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Recommendations for exercise adherence measures in musculoskeletal settings: a systematic review and consensus meeting

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Final Report

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Project title: Recommendations for exercise adherence measures in musculoskeletal settings: a systematic review and consensus meeting

Investigating Team: Dr Sionnadh McLean, Dr Melanie Holden, Dr Kirstie Haywood, Tanzila Potia, Melanie Gee, Ross Mallett, Sadiq Bhanbhro

Supervisor (if applicable): not applicable

Start date: 01 April 2013 **Finish date: 06 June 2014**

1. Executive Summary

Background: Exercise programmes are frequently advocated for the management of musculoskeletal disorders; however, adherence is an important pre-requisite for their success. The assessment of exercise adherence requires the use of relevant and appropriate measures, but guidance for appropriate assessment does not exist. The aim of this study was to recommend outcome measures of exercise adherence that have clinical and research utility in the musculoskeletal field.

Methods: There were two key stages to the research. First, a systematic review of the availability, quality and acceptability of measures used to assess exercise adherence in musculoskeletal disorders; second, a consensus meeting. The systematic review was conducted in two phases and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure a robust methodology. Phase one identified all reproducible measures that have been used to assess exercise adherence in a musculoskeletal setting. Phase two identified published and unpublished evidence of the measurement and practical properties of identified measures. Study quality was assessed against the COnsensus-based Standards for the selection of health Measurement INstruments (COSMIN) guidelines. A shortlist of measures was produced for consideration during stage two: a meeting of relevant stakeholders (n=14) in the United Kingdom. During this meeting consensus on the most relevant and appropriate measures of exercise adherence for application in research and/or clinical practice settings was sought.

Key findings: Our systematic review identified numerous measures which had been used as measures of exercise adherence within musculoskeletal research. Of these 36 were deemed reproducible. However, only six had been evaluated as specific measures of exercise adherence for musculoskeletal research: evidence of essential measurement and practical properties was mostly limited or not available. Assessment of relevance and comprehensiveness was largely absent and there was no evidence of patient involvement during the development of any measure. During the consensus process the stakeholders reached agreement that none of the measures were relevant, appropriate or acceptable for use in musculoskeletal clinical or research settings.

Conclusions and recommendations: Numerous exercise adherence measures are currently used within musculoskeletal research. However, many of these measures were not originally developed for this purpose; many approaches are not reproducible; and evidence of essential measurement and practical properties was only identified for a limited number of measures. Moreover, substantial methodological and quality issues were identified in the development and evaluation of the six short-listed measures which reduces confidence in the ability of these measures to reliably and validly evaluate adherence to exercise. Furthermore key stakeholders unanimously agreed that these measures were not fit for purpose. Measures of exercise adherence must be clearly conceptualised. Future development and evaluation should seek to involve patients, clinicians and researchers as active collaborators and use credible methods to develop and evaluate an appropriate measure of exercise adherence.

(457 words – 500 max)

The full report can be obtained from the lead author (Dr Sionnadh McLean; s.mclean@shu.ac.uk)

2. Research Report (4 pages – max)

2.1 Project aims and objectives: Aim: To recommend outcome measures of exercise adherence that have clinical and research utility in the musculoskeletal field. Specific objectives were to:

a. identify all measures of exercise adherence appropriate for musculoskeletal conditions.
b. evaluate the measurement and practical properties of available adherence measures against established criteria to provide a shortlist of candidate measures.
c. convene a consensus workshop with patient representatives and other stakeholders to discuss the relevance and appropriateness of candidate measures and prioritise those which are useful, acceptable and feasible for use in clinical and research practice.
d. publish recommendations regarding measures of exercise adherence for use in both clinical practice and research within the musculoskeletal field.

2.2. Methodology and methods: A detailed protocol has already been published [1] and is summarised here. There were two key stages to the proposed research. First, a systematic review of the quality and acceptability of measures used to assess exercise adherence; second a consensus meeting of UK stakeholders. The systematic review was conducted in two phases and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [2].

Stage 1.1 Review: Identification of exercise adherence measures: A comprehensive search strategy was used to locate all measures used to assess exercise adherence in a musculoskeletal context. The search was run in multiple databases from their inception until May 2013: Titles and abstracts of all identified articles were reviewed for inclusion by two independent reviewers and agreement checked. A third independent reviewer was used to resolve any differences regarding eligibility.

Studies were included if they involved: i) adults with musculoskeletal disorders, ii) any therapeutic exercise or physical activity intervention, iii) clearly defined and reproducible measures used to assess adherence to exercise or physical activity, including patient-reported or clinician-reported measures or exercise diaries (if converted to an adherence measurement scale), and iv) exercise or activity delivered in any therapeutic setting including inpatient, outpatient, and community settings. Studies were excluded if they were not written in English; involved participants under 18 years of age; participants with non-musculoskeletal conditions such as diabetes, asthma, and cancer, or iii) if they include healthy volunteers. Performance measures (i.e., muscle strength and joint range of movement), performance of exercise technique and attendance at sessions are often considered proxy measures of exercise adherence and were therefore excluded from this review. Following title and abstract screening, full text articles of retained studies were reviewed for inclusion and adherence measures were identified. Cleary defined and reproducible measures of exercise adherence used within the musculoskeletal field were then located and collated.

Stage1.2 Review: Identification of development and/or evaluative papers: Published articles reporting the development and/or evaluation of measurement and/or practical properties for all reproducible measures were sought by performing further measure-specific searches. Evidence was sought from within and outside musculoskeletal settings. All titles and abstracts, and where applicable full text articles, were assessed for inclusion by two independent reviewers and a third reviewer resolved any disagreements. Reference lists of included articles were reviewed for additional published articles. Where possible, measure developers were contacted to locate additional published or unpublished evidence of measurement development and/or evaluation.

A standardised data extraction form was used to ensure that data necessary to support an evaluation of both study and measure quality was extracted. Data extraction captured study-specific information and measurement tool-specific information including evidence of reliability, validity, hypothesis testing; evidence of the conceptual underpinning and the aspects of exercise adherence which the measure purports to assess; responsiveness; interpretation; precision and evidence of practical properties. The extent of patient involvement in measurement development and/or application was also sought. In accordance with the COSMIN checklist, each measurement property reported by the study was rated on a 4-point scale (i.e., excellent, good, fair, poor)[3,4]. Study methodological quality was evaluated per measurement property and determined by the lowest checklist rating [3,4]. Two reviewers independently undertook data extraction and

applied the checklist to each included study. Consensus was sought through discussion; any disagreements were resolved using a third reviewer.

All data was qualitatively synthesised to determine the overall quality and acceptability of each reviewed measure. The synthesis took the following factors into account: i) study methodological quality (COSMIN scores); ii) the number of studies reporting specific evidence per measure; iii) the results for each measurement/practical property per measure; and iv) consistency between studies [5]. The data synthesis score has two elements. First, the overall quality of a measurement property was reported as: adequate (+), not adequate (-), conflicting (+/-), or unclear (?). Second, levels of evidence for the overall quality of each measurement property was further defined to indicate 'strong', 'moderate', 'limited', 'conflicting', or 'unknown' evidence [5]. The synthesis produced a shortlist of relevant measures that was further considered in stage two.

Stage 2: Consensus meeting: The final stage of the project was a one-day 'expert' meeting to gain consensus on the 'best' measures of exercise adherence for musculoskeletal settings. A structured group decision-making approach, or Nominal Group Technique [6-8], was used to work towards consensus on two main questions; 1) What should be measured when assessing exercise adherence? and 2) How 'useful' are the shortlisted measures of exercise adherence with respect to: relevance (to the aspects of exercise adherence viewed as most important); acceptability (to patients who are required to adhere to exercise regimes); appropriateness (to the musculoskeletal population) and; feasibility (for use in clinical research and/or routine practice settings)?

The results of stage 1 were used to inform the development of a nominal group questionnaire which further supported exploration of the key questions posed (above). A synthesis of stage 1, the aspects of adherence to exercise assessed by the short-listed measures, copies of the six short-listed measures, and the questionnaire were sent to participants in advance of the meeting. Participants were asked to rate the relative importance of each aspects of exercise adherence using a 9-point GRADE scale (1 to 3 = not important; 4 to 6 = important; 7 to 9 = critical) [9,10]; additional aspects could be added and rated for importance. Participants were also asked to consider the relevance and feasibility of each measure for research or clinical musculoskeletal settings on a similar 9-point GRADE scale. Finally, participants were asked to rate the suitability of each measure for the assessment of exercise adherence in i) research (yes/no) or ii) routine practice (yes/no). Completed questionnaires were returned in advance of the meeting to allow results to be collated.

The consensus meeting was structured into three discrete sections [11-13]. First the evidence synthesis was represented [10], and group results from postal completion of questionnaires was shared with the group. Next, semi-structured group discussions were facilitated and participants were again invited to address the two core questions stated above. Finally, a plenary session was convened and the results from the group sessions fed back to all participants. There was an anonymised voting process, during which a common view was reached on which aspects of exercise adherence should be assessed (1. What to measure?). Recommendations for the most relevant and appropriate method of assessment (2. How to measure?) were also reached. During the final vote participants were invited to vote (yes/no) as to whether each domain and each outcome measure should be included in the assessment of exercise adherence. 70% agreement was chosen as the threshold at which a domain would make an important contribution to the measurement of adherence or a measure would be considered relevant, feasible, acceptable or appropriate.

2.3. Sampling and recruitment: 14 participants representing key stakeholders were recruited to the consensus meeting. We originally intended to recruit 15 stakeholders, but were unable to recruit a researcher with an exercise background; however we feel that we did recruit key stakeholders.

2.4 Findings

Identification of studies and outcome measures: The flow charts showing the results of study selection are shown in Appendix 1. In stage1.1 the initial search yielded 11,981 records. Following independent screening of titles, abstracts and full-text articles 313 relevant articles were identified which investigated adherence to therapeutic exercise in patients with a musculoskeletal disorder. Though many different measures of

adherence were utilised within these studies, many were not clearly described, defined or reproducible and/or lacked citation to an original source. Consequently, only 36 clearly defined and reproducible measures which had been used to evaluate adherence to therapeutic exercise were identified. Stage 1.2, the measure-specific search yielded 3735 records. Following independent screening of titles, abstracts and full-text articles, 10 articles, reporting on 14 separate studies, were identified which were related to measurement and practical properties of the identified measures of exercise adherence. Of the original 36 outcome measures only 6 were evaluated exercise adherence. These are summarised in Appendix 2.

Measurement and practical properties of adherence measure: The measurement and practical properties of the six measures are summarised in Appendix 3. Limited evidence of reliability and validity was extracted for five of the measures; the PRPS had only limited evidence of validity. However, evidence of responsiveness, interpretation, precision and acceptability was not identified. There was no involvement of patients in the development of any of the measures which raises questions about their content validity and acceptability to patients. The key characteristics and measurement properties for each measure is summarised below:

1) The Sport Injury Rehabilitation Adherence Scale (SIRAS) [14] is a 3-item scale completed by the therapist to rate the degree to which patients exert themselves, follow practitioners instructions and advice, and are receptive to change in the rehabilitation program. Nine studies provided limited evidence of internal consistency, test-retest reliability, convergent and known-groups validity.
2) Hopkins Rehabilitation Engagement Rating Scale (HRERS) [15] is a 5-item questionnaire completed by the health professional in acute in-patient rehabilitation. This scale is completed once only, at the time of discharge from treatment, providing a summary of the health professional's perception of patient participation. One poor quality study provided limited evidence of its internal consistency, test-retest reliability, convergent and known-groups validity.
3) Pittsburgh Rehabilitation Participation Scale (PRPS) [16] is a single item, therapist-completed rating of the extent of patient participation (effort and motivation) during each treatment session of acute inpatient rehabilitation. The question is completed after each treatment session. One moderate quality study provides limited evidence of test-retest reliability and convergent validity.
4) Adherence to Exercise Scale for Older Patients (AESOP) [17] is a patient completed 43-item questionnaire administered verbally during a face-to-face interview. One low quality study provides limited evidence of moderate test-retest reliability and limited evidence of no convergent validity.
5) Community Healthy Activities Model Program for Seniors (CHAMPS) Activities Questionnaire for Older Adults [18] is a 41-item questionnaire which can be completed by the patient or administered by someone else. One poor quality study provides limited evidence of moderate test-retest reliability, modest convergent validity, known groups validity and small to moderate level of responsiveness.
6) The modified Rehabilitation Adherence Questionnaire (RAQ-M)[19] consists of 25 items designed to assess perceived exertion, pain tolerance, self-motivation, support from significant others, scheduling, and environmental conditions. One poor quality study provides limited evidence of poor internal consistency, (inconsistent/conflicting/variable) test-retest reliability and modest convergent validity.

Findings from the consensus meeting: Prior to the consensus meeting 38 domains related to the measurement of exercise adherence were identified from the 6 measures. A further 8 were identified by stakeholders during the consensus process. Participants were asked vote (Yes/No) whether each of the 46 possible domains made an important contribution to the measurement of exercise adherence. Participants reached 70% consensus agreement or above on 25 domains. The domains considered and the consensus level reached are summarised in Appendix 4. Participants were asked to rate the relevance, feasibility, acceptability and appropriateness of the six measures in clinical trials and routine clinical settings. Participants agreed that SIRAS, HRERS and PRPS were feasible for use in routine clinical practice, but that they were not feasible for use in clinical trials. With these exceptions, participants agreed that none of the measures were relevant, feasible, acceptable or appropriate for use in either routine clinical settings or in clinical trials. The level of agreement for use of the shortlisted measures is summarised in Appendix 5.

2.5 Discussion: This is the first published review investigating the measurement and practical properties of measures of exercise adherence used within the musculoskeletal field and the first occasion that adherence measures have been reviewed by a stakeholder group that includes patient representatives. Our systematic review revealed that available exercise adherence measures are of low quality. Furthermore key stakeholders

agreed that these measures were not relevant, feasible, acceptable or appropriate for use in routine clinical settings or in clinical trials. Based on the findings of our study we are not able to recommend the use of any of the current available exercise adherence measures. Adherence measures need to be clearly conceptualised and developers must seek to involve patients, clinicians and researchers as active collaborators and use credible methods to develop and evaluate an appropriate measure of exercise adherence.

This review has been developed and conducted in accordance with PRISMA guidelines, used COSMIN guidelines to evaluate study quality and has utilised key stakeholders views to reach a consensus view that current available exercise adherence measures are not fit for purpose. The possibility of publication bias cannot be excluded and we were unable to contact a number of developers in order to confirm or refute the existence of further relevant unpublished studies.

3. Conclusion: We located 6 relevant measures of exercise adherence but found that overall they were poorly developed, inadequately tested for measurement and practical properties and according to our key stakeholders they were not suitable for use in either routine clinical settings or in clinical trials.

4. **Financial Statement:** see Appendix 6

5. **Dissemination**

Holden MA, Haywood KL, Potia TA, Gee M, McLean S (2014) Recommendations for exercise adherence measures in musculoskeletal settings: a systematic review and consensus meeting (protocol). *Systematic Reviews*. Published online first: February 2014, Available at http://www.systematicreviewsjournal.com/content/pdf/2046-4053-3-10.pdf

Proposed publications and presentations:

- McLean et al. Exercise adherence measures for musculoskeletal settings: a systematic review. Target journal: Rheumatology, planned submission date: Autumn 2014.
- Mallett et al. Recommendations for exercise adherence measures in musculoskeletal settings: a consensus meeting. Target journal: Archives of Physical Medicine and Rehabilitation or BMC Musculoskeletal Disorders, planned submission date: Autumn 2014.
- The findings will also be presented at national and international conferences. The following conferences are being targeted: World Congress of Physical Therapy 2015; Rheumatology 2015; Physiotherapy 2015

6. Clinical Impact: Exercise adherence is currently measured in many different ways and none of those reviewed in this study are fit for purpose. There is considerable uncertainty about what exercise adherence actually is and how it should be measured. We are therefore unable to recommend an appropriate measure of exercise adherence for use in either clinical or research settings at this time. Exercise adherence needs to be reconceptualised by methods involving patients, clinicians and researchers as active collaborators, and credible methods are then needed to develop and evaluate an appropriate measure of exercise adherence.

7. Acknowledgements: We would like to acknowledge the participants of the consensus group: Ruth Davies – PPI, Kirsty Wilde – PPI, Bernice Cowton – PPI, Hazel Cowton – PPI, Tim Eady – PPI, Di Smith – PPI, Helen Copeland – PT, Nicola Oxspring – PT, Anna Green – PT, Jon Fawcett – manager, Sharon Sweeting - manager, Jane Auckland – manager, Rachel Frost - adherence expertise, Annette Bishop – measurement expertise. Members of the steering group were: Hazel Horobin – PPI; Devdeep Ahuja – PT, Jeff Breckon - researcher

8. **Research Capacity Building:** Dr Melanie Holden has successfully applied for an ACORN studentship from Keele University for a doctoral student to undertake a programme of research leading to the development of an exercise adherence measure. Successfully obtaining this grant and undertaking this research has contributed to Dr Melanie Holden being awarded a Bridging Fellowship from the NIHR School of Primary Care to enable her to continue to develop her expertise in the area of exercise and osteoarthritis. Dr Sionnadh McLean was appointed as a Reader in Physiotherapy after getting this award.

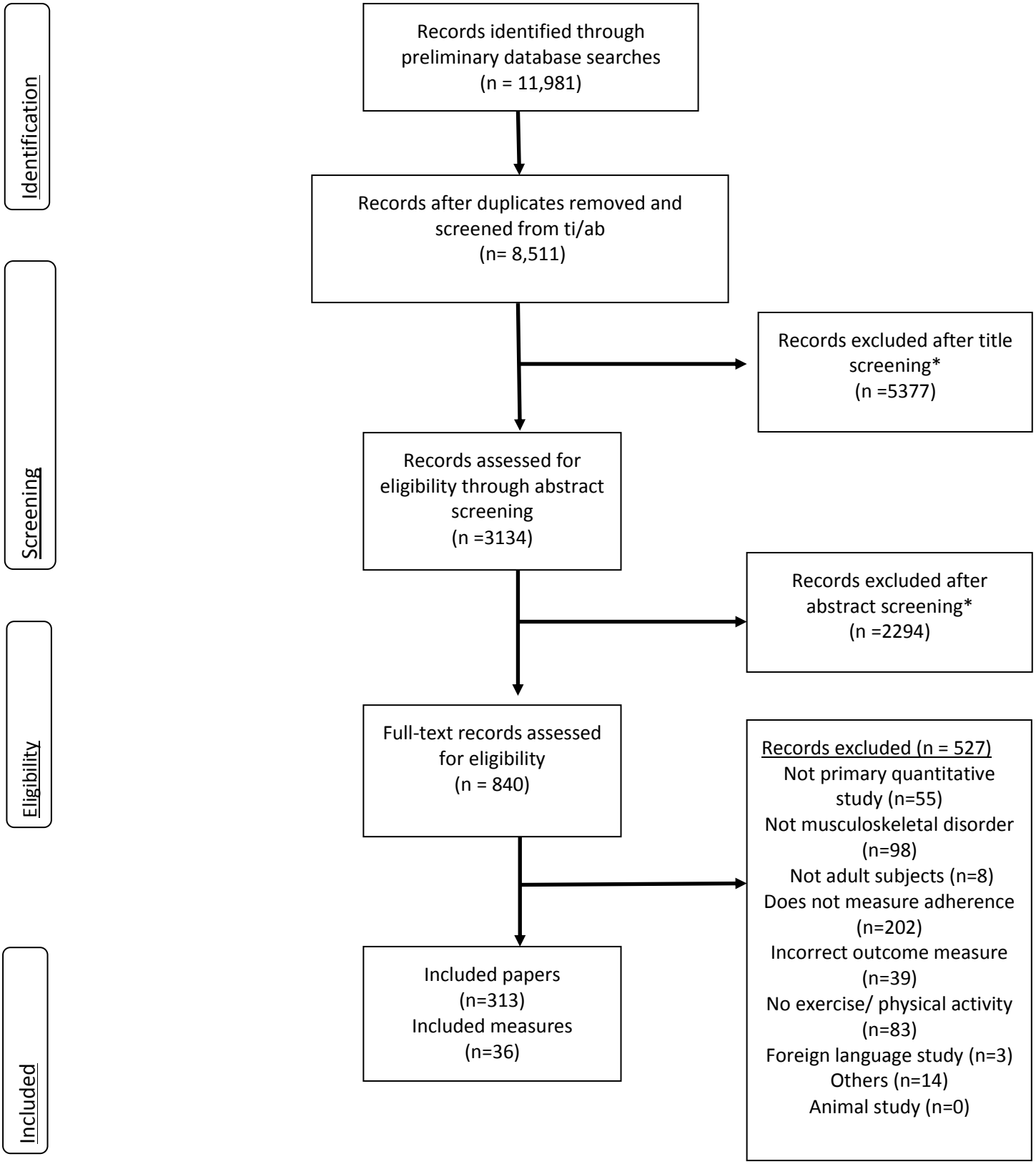
Principal Investigator: Sionnadh McLean Date: 06 June 2014

References:

1. Holden MA, Haywood KL, Potia TA, Gee M, McLean S: Recommendations for exercise adherence measures in musculoskeletal settings: a systematic review and consensus meeting (protocol). *Systematic Reviews*. Published online first: February 2014, Available at http://www.systematicreviewsjournal.com/content/pdf/2046-4053-3-10.pdf
2. The PRISMA group: Preferred Reporting Items for Systematic reviews and Meta-Analyses: The PRISMA statement. 2009. http://www.prisma-statement.org/.
3. Terwee CB, Mokkink LB, Knol DL, Ostelo RW, Bouter LM, de Vet HC: Rating the methodological quality in systematic reviews of studies on measurement properties: a scoring system for the COSMIN checklist. Quality of Life Research 2012, 21:651–657.
4. Mokkink LB, Terwee CB, Patrick DL, Alonso J, Stratford PW, Knol DL, Bouter LM, de Vet HC: The COSMIN study reached international consensus on taxonomy, terminology, and definitions of measurement properties for health-related quality patient-reported outcomes. Journal of Clinical Epidemiology 2010, 63:737–745.
5. Elbers RG, Rietberg MB, van Wegen EE, Verhoef J, Kramer SF, Terwee CB, Kwakkel G: Self-report fatigue questionnaires in multiple sclerosis, Parkinson's disease and stroke: a systematic review of measurement properties. Quality of Life Research 2012, 21:925–944.
6. Gallagher M, Hares T, Spencer J, Bradshaw C, Webb I: The nominal group technique: a research tool for general practice? Family Practice 1993, 10:76–81.
7. Harvey N, Holmes CA: Nominal group technique: an effective method for obtaining group consensus. International Journal of Nursing Practice 2012, 18:188–194.
8. Foster NE, Dziedzic KS, van der Windt D, Fritz J, Hay EM: Research priorities for non-pharmacological therapies for common musculoskeletal problems: nationally and internationally agreed recommendations. BMC Musculoskeletal Disorders 2009, 10:3.
9. Grade Working Group. http://www.gradeworkinggroup.org.
10. Williamson PR, Altman DG, Blazeby JM, Clarke M, Devance D, Gargon E, Tugwell P: Developing core outcome sets for clinical trials: issues to consider. Trials 2012, 13:132
11. Murphy MK, Black NA, Lamping DL, McKee CM, Sanderson CF, Askham J, Marteau T: Consensus development methods, and their use in clinical guideline development. Health Technology Assessment 1998, 2(3):1–88. i–iv.
12. Vella K, Goldfrad C, Rowan K, Bion J, Black N: Use of consensus development to establish national research priorities in critical care. BMJ 2000, 320:976–980.
13. Sarre G, Cooke J: Developing indicators for measuring research capacity development in primary care organizations: a consensus approach using a nominal group technique. Health **&** Social Care **in the** Community 2009, 17:244–253.
14. Brewer BW, Daly JM, van Raalte JL, Petipas AJ: A psychometric evaluation of the Rehabilitation Adherence Questionnaire. Journal of Sport & Exercise Psychology 1999, 21:167-173.
15. Kortte KB, Falk LD, Castillo RC, Johnson-Greene D, Wegener ST: The Hopkins Rehabilitation Engagement Rating Scale: Development and psychometric properties. Archives of Physical Medicine and Rehabilitation 2007, 88:877-884.
16. Lenze EJ, Munin MC, Quear T, Dew MA, Rogers JC, Begley AE, Reynolds CF: The Pittsburgh rehabilitation scale: Reliability and Validity of a clinician-rated measure of participation in acute rehabilitation. Archives of Physical Medicine and Rehabilitation 2004, 85:380-384.
17. Hardage J, Peel C, Morris D, Graham C, Brown CJ, Foushee HR, Braswell J: Adherence to exercise scale for older people (AESOP): A measure for predicting exercise adherence in older adults after discharge from home health physical therapy. Journal of Geriatric Physical Therapy 2007, 30:69-78
18. Stewart AL, Mills KM, King AC, Haskell WL, Gillis D, Ritter P : CHAMPS physical activity questionnaire for older adults : Outcomes for interventions. Medicine & Science in Sports & Exercise 2001, 33(7):1126-1141.
19. Shin JT, Park R, Song WI, Kim SH, Kwon, SM: The redevelopment and validation of the Rehabilitation Adherence Questionnaire for injured athletes. International Journal of Rehabilitation Research 2010, 33(1):64-71.

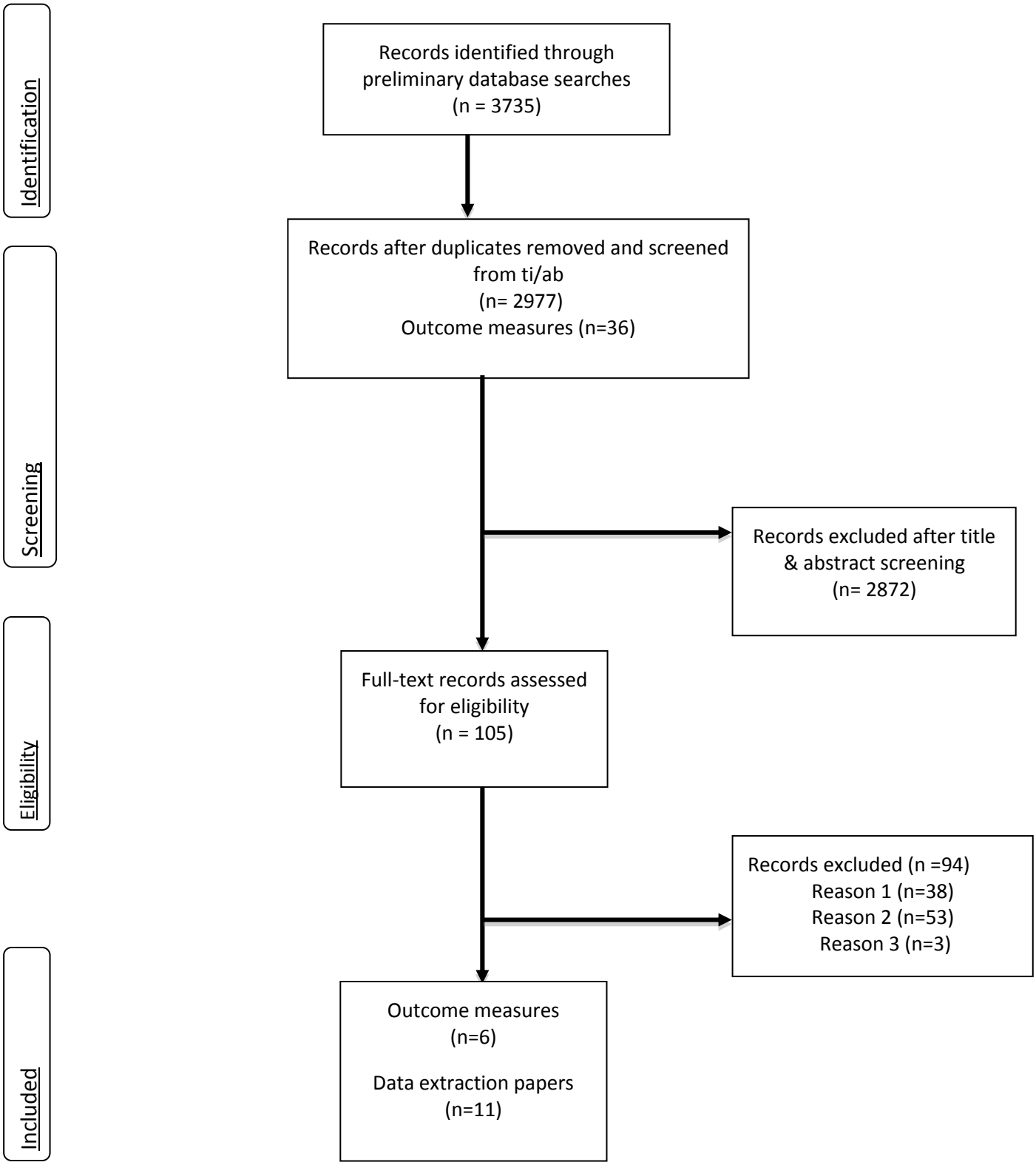
Appendix 1

PRISMA flow-chart for Phase 1 of the Systematic Review



Note: * The exclusion criteria used for the title and abstract screenings were the same as that detailed in the flow chart for full text screening

PRISMA Flow-chart for Phase 2 of the Systematic Review



Note: Reason 1= Fail to report evidence of measurement development, measurement or practical properties following application as a measure of exercise adherence. Reason 2= study reports application of the measure to assess a construct different to exercise adherence. Reason 3= not published in the English Language

Table: Summary of Final Six Exercise Adherence Measures Included in Review **Appendix 2**

Measure	Developer	Primary purpose (e.g. adherence, physical activity/ population etc)	Brief description of domains measures	Notes
Sports Injury Rehabilitation Adherence Scale (SIRAS)	Brewer et al 2000	Adherence during clinic-based rehabilitation programmes	3 item measuring 1) Intensity of effort on rehabilitation exercise; 2) Frequency of following practitioner's instructions and advice and 3) receptivity to changes in the physical therapy programme.	Evidence suggests that development was clinician-driven without patient involvement; content validity, relevance and acceptability to patients was not evaluated
Hopkins Rehabilitation Engagement Rating Scale (HRERS)	Kortte et al. 2007	Used in rating behavioural observation during acute in-patient rehabilitation	5 items measuring 1.Attendance at rehabilitation session (1); 2.Frequency of required Verbal/Physical Prompts (1); 3.Perceived Positive attitude to exercise (2) ;4.Active participation in rehabilitative exercise (1)	Items developed by researchers with expertise in rehabilitation of patients with medical problems, which were then reviewed and endorsed by the rehabilitation therapy staff for comprehensiveness in capturing the key elements of engagement.
Pittsburgh Rehabilitation Participation Scale (PRPS)	Lenze et al. 2004	Observed patient participation in a therapy session	2 items measuring 1.Perceived Intensity/Effort/Exertion (1) 2. Perceived Self-motivation (1)	This scale was developed based on observations by occupational and physical therapists and study investigators.
Adherence to Exercise Scale for Older Patients (AESOP)	Hardage et al. 2007	Self-efficacy expectations, outcome expectations, and outcome expectancies for predicting adherence	42 items measuring 1. Self-efficacy expectations (15 items); 2. Outcome expectations (16 items); 3. Outcome expectancies (11 items)	The AESOP was developed to assess exercise adherence in older patients. Items developed by an expert panel of physical therapist, no involvement of patients.
Community Healthy Activities Model Program for Seniors (CHAMPS) Activities Questionnaire for Older Adults	Stewart et al. 2001	Types and intensity levels of Physical activity	41 items measuring activities of daily living, work –related, social activities and leisure activities	The CHAMPS was originally developed as a measure of general activity and activities of daily life, however it has been adapted for use as a measure of exercise adherence.
Modified - Rehabilitation Adherence Questionnaire (RAQ-M)	Fisher et al 1988	Rehabilitation adherence in injured athletes	40 items measuring Self-report inventory with subscales designed to assess 1) perceived exertion, 2) pain tolerance, 3) self-motivation, 4) support from significant others, 5) scheduling and 6) environmental conditions.	Modification of the 41 item Rehabilitation Adherence Questionnaire developed by Fisher et al 1988. Items in the modified version were reviewed for relevance by an expert panel which did not include patients.

Measurement and Practical Properties of the 6 Exercise Adherence Measures **Appendix 3**

Measure	Eval (n)	Reliability			Validity				Responsiveness
		Test-retest	Internal consistency	Measurement error	Content	Convergent/ divergent	Known groups	Structural	Responsiveness
Therapist-completed									
HRERS	1	+ limited	+ limited	Nil	Nil	+ limited	+ limited	Nil	Nil
PRPS	1	Nil	Nil	Nil	Nil	+ limited	Nil	Nil	Nil
SIRAS	9	+ limited	+ limited	Nil	Nil	+ limited	+ limited	Nil	Nil
Patient-completed									
AESOP	1	- limited	Nil	Nil	Nil	+ limited	Nil	Nil	Nil
CHAMPS	1	- limited	Nil	Nil	Nil	+ limited	? limited	Nil	- limited
RAQ	1	- limited	+ limited	Nil	Nil	+ limited	Nil	Nil	Nil

Notes: n= number of studies evaluating the measurement and practical properties of each measure; the overall quality of a measurement property is reported as: adequate (+), not adequate (-), conflicting (+/-), or unclear (?); levels of evidence for the overall quality of each measurement property is ‘strong’, ‘moderate’, ‘limited’, ‘conflicting’, or ‘unknown’ evidence

Appendix 4

Table 4: Results in rank order of consensus inclusion of the domains for the assessment of exercise adherence in therapeutic exercise (n= 46).

	Yes (%)	No (%)
The amount and frequency of completed exercise (Patient's Perspective):	100.0	0.0
Accuracy of exercise completion (Patient's Perspective):	100.0	0.0
The patient's ability to complete exercise despite other commitments (Patient's Perspective):	100.0	0.0
The patient's understanding of the benefits of exercise (Patient's perspective):	100.0	0.0
Agreement of exercise recommendations (Patient's perspective):	100.0	0.0
The extent to which the patient follows a therapist's instructions (Patient's Perspective):	92.9	7.1
Attendance at rehabilitation sessions (Clinician's Perspective):	92.9	7.1
The extent to which the exercise works towards an agreed goal (Patient's Perspective):	92.9	7.1
Accuracy of exercise completion (Clinician's Perspective):	92.9	7.1
The amount and frequency of completed exercise (Clinician's Perspective):	85.7	14.3
The extent to which the patient follows a therapist's instructions (Clinician's Perspective):	85.7	14.3
Attendance at rehabilitation sessions (Patient's Perspective):	85.7	14.3
The extent to which the patient actively participates in exercise (Patient's Perspective):	85.7	14.3
The extent to which the exercise works towards an agreed goal (clinician's Perspective):	85.7	14.3
Self-motivation of the patient during exercise (Patient's Perspective):	85.7	14.3
The patient's ability to complete exercise although it is challenging (Patient's perspective):	85.7	14.3
The patient's understanding of the benefits of exercise (Clinician's perspective):	85.7	14.3
The patient's attitude toward exercise (Patient's perspective):	85.7	14.3
Agreement of exercise recommendations (Clinician's Perspective):	85.7	14.3
The level of patient support received from family and friends (Patient's Perspective):	78.6	21.4
The patient's ability to complete exercise despite other commitments (Clinician's Perspective):	78.6	21.4
The patient's ability to complete exercise although it is challenging (Clinician's perspective):	78.6	21.4
The extent to which the patient actively participates in exercise (Clinician's Perspective):	71.4	28.6
The patient's attitude toward exercise (Clinician's perspective):	71.4	28.6
Relationship between therapist and patient (Patient's perspective):	71.4	28.6
The patient's pain tolerance during exercise (Patient's Perspective):	64.3	35.7
Self-motivation of the patient during exercise (Clinician's Perspective):	64.3	35.7
Relationship between therapist and patient (Clinician's perspective):	64.3	35.7
The signs of physical or mental demands during exercise (Patient's Perspective):	57.1	42.9
The patient's pain tolerance during exercise (Clinician's Perspective):	50.0	50.0
The patient's receptiveness to change in a therapeutic exercise programme (Patient's Perspective):	50.0	50.0
The extent to which the patient completes exercise without encouragement (Clinician's perspective):	50.0	50.0

The patient's ability to resume exercise following a forced break (Patient's perspective):	50.0	50.0
The signs of physical or mental demands during exercise (Clinician's Perspective):	42.9	57.1
The patient's receptiveness to change in a therapeutic exercise programme (Clinician's Perspective):	42.9	57.1
The patient's enjoyment of exercise (Patient's perspective):	42.9	57.1
The patient's ability to resume exercise following a forced break (Clinician's perspective):	42.9	57.1
The level of patient support received from family and friends (Clinician's Perspective):	35.7	64.3
The extent to which the patient completes exercise without encouragement (Patient's perspective):	35.7	64.3
The amount of prompting required to complete an exercise correctly (Clinician's Perspective):	21.4	78.6
The suitability of the exercise environment for the patient's needs (Patient's Perspective):	21.4	78.6
The patient's enjoyment of exercise (Clinician's perspective):	21.4	78.6
Calorie expenditure of a given exercise (Patient's Perspective):	14.3	85.7
The amount of prompting required to complete an exercise correctly (Patient's Perspective):	14.3	85.7
The suitability of the exercise environment for the patient's needs (Clinician's Perspective):	14.3	85.7
Calorie expenditure of a given exercise (Clinician's Perspective):	0.0	100.0

Note:

1. Dichotomous scale (Yes / No) – 70% consensus required for domain to be included.
2. 8 items in bold/italics – identified by stakeholders during consensus process

Appendix 5

Table: The percentage level of agreement for relevance, feasibility, acceptability, appropriateness and suitability of the 6 shortlisted measures. Voting was on a dichotomous (Yes/No) scale.

	Relevant Yes (%)	Feasible Yes (%)	Acceptable Yes (%)	Appropriate (Yes %)	Suitable overall (Yes %)
HRERS in Routine Practice	7.1	85.7	7.1	7.1	14.3
HRERS in Clinical Trials	7.1	64.3	7.1	0.0	0.0
PRPS in Routine Practice	14.3	85.7	0.0	14.3	14.3
PRPS in Clinical Trials	7.1	50.0	7.1	0.0	0.0
RAQ in Clinical Trials	14.3	21.4	0.0	0.0	0.0
SIRAS in Routine Practice	14.3	85.7	7.1	7.1	7.1
SIRAS in Clinical Trials	7.1	64.3	14.3	0.0	0.0
AESOP in Routine Practice	0.0	7.1	0.0	0.0	0.0
AESOP in Clinical Trials	0.0	14.3	7.1	0.0	0.0
CHAMPS in Routine Practice	0.0	0.0	0.0	0.0	0.0
CHAMPS in Clinical Trials	0.0	21.4	0.0	0.0	0.0
RAQ in Routine Practice	7.1	0.0	0.0	0.0	0.0
RAQ in Clinical Trials	14.3	21.4	0.0	0.0	0.0

Table: Financial statement **Appendix 6**

Project Name : Exercise Adherance Measures								
PI: Sionnadh McLean								
Start Date : 01/04/2013								
Duration : 14 Months								
	BUDGET			ACTUALS			VARIANCE to	
	Year 1	Year 2	TOTAL	Year 1	Year 2	TOTAL	BUDGET	
SHU Salaries								
S Mclean	9,332.00	-	9,332.00	9,332.30	-	9,332.30	-	0.30
R Mallett	10,018.50	3,595.00	13,613.50	4,235.19	8,512.80	12,747.99		865.51
S Bhanbhro		2,006.00	2,006.00	-	2,006.00	2,006.00		-
Information Scientist		622.50	622.50		622.50	622.50		-
M Gee	4,071.00	679.00	4,750.00	4,071.40	678.60	4,750.00		-
TANZILA ASIF POTIA	11,346.00	1,893.00	13,239.00	9,532.08	3,706.92	13,239.00		-
NON SHU Salaries								
M Holden - Keele	13,800.00	2,364.00	16,164.00	9,699.00	6,465.00	16,164.00		-
K Haywood - Warwick	10,988.00	1,832.00	12,820.00	-	12,820.00	12,820.00		-
Travel & Subsistence	604.00	99.00	703.00	107.46	200.00	307.46		395.54
Equipment & Consumables	44.00	7.00	51.00		-	-		51.00
Other	1,274.00	2,037.00	3,311.00	10.80	1,111.95	1,122.75		2,188.25
Congress presentation		600	600		4,100.00	4,100.00	-	3,500.00
TOTAL	**61,477.50**	**15,734.50**	**77,212.00**	**36,988.23**	**40,223.77**	**77,212.00**		0
		Invoices Raised						
		HWI07863		19,406.88				
		HWI08269		17,920.65				
		TOTAL INVOICED		37,327.53				
		Balance to invoice as at June 2014		39,884.47				