocate for a health-care model that embraces both primary and secondary prevention, in which exercise and physical activity play a dominant role. Future research endeavours should include investigations of 'precision physiotherapy' (individualized prescription of exercise based on patient-specific assessment findings and intended goals), as well as pharmaco-rehabilitation (synergistic use of pharmaceuticals and exercise to optimize patients' outcomes). 📌



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What is the role of the PT in developing, prescribing, and using technology?

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Technology in PT practice

Physiotherapists have always used a wide variety of tools, ranging from simple to sophisticated devices, to find creative ways to deliver effective physio-therapeutics in interesting and motivating ways to patients. We define technology in physiotherapy as the application of science to develop technical solutions for either assessments or interventions in the practice of physiotherapy. Technologies include measurement tools ranging from goniometers and dynamometers, to more recent computer-based developments such as virtual reality applications for rehabilitation, robotics, mobile apps, and tele-rehab applications (Figure 1). These tools have evolved over the years and physio-therapeutics have evolved along with them. Physiotherapists have to choose the technologies to have in their “bag of tricks”.



Figure 1: Examples of 3 technologies that can be found in physiotherapy practice. A. Game-like virtual rehabilitation (VR) application for uni- and bimanual upper limb training in a real-world context of grocery shopping. The VR application tracks the user’s arm and trunk movements and provides feedback about task success or failure (i.e., retrieving a can and putting it in a shopping basket). The physiotherapist provides feedback about arm ranges of movement and undesirable compensatory movement. B. The ReWalk exoskeleton (ReWalk Robotics, Inc.) contains motors at the hip and knee joints to assist with walking, while the ankle joint is held stationary in a neutral position. The user triggers steps with a forward lean of the upper body, and maintains balance with forearm crutches. The task to be performed is controlled by the user with a wrist worn controller. The therapist ensures safety by walking behind the user and holding the pelvic band. C. Exerciser (end effector robot) and visual feedback displayed in front of the client to assess and train upper limb bilateral movements and coordination. The exerciser was developed with a multidisciplinary team of rehabilitation researchers, biomedical engineers, physical and occupational therapists and end-users.

We do not have many statistics on how much current or new technology is used in physiotherapy, but it appears that this uptake may be low due to a variety of factors. In a cross-Canada survey by Levac et al.,¹ 46 per cent of the 1,071 of occupational and physical therapists who responded had used virtual reality and active videogame-based practice. However, the daily use of these technologies was very low with only 12 per cent of respondents reporting using them currently. What factors should we consider when adopting a new technology?

When adopting a technology, we want to ensure that it is valid, reliable, and minimally obtrusive, so that it alters the movement as little as possible.

Adoption of technology

When adopting a technology, such as for measuring movement, we want to ensure that it is valid, reliable, and minimally obtrusive, so that it alters the movement as little as possible. For example, technologies for measuring walking are many. One popular type is based on inertial measurement units (IMUs), typically incorporating accelerometers and/or gyroscopes that allow the quantification of steps or activity. IMUs may quantify how much activity is being performed minute-by-minute over long periods of time, and can be used in the patient's own living environment. In some cases, physiological parameters such as heart rate and other variables can also be obtained. These types of devices are relatively unencumbering to the wearer, inexpensive, and widely available. They can be used to provide an estimate of the number of steps a person takes over specific windows of time at home or during interventions in the clinic. They can also estimate the intensity of the activity based on how often that activity is performed within a time frame.

As with any type of technology, however, we should always question the validity and accuracy of the device, i.e., we should never accept the manufacturer's claims without verification. The same technology could be valid in certain circumstances and not in others. For example, activity monitors may not work well in patients who walk very slowly, because accelerations from their movements could be below the threshold required by the device to count steps.² Furthermore, devices validated for certain individuals, such as adults may not be valid for others such as young children, who have shorter limbs, different acceleration profiles, and different ways of walking and running. Therefore, choosing a device that has been validated for the intended use is very important. The process of validation in some cases might be complex, and require a laboratory with specialized equipment. In other situations, however, the process can be relatively simple. For example, if you want to know if a step counter is working well for a patient, you could videotape and record with the step counter while your patient does the activity you want the device to count, and verify how close the count is to your own counting by replaying the video. In any case, critical evaluation of devices is paramount.

Devices for retraining walking are also proliferating. For example, since the introduction of a treadmill-based powered exoskeleton to replace the manual assistance required when using body-weight supported treadmill training,³ there are now multiple powered exoskeletons, many allowing some form of walking over ground (reviewed in^{4,5}). These are complex and powerful machines costing \$10,000 to more than \$100,000 in Canada. They could potentially offer patients with limited walking ability a way to walk or improve in walking, and they could assist therapists with walking training by reducing the manual labour required.

To adopt technology, physiotherapists should be part of a multidisciplinary team and collaborate with other professionals to ensure that the technology matches their needs and the

needs of their clients. Clients often have good knowledge of technologies through self-education. The role of the physiotherapist is to ensure that the client has considered all the possibilities when making a choice. Surprisingly, the involvement of clients and therapists in the development of technology has been inconsistent. Ideally, the users of the device (i.e. clients and physiotherapists) and the developers (i.e. various types of engineers) should engage in the development together.

Facilitators and barriers to technology uptake

The choice of which technology to use in a particular case must be informed by the evidence of its effectiveness for the intended pathology, the preferences of the individual, and the stage of recovery. Factors affecting the implementation of a new technology in clinical practice include the physiotherapists' judgement of the utility of the technology, the added benefit of using the technology compared to other treatments, the time investment (i.e. learning, set up, and cleaning), the ease of use as well as the cost, reliability, popularity, and availability of the technology.^{6,7} In addition, the choice is also governed by time constraints and the feasibility of application of the technology within the limitations of the clinical environment. Therefore, the resources and organizational structures (e.g. technical support, dedicated personnel, protected time to practice) of the environment are also important aspects to consider when implementing new technologies.⁶

There are several serious but resolvable barriers to technology uptake. Barriers include differences in the terminology used by each group, making it difficult for the groups to foster a constructive interdisciplinary dialogue. Further, aspects of the technology that are considered important may be very different between the groups, such as its functionality, ease of use, aesthetics, efficacy for physiotherapy outcomes, durability of the hardware, and cost.

The cost for the customer may limit the use of the technology even if it has demonstrated an added value. Reimbursement of costs is not always possible. The physiotherapist must, therefore, offer options that can meet the client's expectations. In addition, privacy and security are often a concern when using technology. For example, tele-rehabilitation may allow the viewing of private household activities and there is a risk of individual's data being accessed by unauthorized persons.

How can we overcome these barriers? Solving these issues requires a lot of dialogue, patience, commitment, and learning from all parties, and the desire to come together for a common purpose. We feel that for devices to be useful in clinical practice, physiotherapists need to be part of the solution. Consequently we suggest that physiotherapists should neither be blinded by the allure of technology, nor be uniformly resistant to the use of new technology, but rather be informed and smart consumers, engage in studying the utility of existing technology, and participate in the development of new technology that will serve us and our patients.

The literature is unanimous about the importance for physiotherapists to improve their skills and knowledge in the use and evaluation of technologies so that the technologies can be more suitably integrated into our field of practice. Therapists, teachers, and researchers who know more about technologies should share their knowledge. Exchanges between these knowledgeable stakeholders will promote a better understanding of how to integrate technology into practice in order to address client and physiotherapist needs. Keeping up to date is also a challenge. Physiotherapists can learn about new technologies at the following, for example: Electrologic (<https://electrologic.umontreal.ca/>), Physiography (<http://www.physiographie.umontreal.ca/>) and IISART (www.iisart.org); or by joining societies such as the International Society for Virtual Rehabilitation (<http://www.ISVR.org/>).

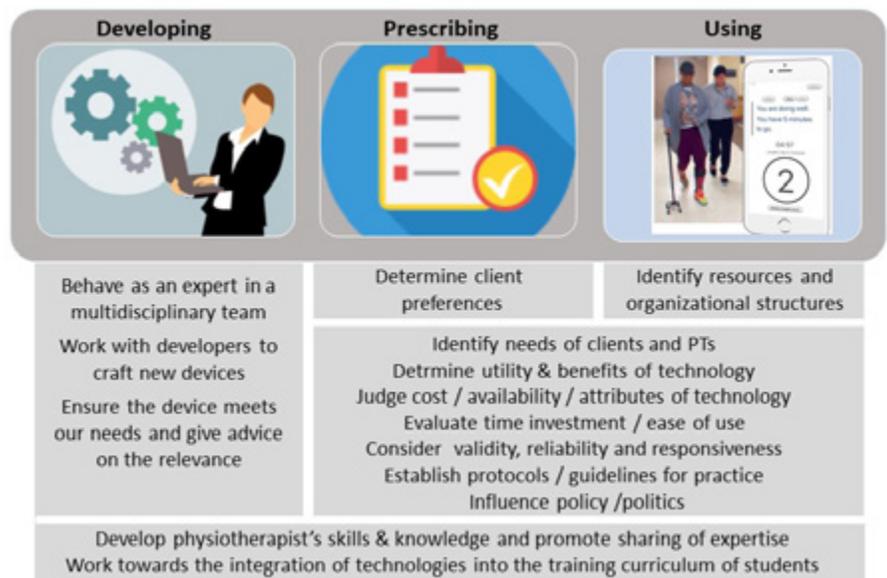
Critical to increasing clinical uptake is the integration of technologies into the training curriculum of students. Professors, including clinical supervisors, must be competent in using technology and able to adapt quickly to the rapid evolution of technologies. Adequate training of students, the physiotherapists of tomorrow, will allow a better appropriation of technologies in clinical practice. Trained students could assist experienced therapists, less familiar with new technologies, to develop their knowledge.^{6,7}

Adopting technologies also requires a team with skills in computer science, engineering, ethics, etc. The therapist's role is to help establish the scientific evidence for the device such as determining the measurement properties and guidelines for the administration of treatment protocols. Indeed, physiotherapists are experts in judging the relevance and effectiveness of interventions and the value of a new technology-based assessment or treatment. It is also one of the roles of professional orders and associations to encourage the establishment of these protocols, in addition to proposing guidelines for practice (e.g. telerehabilitation) and influencing policy regarding the importance of technology in physiotherapy. Beyond these aspects, physiotherapists can assess the relevance of a technology for their clients with case studies, a research strategy well known to therapists.

Physiotherapy researchers can facilitate the uptake of technologies in practice. They have always promoted the use of cutting-edge technology and are key players in the evaluation of technology and its development. For example, they were among the first to establish and promote the use of laboratory assessment for describing abnormal gait patterns using motion analysis equipment (e.g. CL. Richards, SJ Olney), abnormal muscle activation using EMG recording (e.g. AB Arseneault), and strength deficits using dynamometry (e.g. RW. Bohannon). Nowadays, physiotherapy researchers are developing evaluation and training devices (e.g. Montreal Spasticity Measure, MF Levin; iWalkAssess for walking assessment post-stroke; <http://www.iwalkassess.com/>). Collaboration between researchers and therapists can lead to the development of technology with a high likelihood of being integrated into clinical practice. A particular attribute of technology is that it can be used to increase therapy time and/or intensity by providing the opportunity for additional practice outside of regular therapy sessions, and improve access for remote areas (tele-rehab). We must engage our clients in technological research projects and ask therapists and researchers to work together to improve and evaluate it.

Technologies can assist in providing standardized, objective evaluation, and treatment anchored in foundational rehabilitation knowledge and skills. Building knowledge and skills in key areas of physiotherapy practice will help demystify the use of technology in the clinic and increase clinical uptake. It is conceivable that technologies will allow the profession to provide more evidence of the effectiveness of interventions and even justify new niches in physiotherapy practice. A summary of the actions is presented in Figure 2.

Figure 2: Diagram of the different roles that a physiotherapist can take in the development, prescription and use of technology in rehabilitation.



We should not allow ourselves to be constrained by barriers but instead make efforts to find ways to move beyond them. The likelihood of adopting a technology may be related to how comfortable we feel with the technology, how easy it is to use, and whether the technology can be easily and effectively adapted to meet our treatment goals. For example, although it may be easy to use a commercially available video game to encourage upper limb reaching movements or train standing balance, we may be limited by the tasks that the game developer included in the application, as well as the possibility that movements made in the game may not be the ones that we want the patient to practice. If we cannot modify the game requirements to suit our needs, how likely is it that we will adopt such a technology? Physiotherapists are experts in what a device should be able to do in order to enhance the effectiveness of our therapy. The onus, therefore, falls on us to step forward and work with developers to craft new devices that truly meet our needs, instead of adapting our needs to fit the technology. Incorporating relevant new technology can: increase the amount of treatment delivery; streamline administrative processes such as data management; improve patient engagement, motivation, and enjoyment; and, lead to better treatment outcomes. Technology is here to stay and physiotherapists will need to continue to make it their own. 🧩

The onus falls on us to step forward and work with developers to craft new devices that truly meet our needs, instead of adapting our needs to fit the technology.

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The Clinician-Scientist in Rehabilitation Science – A career destined for development or extinction?

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A clinician-scientist is a clinician who, in addition to their professional education, has pursued graduate research training at a doctoral level¹. A clinician-scientist bridges the gap between research and practice, embracing a bi-directional role of integrating research findings into clinical practice, while simultaneously developing clinically-relevant research questions². Ensuring clinical and patient perspectives are incorporated into the research agenda is a key aspect of the clinician-scientist role¹.

The clinician-scientist role in medicine is a much more developed career pathway, hence the synonymous term physician-scientist³. A recent scoping review of the clinician-scientist literature identified that almost three-quarters of the publications from 1976-2020 were related to medicine and a number of specialized training programs were identified for physicians. In contrast, only four per cent of the publications were related to the clinician-scientist role in physiotherapy, and none of those publications discussed training programs. The majority of publications were from North America, with Oceania, Europe, and Asia. In Canada, there are only three Universities offering five-year dual entry to professional degree (e.g. OT/PT) and PhD programs in the rehabilitation sciences⁴.

The prospect of enrolling in a five-year combined entry to a practice and research program may be daunting from a financial and time-resource perspective. In fact, recent reports suggest limited interest in pursuing CS training programs⁵. In addition, dual degrees, combining entry to practice and research requirements, assumes that individuals know that they wish to pursue both a clinical and research career at program outset. This may not be the case for many individuals, who are drawn to a specific career due to their specific interests.

The findings of the recent clinician-scientist scoping review identified that the clinician-scientist is poorly operationalized and lacks clear definition of its role and responsibilities. Several barriers and facilitators were highlighted, primarily arising in the CS medicine-related literature. Barriers included:

- time constraints related to education, training, the challenges of maintaining a dual clinician-researcher role including the time required to write and submit grant applications, as well as seeking to maintain a work-life balance;
- financial considerations with respect to lengthy education costs and low wages due to the lack of a clear career pathway and, in turn, career progression, as well as the very competitive nature of securing research funds; and,
- mentorship, access to senior CS's, and infrastructure to support the CS role. Facilitators were discussed much less but identified training, funding, role models, and mentoring⁴.

Clinician-scientists in rehabilitation science draw upon diverse but inter-related professions including physiotherapy, occupational therapy, speech language pathology, audiology, respiratory therapy, and others⁶. Bi-directional knowledge translation is an integral aspect of evidence-informed clinical practice and research, is essential to the development of the healthcare professions, and advancing practice and research⁵. Although this is inherently understood, the role of the clinician-scientist in rehabilitation science is not well defined from multiple perspectives. As such, clinician-scientists in rehabilitation science are a rare breed with an accompanying lack of evidence on their professional role⁷.

In Canada, it was recently reported that there are fewer clinician-scientists now than in 2010



Clinical practice and research inhabit different worlds, demand different qualities, have very different funding structures. Thus, the struggle for the clinician-scientist role, particularly in rehabilitation science, has philosophical, social, cultural, and economic roots. Clinicians are directly interacting with patients and take immediate job satisfaction in helping resolve or mitigate clinical problems, while simultaneously seeking to improve the quality of life of their patients⁸. Clinical reimbursement systems are well delineated, understood, and, for the most part, have longevity; therefore issues of financial and job security are clearly identified. On the other hand, research scientists often do not have regular direct contact with patients and, therefore, do not have daily reinforcement of common clinical issues. Although the benefits to patient health as a result of successful research are undeniable, those benefits are realized over an extended time frame and so gratification is not immediate⁸.

Funding for clinician-scientist positions is required at multiple levels including scholarships, salary support, research fellowships, and start-up funding for small projects⁵. These funds provide the much-needed research experience for clinician-scientists to become competitive for research grants. Although institutional funding has been available for physician clinician-scientists in the U.S. and Canada, similar funding models for non-physician clinician-scientists are extremely limited⁵. As a result, the ability to fund and implement a clinician-scientist directed program of research in rehabilitation science is extremely difficult to sustain.

Concerns about the development and sustainability of the clinician-scientist workforce are not new to the literature. However, actions to attempt to address common issues such as job context and career pipeline have not been particularly successful⁷. In fact, in Canada it was recently reported that there are fewer clinician-scientists now than in 2010⁵. A recent international expert meeting further identified that integrated training, as well as accreditation and governance were potential factors in developing a sustainable clinician-scientist workforce⁷.

Mentorship is a key aspect of any profession and access to clinician-scientist mentors is essential to the development of the CS role in rehabilitation science⁵. Therefore, identifying mentors and developing positions to maintain clinician-scientist rehabilitation science mentors is an important component of recruitment, training, and retention. Given the time and financial resource investment involved in developing clinician-scientists, retaining them and developing mentorship capacity is critical.

Clinical practice enables development of professional practice knowledge when combined with an in-depth understanding of its respective evidence base illuminates the gaps in the evidence. It is through this time-intensive professional journey that the clinician begins to appreciate key clinical issues requiring research. Likewise, research training requires a considerable investment in time and financial resources. Understanding research methods, as well as funding sources, and the metrics used to determine research success and progression is an enormous undertaking. The clinician-scientist operates at the juncture of these two distinct worlds focusing research questions that are clinically relevant and ultimately benefiting patients, clinical practice, and the systems in which they operate. 📌



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Knowledge translation shared responsibility



Jocelyn Chandler, Caitlin DuBiel and Josina Rhebergen

Physiotherapy is a beautifully diverse discipline of modern medicine. New graduates emerge with an excellent foundation, but are typically only exposed to a small fraction of the expertise that our profession has to offer. As we nestle into the practice areas we are drawn to, a clinician in cardiorespiratory therapy, for example, can feel worlds apart from the daily practice of a clinician in pediatrics or orthopedics. Within areas of our profession, there also exists considerable variability in practice styles, beliefs, and preferences. Clinical colleagues and potential clients may have questions about who we are and what our practice includes. They are often surprised to learn about the diversity of what we have to offer. We are regularly drawn to courses and professional development opportunities that provide rapidly-changing lenses on how we view our world and it can be hard, at times, to wade through the information to ensure that it is both current and evidence based. If we, as practicing clinicians, feel unsure that our approach is still the most current and evidence based, how does that impact our interprofessional colleagues' and our clients' faith in our practice?

The Canadian Physiotherapy Association (CPA) and provincial divisions have done an excellent job over the years to make our profession more accessible. Clients can find a suitable practitioner in their community via a quick online search. However, this does not necessarily help them to understand what to expect during their physiotherapy visits. There is evidence to support many different treatment approaches. Evidence-based physiotherapy for low back pain with one practitioner might look quite different than with another. There is evidence for education, manual therapy, and exercise in treating low back pain, but the emphasis may vary in different practice settings or approaches. One clinician might include more time on education and exercise with no manual therapy, while another might emphasize manual therapy before education and exercise.

Striving to be evidence based

Regardless of the approach, the bottom line is that we all strive to be evidence based. We want to provide clients with the best our profession has to offer by relying on the work of our academic colleagues. We learn to be critical thinkers early in our careers, but ensuring we are always informed about the latest, best-quality research is daunting and time-consuming given busy clinical schedules and the vast pool of research available. Ensuring that evidence-based practice is the foundation of our profession ensures that both the public and our interprofessional colleagues continue to have confidence in our profession. However, this can be more challenging than it might seem.

Accessing information can be difficult even with the resources provided through the CPA, provincial divisions, and employers. Once a resource is found, there is often a financial barrier such as journal paywalls, membership fees, course fees, or travel costs to courses or conferences. These barriers are amplified in rural and remote settings with the additional challenge of finding mentors after graduation, no regular educational in-services as sole practitioners, limited or no access to virtual resources due to technology challenges, and because practitioners are working with populations under-represented in research. It's no wonder then that clinicians can be tempted to use the first resource available, regardless of the source and if the information is current.

Research is the foundation of an evidence-based practice and it inspires us to be progressive and adaptive practitioners. In order for us to integrate findings into our practice, we need it to reflect the needs of our clients and real-world clinical questions. Currently many of us don't know what researchers are investigating, how to connect with researchers that are investigating in areas that we have an interest in, or how to communicate gaps that we see in our clinical settings. And while clinical research protocols often have specific criteria



for studying interventions in different populations, it can be challenging for clinicians to apply these results in *our* clinical population. For example, a research protocol might use a daily intervention, but in the clinical setting this is not feasible. It is hard to feel confident in calling it an evidence-based practice when we, as clinicians, have to modify research findings to the realities of our practices.

Access to research growing exponentially, but barriers still exist

This is an exciting time for physiotherapists in Canada. Our scope is expanding and access to physiotherapy research is growing exponentially. It has been an unprecedented year highlighting both the challenges and the exciting opportunities that technology can provide. There has been an emphasis on virtual care allowing clients to access specialist services with more convenience using video or phone appointments. As clinicians we have also become adept at taking courses or attending meetings using the same video platforms such as Zoom. These tools increase our access to other clinician experts and to the research community. How can we then best use this new familiarity with technology to further improve access to, and the development of, the most clinically valuable and applicable evidence?

Knowledge translation (KT) is complicated. The Canadian Institute of Health Research (CIHR) defines KT as the exchange, synthesis, and ethically-sound application of research findings within a complex system of relationships among researchers and knowledge users. It's not as simple as just making research articles accessible to clinicians. Given the barriers that exist for clinicians, more support is needed to be able to acquire new knowledge as it becomes available and to translate research into meaningful clinical practice guidelines.

Currently there is support within the CPA and the provincial divisions to facilitate the integration of research into clinical practice. For example, in British Columbia PABC members have access to a librarian and to a knowledge broker (funded by the University of BC Department of PT, Arthritis Research Canada, and the Physiotherapy Association of BC). The librarian is able to conduct a review of the research and send relevant articles to the clinician, and the knowledge broker exists to both create clinical practice guidelines and facilitate collaboration between researchers and clinicians. The resources that do exist such as articles and toolkits are concise, informative, and relevant. Unfortunately, as the task of knowledge translation is complicated and extensive, the resources are limited.

In speaking with clinician colleagues to write this article, it became evident that the weight of staying up-to-date with evidence is heavy when we already bear the weight of our clients and their needs. We are a profession of broad scope and profound knowledge, but the ability of clinicians and researchers to communicate and collaborate feels limited. We need efficient access to skilled knowledge translators and the resources that already exist. We need better opportunities for communication between clinicians and researchers in similar practice areas so that priorities and perceived barriers can be shared. Knowledge translation is the responsibility of all of the professionals involved.

As the authors of this article, we are writing from the perspective of three sole practice clinicians primarily working with rural, remote, and/or marginalized populations. Our practice feels far removed from other clinicians and the research community. It doesn't currently feel like we have a good way to connect with other clinicians working in similar areas or researchers who might be interested in working with our communities. However, with the ever-expanding ability to network virtually, the possibilities for improved collaboration and knowledge translation are endless. Access to evidence-based resources (such as toolkits) is certainly one part of what we need. But increasing access to each other brings an even larger potential for generating and sharing the knowledge we already possess. It would be a dream to easily access other clinicians working in a similar setting and to connect with researchers interested in elevating the potential of the communities in which we work.

This is an exciting time for physiotherapists in Canada. Our scope is expanding and access to physiotherapy research is growing exponentially.

Improved collaboration encourages innovation

Ongoing efforts to improve access and utility of evidence and improved collaboration between clinicians and researchers will continue to allow our profession to innovate and adapt to our changing world. When we asked clinician colleagues for their current resources for evidence-based information, we received a wealth of quality information, but the recurrent theme was that they are hard to find, all in different formats, and varied in publication dates. The same problem existed for a database of researchers and clinicians through UBC—it existed in theory but not so much in reality. So how do we continue to improve? It certainly isn't a new idea with different countries and professions approaching the idea of effective knowledge translation in various ways. For example, there are subscription-based models such as the physician database, UpToDate, where authors synthesize medical literature, incorporate the latest evidence, and provide specific graded recommendations for patient care. Could something like this exist in the Canadian physiotherapy profession? We could only benefit from a centralized database that was consistent in format, easy to access via technology, and facilitated by experienced knowledge brokers. We have so much quality evidence-based information already that could be more widely used if it was easier to access. Think of where physiotherapy in Canada could go if clinicians and researchers with similar interests across the country can be easily connected through something similar to the general public's "Find a Physio" database in BC. Future development of evidence-based knowledge translation for physiotherapy clinicians needs to be technologically forward, easily accessible, and collaborative, bringing clinicians and researchers together so that priorities can be shared and barriers overcome.

An evidence-based practice is not a new notion in physiotherapy but, for many clinicians, putting it into practice does not always feel attainable, especially with constantly evolving research findings. We risk letting it fall to the wayside in our busy daily clinical settings.

Ongoing efforts to improve access and utility of evidence and improved collaboration between clinicians and researchers will continue to allow our profession to innovate and adapt to our changing world.

As physiotherapists, in both the clinical and academic settings, we should consider:

1. Evidence-based practice is not only important for uniting the current diversity and scope of our profession, but also to guide us in future directions.
2. Connecting clinicians and researchers has great potential to improve both the clinical applications of research and help inform future research.
3. Knowledge transfer for clinicians needs to be easily accessible, technologically forward, and facilitated by expert knowledge brokers.

As the Strategic Research Committee members noted, knowledge translation into physiotherapy practice is a shared responsibility of both the knowledge generators and the knowledge users (Strategic Research Committee Final Report, 2020). We all must continue to advocate for the development and dissemination of high-quality research that meets our collective goal of providing excellent quality physiotherapy. 🧠



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