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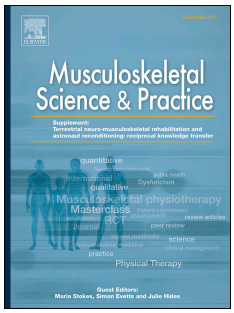

Agreement between telehealth and in-person assessment of patients with chronic musculoskeletal conditions presenting to an advanced-practice physiotherapy screening clinic

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Agreement between telehealth and in-person assessment of patients with chronic musculoskeletal conditions presenting to an advanced-practice physiotherapy screening clinic.

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Abstract:

Objective: To determine the level of agreement between a telehealth and in-person assessment of a representative sample of patients with chronic musculoskeletal conditions referred to an advanced-practice physiotherapy screening clinic.

Design: Repeated-measures study design.

Participants: 42 patients referred to the Neurosurgical & Orthopaedic Physiotherapy Screening Clinic (Queensland, Australia) for assessment of their chronic lumbar spine, knee or shoulder condition.

Intervention: Participants underwent two consecutive assessments by different physiotherapists within a single clinic session. In-person assessments were conducted as per standard clinical practice. Telehealth assessments took place remotely via videoconferencing. Six Musculoskeletal Physiotherapists were paired together to perform both assessment types.

Main Outcome Measures: Clinical management decisions including (i) recommended management pathways, (ii) referral to allied health professions, (iii) clinical diagnostics, and (iv) requirement for further investigations were compared using reliability and agreement statistics.

Results: There was substantial agreement (83.3%; 35/42 cases) between in-person and telehealth assessments for recommended management pathways. Moderate to near perfect agreement (AC1=0.58-0.9) was reached for referral to individual allied health professionals. Diagnostic agreement was 83.3% between the two delivery mediums, whilst there was substantial agreement (81%; AC1=0.74) when requesting further investigations. Overall, participants were satisfied with the telehealth assessment.

Conclusion: There is a high level of agreement between telehealth and in-person assessments with respect to clinical management decisions and diagnosis of patients with chronic musculoskeletal conditions managed in an advanced-practice physiotherapy screening clinic. Telehealth can be considered as a viable and effective medium to assess those patients who are unable to attend these services in person.

Introduction:

Musculoskeletal conditions are a leading cause of pain and disability and affect almost one-third of Australia's adult population (1). The increased prevalence of these conditions over the past two decades have subsequently placed unprecedented demands on public specialist orthopaedic and neurosurgical outpatient services (2, 3). Advanced-practice physiotherapy screening clinics have been shown to be an effective model of care in the tertiary setting (4, 5), particularly as a large proportion of non-urgent referrals can be successfully managed without the need for surgical consultation (6). Previous literature demonstrates a high level of concordance between advanced-practice physiotherapists and orthopaedic surgeons regarding decisions surrounding diagnosis and management, concluding that advanced-practice physiotherapists are well placed to provide patients' earlier access to an expert assessment and identification of appropriate management (non-surgical vs. surgical) pathways (6-12). Subsequently, advanced-practice physiotherapy services have been embedded as a model of care in many Australian and international health services (13). Unfortunately many patients are still unable to attend these services, particularly those who are required to travel large distances in order to access their closest neurosurgical or orthopaedic department (14, 15).

A potential solution to overcome many of the environmental barriers associated with poor healthcare access may be the implementation of telehealth, as an additional method of service delivery. Telehealth is defined as the provision of health care at a distance using telecommunication technology and is considered to be a medium through which equitable access to healthcare services may be achieved (16). A recently published systematic review (17) concluded that whilst performing a musculoskeletal physiotherapy assessment via telehealth (specifically videoconferencing) is technically feasible with overall excellent reliability, several aspects of the physical examination had low to moderate concurrent validity. Diagnostic agreement between telehealth and in-person physiotherapy assessments has also been investigated for a variety of musculoskeletal conditions, where agreement between the two mediums ranged from 60% to 93% (18-22). These studies were conducted within a university laboratory setting and therefore may not have

recruited participants with the often complex and chronic conditions that routinely present to tertiary public specialist outpatient services. To the best of our knowledge, no published studies have yet compared the level of agreement between telehealth and in-person physiotherapy assessments with respect to clinical management decisions, which is the primary objective of advanced-practice physiotherapy screening clinics in Australia. This represents a gap in current understanding, and as such needs to be addressed prior to the implementation of telehealth into standard clinical practice.

Therefore, the objective of this study was to determine the level of agreement between telehealth and in-person assessment of a representative sample of patients with chronic musculoskeletal conditions referred to an advanced-practice physiotherapy screening clinic. The primary aim was to assess the level of agreement regarding clinical management decisions, whilst secondary aims included the level of agreement for diagnosis and the requirement for further investigations.

Method:

Design:

A repeated-measure, inter-rater agreement study was undertaken between May to December 2016. An a priori decision was made to specifically recruit participants who had been referred for musculoskeletal complaints at either the lumbar spine, knee, or shoulder, as these three body regions constituted over 80% of referrals into the service under study. Written consent was provided by all participants prior to their commencement into the study. Approval to conduct this study was granted by the X (HREC/15/QRBW/591) Human Research Ethics Committee and the X Human Research Ethics Committee (2016000066).

Participants:

Participants were recruited from current X waiting lists at either the X Hospital or X Hospital located in X,X. To be eligible, participants were required to be over 18 years of age, with their X referral being triaged as non-urgent (ie. Category 2 [semi-urgent] or 3 [routine]) for the assessment of their musculoskeletal condition at either the lumbar spine (± referred pain or neurological symptoms), shoulder, or knee. Participants were also required to have available radiological investigations, relevant to their musculoskeletal condition, and performed within the previous 12 months, as per departmental referral criteria. Patients were excluded if they reported any medical conditions that may have precluded a safe examination (eg. significant cardiac or neurological disease); any hearing or visual impairments that would preclude adequate participation in the telehealth assessment; the inability to mobilise independently (± a mobility aid); or required the use of an interpreter.

Six physiotherapists (assessors) conducted the assessments. All assessors were post-graduate qualified Musculoskeletal Physiotherapists, and employed in an advanced-practice role in the X service at the time of the study. Assessors were paired together to complete assessments for one (out of the three) specific musculoskeletal regions of interest – lumbar spine (X,X), knee (X,X), and shoulder (X,X).

Intervention:

Participants who met the eligibility criteria and agreed to participate in the study underwent two consecutive assessments (in-person, telehealth) within a single clinic session. Participants were offered a thirty minute rest following their first assessment, as well as the opportunity to further delay the second assessment if symptoms had been exacerbated. Assessors had equal access to the participant's medical records and any available radiological investigations. The order of the assessments (in-person, telehealth) and the physiotherapist performing the assessment (Assessor 1, Assessor 2) were both randomised for each

participant using a balanced block of design of size four (23). This design minimised potential bias as it guaranteed that for every four participants, two participants completed their telehealth assessment first, whilst ensuring each assessor undertook an equal number of telehealth and in-person assessments.

In-person assessment:

As concurrent patients of the X, the in-person assessment constituted the participant's standard initial appointment with the service and therefore was completed as per usual practice. The content of the assessment, including patient interview and physical examination, was pragmatic and remained unchanged from standard clinical practice.

Telehealth assessment:

The telehealth assessment was undertaken using the eHAB® telerehabilitation videoconferencing platform (NeoRehab Pty Ltd, Brisbane, QLD). Participants were located in a room on their own within the hospital which was 'mocked up' to simulate the home environment (eg. bed, towels, broomstick, etc.). Participants were provided with an iPad® on a portable stand connected wirelessly to the Internet. The assessor was located in a separate room, within the same hospital department, and stationed in front of a standard hospital desktop computer connected to the hospital's network.

As per the in-person assessment, the content of the telehealth assessment remained at the discretion of the assessor. Standard physical examination techniques often required modification, with the participant's applying the modified tests to themselves (eg. applying self-pressure for shoulder orthopaedic tests). Details of how aspects of the physical examination can be performed via telehealth have been described elsewhere (19, 22, 24). Finally, as the in-person assessment of this study constituted the participant's initial contact

with the service, it was decided that the telehealth assessor would not discuss the outcomes of the assessment with the participant, so not to cause any confusion for the patient in the event of disagreement.

In preparation for conducting the telehealth assessments, four pilot-test subjects were recruited. This allowed assessors an opportunity to orientate themselves to the videoconferencing platform, and the alterations required to perform a physical examination via this medium. Paired assessors examined these subjects together (minimum one pilot-test subject per pair), such that they could discuss their findings, where any notable differences in clinical interpretation could be resolved prior to participant recruitment.

Outcome Measures:

Participant demographic and clinical examination findings were collected as per usual care. Due to the pragmatic nature of the individual assessments, assessors independently recorded all clinical findings and decisions on a standardised data collection form following the conclusion of each assessment. This data collection form was developed in consensus with all assessors involved with this study, such that all potential response options were available, thus allowing recorded data to reflect standard clinical practice of the service under study. Paired assessors were blinded to each other's findings until all data collection forms had been returned.

Primary outcome: Clinical management decisions

As per standard practice with the X, assessors could recommend one of the following six management pathways following assessment:

- Pathway 1: urgent medical care required, including immediate referral to the Department of Emergency Medicine;
- Pathway 2: expedited (but not urgent) specialist surgical consultation and discharged from the X;

- Pathway 3: expedited (but not urgent) specialist surgical consultation and referred for non-surgical management in the interim;
- Pathway 4: referred for non-surgical management whilst remaining on specialist surgical outpatient wait list at same triage category;
- Pathway 5: discharged from the X (± referral to non-surgical management) and remain on specialist surgical outpatient wait list at same triage category; and
- Pathway 6: discharged from the X (± referral to non-surgical management) and removed from specialist surgical outpatient wait lists.

When referred for a trial of non-surgical management, binary (yes/no) responses were also recorded for referral to the individual allied health professions to whom the patient was referred (eg. physiotherapy, psychology, dietetics, occupational therapy, pharmacy).

Secondary outcomes:

Primary clinical diagnosis was recorded using free-text. The need for further radiological or pathology investigations were recorded as binary (yes/no) responses.

Patient satisfaction:

Following the completion of both assessments, the participant completed a short survey with respect to their satisfaction towards the telehealth assessment. The survey assessed six items, identical to similar studies previously published (19, 22, 24), where participants recorded their responses for each item on a 100mm VAS scale.

Data analysis:

Data was analysed using SPSS software Version 24 (IBM, Chicago, USA) and AgreeStat 2015.6 for Excel (Advanced Analytics; Gaithersburg, MD, USA). Participant characteristics and satisfaction towards telehealth are presented using descriptive statistics. Free-text clinical diagnoses for each participant were paired together and analysed by a blinded, independent clinician as either: the same (an exact match ± minor variations in diagnostic labelling), similar (significant overlap in structure/source of symptoms ± concurrent secondary pathology), or different (large differences in structure / source of symptoms), to determine the level of agreement between the two delivery mediums. The following agreement and reliability coefficients were utilised for analysis of remaining outcomes: exact agreement (25), proportions of specific agreement (negative and positive) (26), Cohen's kappa (27), and Gwet's first order agreement coefficient (AC1) (28).

Whilst Cohen's kappa is widely used in inter-rater reliability studies, the magnitude of the resulting coefficient can be significantly lowered in the presence of high observed agreement (prevalence), which is commonly referred to as the 'kappa paradox' (29). Gwet's AC1 calculations correct inter-rater reliability for chance agreement by adjusting the overall probability when agreement between two raters may be the result of chance, and therefore are considered to be a more stable coefficient when faced with high observed agreement (28, 30). Magnitude of coefficient values were interpreted as: ≤0.2 poor, 0.21-0.4 fair, 0.41-0.6 moderate, 0.61-0.8 substantial, 0.81-1.0 near perfect agreement (31). Proportions of specific (positive/negative) agreement were used to present the level of agreement separately for binary responses, and are considered to provide more clinically meaningful information in addition to exact agreement (25, 26). Positive agreement demonstrates the proportion of cases in which both assessors rate 'yes' when compared to the total number of cases in which at least one assessor rated 'yes'. Negative agreement demonstrates the proportion of cases in which both assessors rate 'no' when compared to the total number of cases in which at least one assessor rated 'no.

Results:

A total of 42 participants were recruited, with 14 paired assessments completed for each musculoskeletal region of interest (total 84 independent assessments). **Table 1** outlines the participant's demographics and baseline characteristics. No adverse events occurred as a result of either the in-person or telehealth assessments. No participant requested a delay in commencing their second assessment, or to cease participation prior to completing both assessments.

Table 1. Participant characteristics

	Lumbar Spine (n=14)	**Shoulder (n=14)**	**Knee (n=14)**	**Total (n=42)**
Age years, mean (SD)	51.6(13.5)	57.7(15.5)	48.9(14.2)	52.7(14.5)
Gender (% female)	57	71	43	57.1
Duration of symptoms, range (months)	6-360	5-60	3-144	3-360
Pain VAS / 100, mean (SD)	61.4(14)	49.2(28.4)	52.7(19.6)	54(21.9)
Function, mean (SD)**:	**ODI** 41(18)	**Quick-DASH** 47.4(21)	**LEFS** 30(12.5)	

*ODI = Oswestry Disability Index; Quick-DASH = Quick Disabilities of the Arm, Shoulder and Hand; LEFS = Lower Extremity Functional Scale. **The Oswestry Disability Index and Quick-DASH are scored on a 0-100 scale, with a higher score indicating greater disability. The Lower Extremity Functional Scale is scored on a 0-80 scale, with a higher score indicating higher function.*

Primary outcome: clinical management decisions

There was exact agreement of 83.3% regarding the patients' recommended management pathway (**Table 2**), resulting in near perfect agreement (AC1 = 0.83), once the bias of high prevalence was accounted for. There were five cases where the in-person assessor recommended expedited specialist surgical consultation (Pathway 1, n=1; Pathway 2, n=1; Pathway 3, n=3) whilst the telehealth assessor recommended non-surgical management without expedited specialist surgical consultation (Pathway 4). There was one case in which the telehealth assessor recommended non-surgical management (Pathway 4), whilst the in-person assessors suggested the participant be discharge from the X and remove from specialist surgical outpatient waiting lists (Pathway 6). This occurred in the opposite direction in one further case.

There was moderate to near perfect agreement (AC1 = 0.58-0.9) regarding referral to individual allied health professions for non-surgical management, with exact agreement varying from 76-93% (Table 2). Of the 29 (out of a possible 210) disagreements, 16 (55%) were the result of the in-person assessor recommending a specific allied health profession whilst the telehealth assessor did not. The remaining 13 (45%) cases were the result of the telehealth assessor recommending a specific allied health profession whilst the in-person assessor did not.

Table 2. Level of agreement between telehealth and in-person assessment for clinical management decisions

	Exact agreement (%)	***Proportion of specific agreement (positive)***	***Proportion of specific agreement (negative)***	***Cohen's K (SE), 95%CI***	***AC1 (SE), 95%CI***
Management Pathway	83.3	-	-	-0.02 (0.02), 0-0.019	0.83 (0.06), 0.70-0.95
Referral to specific Allied Health professions:					
Physiotherapy	90.5	0.95	0	-0.04 (0.03), 0-0.021	0.90 (0.05), 0.785-1
Psychology	85.7	0.67	0.91	0.58 (0.15), 0.27-0.89	0.78 (0.09), 0.6-0.97
Dietetics	85.7	0.8	0.88	0.69 (0.11),	0.74 (0.1),

				0.46-0.92)	0.53-0.95
Occupational Therapy	92.8	0.82	0.96	0.78 (0.12), 0.53-1	0.89 (0.06), 0.77-1
Pharmacy	76.2	0.62	0.83	0.44 (0.15), 0.15-0.74	0.58 (0.13), 0.33-0.84)

Secondary outcome variables:

Clinical diagnostics:

Results for the analysis of clinical diagnoses are presented in **Table 3**. Agreement was 83.3%, with 35/42 cases having the 'same' or a 'similar' clinical diagnosis made between the two delivery mediums.

Table 3. Level of agreement between telehealth and in-person assessment for primary clinical diagnosis

Level of agreement:	**Lumbar Spine (n=14)**	**Shoulder (n=14)**	**Knee (n=14)**	**Total (n=42)**
Same	6/14 (42.9%)	4/14 (28.6%)	6/14 (42.9%)	16/42 (38.1%)
Similar	7/14 (50%)	7/14 (50%)	5/14 (35.7%)	19/42 (45.2%)
Different	1/14 (7.1%)	3/14 (21.4%)	3/14 (21.4%)	7/42 (16.7%)

Additional investigations required:

There was near perfect agreement (97.6%, AC1 = 0.97) as to whether referring the participant for pathology tests would assist in the assessors' diagnostic decision-making. There was substantial agreement (81%, AC1 = 0.74) between assessors with respect to requesting further radiological investigations. Further breakdown of agreement can be found in **Table 4**.

Table 4. Agreement between telehealth and in-person assessment regarding decisions for further investigations

	In-person physiotherapist			
Telehealth physiotherapist	*Request for further pathology?*			
		Yes	No	Total
	Yes	2	1	3
	No	0	39	39
	Total	2	40	42
	Request for further radiological investigations?			
		Yes	No	Total
	Yes	3	4	6
	No	4	31	36
	Total	8	34	42

Participant Satisfaction:

Overall participants were highly satisfied with the telehealth assessment, with results of the survey presented in **Figure 1**.

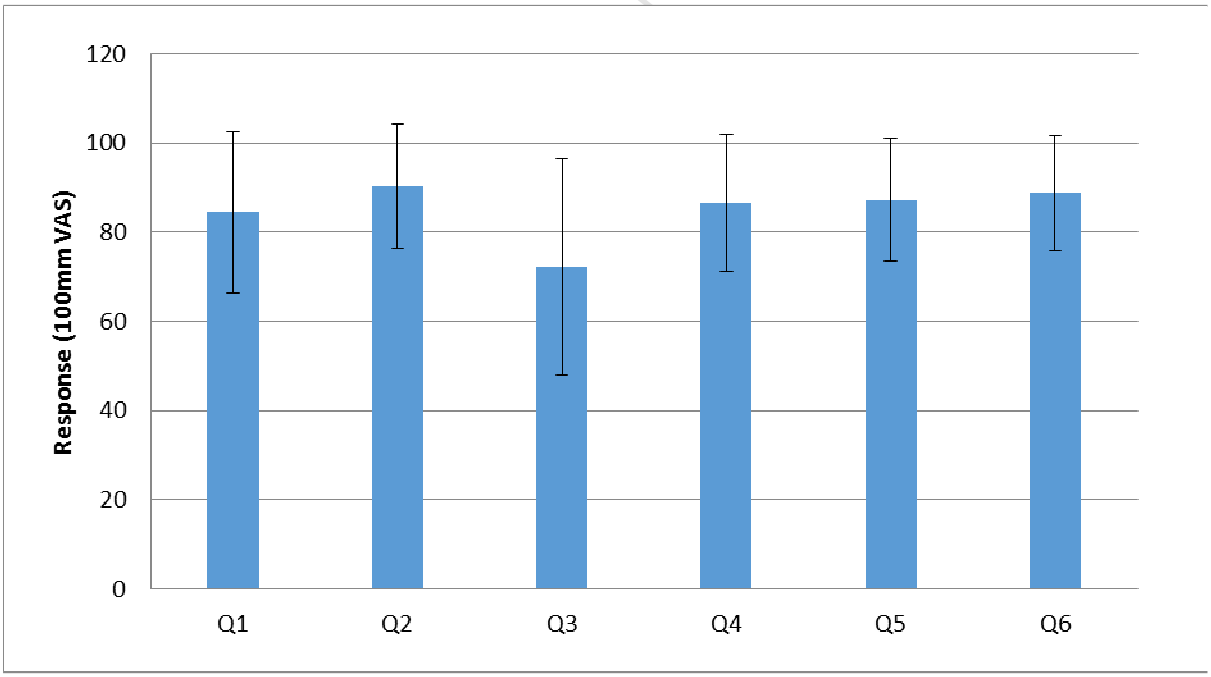

Figure 1. *Mean participant responses (±1 SD) on a 100mm visual analogue scale. (Q1) confidence in using telehealth; (Q2) recommend to friend unable to travel; (Q3) as good as in-person assessment; (Q4) visual clarity; (Q5) audio clarity; (Q6) overall satisfaction.*

Discussion:

The results of this study demonstrate a high level of agreement between telehealth and in-person assessment of patients with chronic musculoskeletal conditions referred to a tertiary advanced-practice physiotherapy screening clinic. Most notably, there was exact agreement between the two delivery mediums regarding recommended clinical management pathway in 83% of cases. This level of agreement demonstrates that even without physical contact, assessment via telehealth is able to produce similar outcomes to an in-person assessment for the majority of cases. As this is the primary objective of a tertiary advanced practice physiotherapy screening clinic, this study represents a significant step towards supporting the use of telehealth in such a service for those patients that would otherwise be unable to attend in person.

Whilst this study demonstrated high agreement, it is the potential clinical consequences resulting from the disagreements which will ultimately determine the appropriateness of introducing telehealth into the service under study, and therefore the overall decision cannot be based solely upon statistical calculation. Of the seven cases in which disagreement of care pathways occurred, five cases (1 knee, 4 shoulders) were the result of the in-person assessor recommending expedited specialist medical care. Despite this, paired assessors still agreed upon a ‘similar’ or ‘same’ clinical diagnosis in three of these cases. Of particular note is the participant presenting with shoulder pain in which the in-person assessor recommended urgent medical care (Pathway 1). Whilst both physiotherapists provided a musculoskeletal diagnosis specific to the shoulder in this patient under concurrent care for known cancer, the in-person assessor wished to expedite contact with the patient’s medical oncologist due to a suspicion of further metastases. In contrast, the telehealth assessor considered that this potential for further metastases was already being investigated by the medical oncology team and therefore did not recommend a more urgent medical review than already

scheduled. The in-person assessor was the same physiotherapist in the remaining three shoulder cases, where it was acknowledged that those patients who were likely surgical candidates were routinely expedited for specialist orthopaedic input whilst they continued to be referred for appropriate non-surgical management in the interim. This was in contrast to the paired assessor who routinely adopted a 'wait-and-see' approach, where if non-surgical treatment was unsuccessful, the patient's care may then be expedited for a specialist surgical consultation. Therefore, clinician preference or bias towards a specific management plan may be one explanation for the discordance seen in this study. This is supported by previous literature (7, 9, 10) which demonstrates variable clinical agreement (52-93%) regarding treatment indicators for several orthopaedic conditions when assessed in-person.

There was also an approximately equal distribution of disagreement between the two mediums of delivery with respect to the recommended referral to specific allied health professions. As the content of individual assessments was pragmatic and left to the discretion of the individual assessor, disagreement may have again arisen as a result of a difference in information obtained from each assessment. In addition, as the in-person assessment constituted the participants' initial contact with the X for their musculoskeletal condition, it was decided a priori that the telehealth assessor would not discuss their recommendations or clinical diagnosis with the participant, so as not to cause confusion in the event of disagreement. This decision may have subsequently resulted in higher levels of disagreement, as discussion with the participant following the in-person assessment may have influenced the assessors' final management decisions.

Overall diagnostic agreement was high (83.3%), and concurs with previous literature which has validated musculoskeletal physiotherapy assessments via telehealth for both knee (19) and shoulder (22) conditions. To date, this is the first study to examine diagnostic agreement between in-person and telehealth assessments in a lumbar spinal pain population. Unfortunately, there is limited evidence available indicating the acceptable inter-rater agreement between physiotherapists in a standard in-person assessment with

respect to clinical management and diagnostics (32). Therefore, as a second in-person assessment was not completed, it is uncertain as to what extent the different delivery mediums impacted on the disagreement reported, which is a limitation of this study. It is however also important to note that no patient was excluded from this study based upon their presenting musculoskeletal condition at either the lumbar spine, knee or shoulder, with many participants presenting with symptoms and/or radiological evidence of neurological compromise. This reflects the nature of a tertiary advanced-practice physiotherapy screening clinic, and indicates that even complex presentations may be safely assessed via telehealth.

Participants' overall satisfaction with the telehealth assessment was much higher than previous studies (18-20, 22). Audio and visual clarity were considered excellent, and the majority of participants rated their telehealth assessment to be as good as their in-person assessment. It could be that this result was in part due to the high level of clinical expertise held by the physiotherapists that took part in this study, as perceived quality of care is considered a significant predictor of satisfaction with telehealth (33). Three participants did require telehealth equipment to be reconnected part-way through the assessment, however it was acknowledged by the specific assessor that this technical disruption did not affect their ability to adequately assess the participant.

There are strengths and limitations to this study. As suggested in previous studies (18, 19, 22), the repeated-measures study design may have enabled a 'learnt effect' in participants, subsequently influencing the responses provided in the second assessment. Provocation of symptoms, particularly for those participants presenting with severe and irritable conditions, may have also influenced their presentation in the second assessment. The involvement of six Musculoskeletal Physiotherapists across two sites strengthens the generalisability of results to other similar advanced-practice physiotherapy screening clinics. By only providing access to items or equipment commonly found within the home, this study also supports the provision of telehealth directly into the patient's own home, or via healthcare facilities in which basic

physiotherapy equipment is not readily available. By having the patient located in a room on their own, this study also demonstrated that a remote healthcare professional may not be necessary to assist with the assessment. In order to evaluate the reliability of telehealth within a 'real-world' clinical setting, the content of the assessment was also left to the discretion of the individual physiotherapist. While this decision may have resulted in some disagreement regarding clinical decisions, this pragmatic approach is in line with contemporary practice and therefore strengthens the overall findings. Finally, as mentioned previously, inter-rater agreement for each specific delivery medium was not evaluated. Further research into diagnostic and treatment agreement of physiotherapists within the same clinical environment would assist in determining to what degree discordance is the result of the delivery medium.

The results of this study add to the growing body of literature that demonstrates telehealth to be a viable and effective method of service delivery in the assessment of patients with chronic musculoskeletal conditions. To our knowledge, this is the first study that has evaluated the level of agreement between the two delivery mediums with respect to clinical management decisions required for patients referred to tertiary advanced-practice physiotherapy screening clinics. The broader clinical implication of this study is to support the implementation of telehealth into standard clinical practice for those patients unable to attend specialised services in person, thus enabling equitable access to healthcare in the management of chronic musculoskeletal conditions.

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Conflict of Interest: Two authors (X,X) have a material interest in the eHAB® telerehabilitation system. They have not been directly involved in the collection or analysis of data in this study.

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Highlights:

- Many patients unable to access advance-practice physiotherapy screening clinics.
- Agreement between in-person and telehealth MSK physiotherapy assessment evaluated.
- 42 patients with low back, knee or shoulder condition recruited from waitlists.
- Substantial agreement between two mediums demonstrated for clinical decisions.
- Telehealth is viable medium to assess patients unable to access service in person.