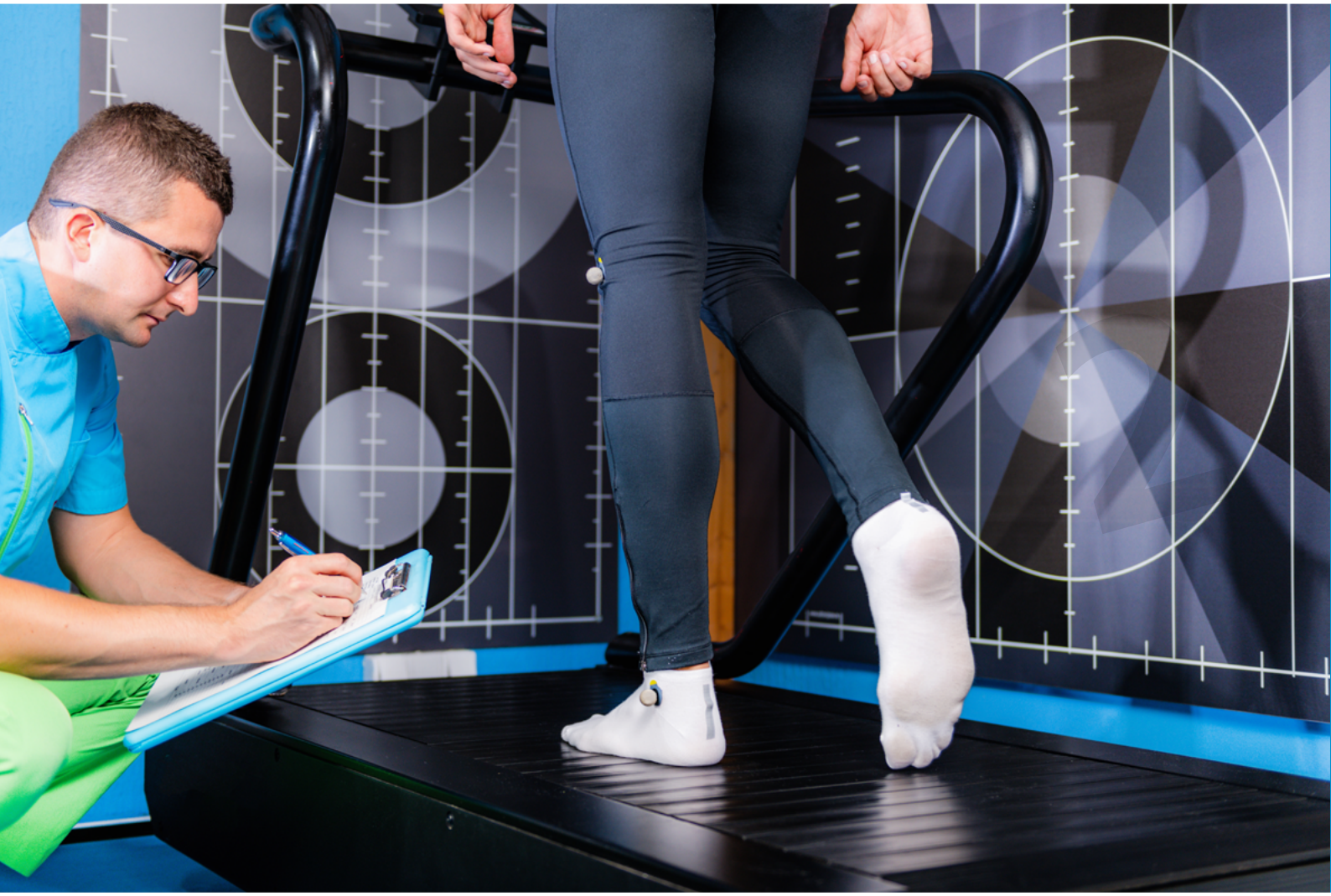
The British Association of Prosthetics and Orthotics



Measuring Change

An introduction to clinical outcome measures in prosthetics and orthotics

2nd Edition

Contents

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Introduction

In today's healthcare environment, it remains important that the effects of medical interventions, including prosthetic and orthotic care, are assessed and recorded. Outcome measures (OMs) are useful in assessment, clinical decision making, and evidencing the outcomes of treatment to either the service user or third parties. OMs may also facilitate clinical audit and research, and help practitioners to reflectively evaluate their own practice. It is the position of the BAPO Outcome Measures Working Group that understanding and using OMs is a core aspect of prosthetic and orthotic practice. The primary aim of this document is to enable prosthetists and orthotists, and other team members such as support workers, to understand and use simple OMs in clinical practice to improve patient care. In his 2024 evaluation of the state of the NHS, Professor Darzi states that 'The National Health Service is in serious trouble',[1]. This highlights the need for change and improvement. In this context, there is a strong case for measuring outcomes within services as part of driving improvements and evidencing success.

This updated 2nd edition of the BAPO 'Measuring Change' document provides an introduction to clinical outcome measures. This new edition comes following the 10th anniversary of the publication; the original project was completed in 2014 by a BAPO working group and published in 2015. This edition has been streamlined by removing some of the original material such as details on the survey methodology, and updates and adds various references. A single sheet designed for reference use in clinic has been added, in addition to an OM audit template to assess the frequency of OM use in a clinic or service.

Since the original publication, UK prosthetists and orthotists have continued to work on implementing outcome measures into practice. Two studies have been published by the project lead, investigating OM use among UK prosthetists/orthotists and other Allied Health Professionals, and reporting barriers to use.[2,3] Natalie Hall has published research on clinician perspectives on OMs.[4] Conor McDaid has worked on developing orthotic specific scales for the Therapy Outcome Measure, and has taught courses on this for the profession. Eileen Morrow is undertaking doctoral studies looking at outcome measures in children's orthopaedics, and has published research to inform the development of a core outcome set.[5] Further work will be needed to improve practice in this area, with the ultimate aim of improving outcomes for patients.

Evidence-based practice

The concept of EBP states that decision making in healthcare should be informed by the best available evidence, clinician experience, and the patient's preferences.[6] On a day to day basis, clinicians may ask such questions as:

- Is the prosthetic/orthotic device working for my patient?
- Might another intervention be better for my patient?
- Is my patient's level of function changing over time?
- What effect is your clinical practice having on the service users you work with?

Answering these questions can be challenging and may require synthesis of research evidence, clinician experience, and patient feedback. Outcome measures can provide useful information as part of this process.

Outcome measures

'Outcome measure' (OM) is a term which describes various tools used to assess diverse aspects of health including physical ability, quality of life and pain. They commonly include clinical assessment procedures such as timed walking tests, and questionnaires. OMs such as timed walking tests are typically described as performance measures. Questionnaires completed by the patient are commonly termed Patient Reported Outcome Measures (PROMs). OMs are used to measure both baseline status, and any change in status due to healthcare interventions or natural progression of a condition. OMs sit within the EBP framework as they should be validated in research, often record patient perceptions, and may require clinician experience to administer and interpret. In the terms of the World Health Organisation's (WHO) International Classification of Functioning, Disability and Health (ICF), OMs may relate to body function, body structure and activities and participation.[7] Appropriate use of OMs requires selection of validated and appropriate measures, standardised administration and evaluation of results.[8]

Alignment with BAPO vision

This document aims to be in line with the vision of BAPO: ***"empowering the profession to enable the user"***. It aims to achieve this by supporting clinicians to use OMs as part of the care of patients who use prosthetic and orthotic devices, or who receive other treatments from prosthetists and orthotists.

Scope and aims of the document

This document is necessarily limited in its scope and pragmatic in its approach. The conditions treated by prosthetists and orthotists are very diverse, and the contexts that clinicians in the UK work in are varied. A previous national survey of prosthetists and orthotists indicated the following:

- Available clinical time is the most commonly reported barrier to using OMs
- Clinicians identify the need for education in OMs
- Available resources, space and administrative support are also barriers to OM use
- Understanding of statistical and validity issues surrounding OMs is limited
- Only a minority of clinicians report routine use of OMs

Considering the results of the survey, it was decided to create a document which:

a) provides background information on the theory and use of OMs, and
b) describes a small number of OMs which are quick, free, and broadly applicable to prosthetic and orthotic populations.

The goal was therefore to create a document that reflects the context of prosthetics and orthotics in the UK, in contrast to existing work which makes recommendations on OMs in individual populations.

Selected outcome measures

While measures of body structure (e.g. joint range of motion or Cobb angle) and instrumented assessments (e.g. gait analysis or plantar pressure measurement) may be used as outcome measures in specialist settings, these were not included in this document. The focus of this guidance is on pragmatic, clinically feasible outcome measures which can be implemented consistently across NHS prosthetic and orthotic services without the need for specialist equipment, advanced training or significant additional resource.

In selecting OMs, priority was given to those which are quick to administer, free for NHS use, require minimal equipment, and broadly applicable to prosthetic and orthotic populations. In this edition, four example OMs are discussed – the Timed Up and Go (TUG), 10 Metre Walk Test (10MWT), Numeric Pain Rating Scale (NRS-11), and Socket Comfort Score (SCS). These measures have a low time burden, are cost free for NHS clinical use and can be integrated easily into routine appointments. All of the OMs selected could be used with either prosthetic or orthotic patients, with the exception of the SCS, which was included due to its strong relevance and widespread applicability within prosthetic practice.

The included measures also reflect current UK practice. Three (TUG, SCS, NRS- 11) were among the most frequently reported OMs in the survey, and three (TUG, NRS-11, 10MWT) are used by prosthetists, orthotists and clinicians in dual practice. Highlighting measures which are already in use was considered most likely to support standardisation, improve consistency of administration and interpretation, and facilitate benchmarking and service evaluation between centres.

Document guide – where to start

- If you are new to OMs, consider starting with the section 2 - 'key terms and measurement properties'.
- If you want a quick supporting guide to using OMs in clinic tomorrow, start by reading the section for the specific tool (e.g. TUG) and then the clinical reference sheet (section 7).
- If you are leading a service, consider reading the 'use and interpretation' summary boxes in the outcome measures sections 3-6, and the audit template section (section 8).

Sources of further information

The update to this document has been completed by practising clinicians, without specific funding, and takes a pragmatic approach. Readers are encouraged to refer to other guidelines where available, to consider recommended processes for selecting and implementing OMs[9], and to review emerging research in order to identify further OMs which will be appropriate for use in their individual context and specialism. Due to the decision not to cover licensed OMs, one notable gap is a generic quality of life measure such as the EQ-5D instrument. Clinicians practising in prosthetics may wish to refer to the BACPAR Toolbox of Outcome Measures.[10] A useful source of information on various outcome measures is available from the Shirley Ryan Ability Lab Rehabilitation Measures Database.[11]

Introduction references

1 Darzi, A. Independent investigation of the NHS in England. 2024. www.gov.uk/government/publications/independent-investigation-of-the-nhs-in-england

2 Young J, Rowley L, Lalor S. Use of Outcome Measures Among Prosthetists and Orthotists in the United Kingdom. J Prosthet Orthot 2018;30(3):152-157.

3 Young J, Bowers R. Use of outcome measures by UK allied health professionals: a cross-sectional online survey. J Healthc Manag 2024; 30(2):1-13.

4 Hall N, Parker D, Williams A. An exploratory qualitative study of health professional perspectives on clinical outcomes in UK orthotic practice. J Foot Ankle Res. 2020; 13:49.

5 Morrow E, Morris C, Theologis T, et al. Allied health professionals' views on important outcomes of children's elective lower limb orthopaedic surgery: a qualitative interview study to inform a core outcome set. Disabil Rehabil. 2023; 46(13):2853-2861.

6 Sackett D, Rosenberg W, Gray J, et al. Evidence based medicine: what it is and what it isn't. BMJ 1996;312:71

7 World Health Organization. International Classification of functioning, disability and health. 2001, World Health Organization, Geneva.

8 Robinson C, Fatone S. You've heard about outcome measures, so how do you use them? Integrating clinically relevant outcome measures in orthotic management of stroke. Prosthet Orthot Int. 2013;37(1):30-42.

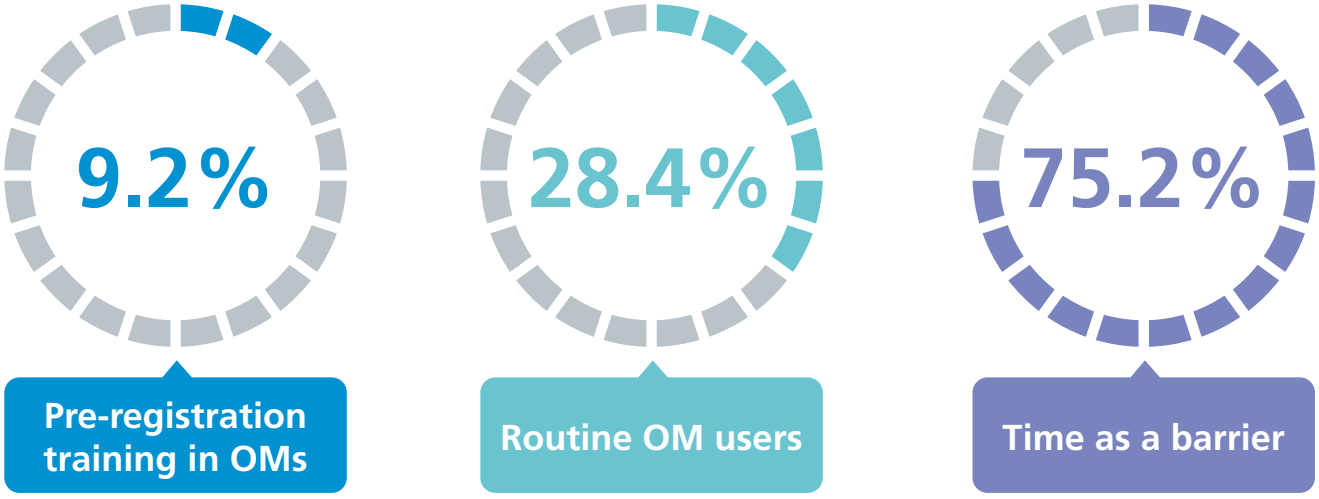
9 Allied Health Professions (AHP) Outcome Measures UK Working Group. Key questions to ask when selecting outcome measures: a checklist for allied health professionals. 2019. www.rcslt.org/outcome-measures-checklist/

10 Cole MJ, Cumming, J, Golland N, et al. BACPAR Toolbox of Outcome Measures. 2014. www.bacpar.org/resources/healthcare-professionals-resources/outcome-measures-toolbox/

11 Rehabilitation Measures Database. Webpage. No date. www.sralab.org/rehabilitation-measures

1 Summary of survey results

Prior to the original project, a national survey was conducted to establish levels of knowledge and usage of outcome measures by prosthetists and orthotists in the UK. The study has subsequently been published.[1] A summary of some key findings is included below.



Understanding of OMs

Only a small number (9.2%) reported any training in OMs during their pre-registration education. 16 yes/no questions were asked concerning a) possible uses of OMs and b) terminology and statistical/validity issues. In each case 'correct' answers were pre-determined. The mean correct response rate was 81.7% for uses of OMs, but only 32.3% for terminology and statistical issues.

Use of OMs

Routine use of OMs was defined as those reporting use 'most of the time' or 'for every episode of care'. 28.4% reported routine use. A large number (75) of individual OMs were reported. The Timed Up and Go (TUG), Socket Comfort Score (SCS) and Numeric Pain Rating Scale (NRS-11) were the most commonly used. The TUG, NRS and 10 Metre Walk Test (10MWT) were all used by prosthetists, orthotists and those in dual practice.

Barriers to use of OMs

The main reported barriers to use of OMs were time limitations (75.2%), insufficient training in OMs (56.0%), and availability of clinical time for review appointments (46.8%). Only 10.0% of participants in services without routine reviews were routine OM users, while the figure for services with routine reviews was 36.8%.

Discussion

Subsequent data on practice among prosthetists/orthotists suggests that there may have been improvements since 2014, with reported routine OM use of 70% in a 2024 study, although the comparison is limited by sample size.[2] The 2024 study also identifies a need for improved education in OMs among Allied Health Professionals as a whole.

Conclusion

Time and lack of training are reported as barriers to OM use among prosthetists and orthotists, which supports an approach focused on education and the use of low time burden OMs.

Summary references

1 Young J, Rowley L, Lalor S. Use of Outcome Measures Among Prosthetists and Orthotists in the United Kingdom. J Prosthet Orthot 2018;30(3):152-157.

2 Young J, Bowers R. Use of outcome measures by UK allied health professionals: a cross-sectional online survey. J Healthc Manag 2024; 30(2):1-13.

2 Key terms and measurement properties

The term **Outcome Measure** is used in this document to refer to a tool or instrument that is used to evaluate the change in the health of an individual, group of people or population which is attributable to a particular healthcare intervention. With the move towards Evidence-Based Practice in the health sciences field, objective measures of healthcare outcomes are important to provide credible and reliable justification for treatments and interventions. When selecting and using an outcome measure, there are many factors to consider

Reliability

How consistent are the results obtained with a specific outcome measure? Reliability of a measure is assessed in research studies. Aspects of reliability include:

- **Inter-rater reliability:** How much difference is there between the results of the outcome measure when used by two or more raters who measure the same patient?
- **Intra-rater reliability:** How large is the difference in the results recorded by one rater across two or more uses of the same measure with the same patient, for example if rating the same video footage of a patient with a time gap between the rater's assessments.
- **Test-retest reliability:** Difference between multiple assessments made over time, when no change in the construct being measured is expected.

Internal consistency

In a measure with multiple items, such as questions in a questionnaire, do the questions correlate well with each other, showing that all parts of the instrument measure the same underlying construct.

Responsiveness

Is the outcome measure being used sensitive enough to detect change in the construct being measured?

Floor effects

Floor effects occur when a measure's lowest score is unable to assess a patient's level of ability. For example, if low and very low functioning individuals all achieve the lowest possible score on a measure, then the measure is unable to distinguish between their functional levels.

Ceiling effects

Ceiling effects occur when a measure's highest score is unable to assess a patient's level of ability. For example, a patient's pre-rehab score may be in-range at the initial evaluation, but the patient's ability exceeds the measure's highest score over time. Therefore, it is unable to accurately assess progress as the patient improves.

Interpreting the results

When interpreting the results of an outcome measure, the following issues should be considered:

MCID values

Minimal clinically important difference (MCID) values are calculated in research studies, using different methods, to estimate the smallest change in OM score which would be considered clinically significant to the patient. These values can be used to assess the difference between two OM scores in a patient or patient group. Differences exceeding the MCID value are said to be 'clinically significant'.

Normative data

Many OMs have normative data available, where the measure has been administered to a group and the results have been published. The group may be a 'healthy' or 'normal' group without a specific pathology, or may be a group with a specific condition, for example unilateral trans-tibial amputees. Where available, this data can be used to evaluate OM results, either by comparing to people without the patient's condition, or to others with a similar condition.

Cut-off scores

Cut-off scores are scores on an OM which predict, or are associated with, a clinical outcome. For example, slower Timed up and Go test scores have been associated with increased falls risk.

Further reading

- Stokes EK. Rehabilitation outcome measures. London: Churchill Livingstone Elsevier; 2010.
- Robinson C, Fatone S. You've heard about outcome measures, so how do you use them? Integrating clinically relevant outcome measures in orthotic management of stroke. Prosthet Orthot Int. 2013;37(1):30-42.
- Thomas JR, Nelson JK, Silverman SJ. Research Methods in Physical Activity. Illinois: Human Kinetics; 2005.

3 Numeric Rating Scale (NRS-11)

Introduction

Assessing an individual's experience of pain and the influence of treatment on pain is a key clinical skill which can inform the formation of a management plan as well as assessing the effectiveness of an intervention. Assessing pain is a difficult task due to its highly subjective nature, and healthcare professionals have been shown to underrate patients' pain.[9,25] In the face of this complex task, a single dimension of pain, pain intensity, is commonly used to assess pain.

Format	Instructions	Equipment and space needed	Time to complete	Cost/license requirements
Patient reported outcome measure. Typically administered verbally. May be structured in a written format	Patients are asked to rate their pain as a whole number on a scale between 0 and 10, where 0 is 'no pain' and 10 is 'worst pain imaginable'[16]	None	Around 30 seconds	None

Table 1 – General information

Terminology

A numeric rating scale (NRS) can be used to rate pain intensity. When an 11-point (0-10) scale is used the scale is termed the NRS-11. Various similar names are used for this scale, such as Numeric Pain Rating Scale,[4,8,17,26] verbal numeric rating scale,[3,11] and verbal numeric scale.[1] However, the terminology NRS is commonly used[2,5,10,14,15,18,21,22,29] and was also used in the earliest reference to the scale which was identified during this review.[7] 15 different anchors have been used with numeric rating scales[12] e.g. for the extreme end terms include 'worst pain imaginable', 'worst possible pain', 'the most intense pain imaginable'. While it is unclear if the anchors make a difference, we will recommend the use of the anchors 'no pain' (0/10) and 'worst pain imaginable' (10/10) after McCaffery and Beebe.[16]

Reasons for selecting the NRS-11

Some general information is summarised below in table 1. The NRS-11 is quick and easy to administer and has been validated with a broad range of conditions including adult and paediatric populations (see table 2). It has been recommended over other measures of pain intensity due to factors including ease of use, compliance and responsiveness.[12]

Correlation with the VAS

The NRS-11 has been shown to strongly correlate with another common measure of pain intensity, the visual analogue scale (VAS),[2,6,13,19,20,23,24,27,28] but has not always been found to be interchangeable with the VAS.[1,5,12] The VAS is a 100mm line with text anchors at each end which is physically marked by the patient to indicate their pain intensity. It is scored in millimetres between 0 and 100.

Using NRS-11 with children

The NRS-11 has been validated for use with children[1,3,5,18,21,29] although this is limited to studies considering acute pain. It may be reliable with children as young as six years old[3] however this may vary depending on the individual child. Children are reported to prefer the NRS-11 to the VAS,[1] but prefer the Faces Pain Scale Revised in comparison with numeric rating scales.[21]

Assessing chronic or variable pain

Not all patients can easily describe their pain with a number. This is made more difficult when the pain is chronic and occurs in varying levels, or when pain varies according to activity level. To overcome these difficulties, multiple NRS-11 scores can be collected, corresponding to different times or activity levels, and averaged.[14,17] See below for some examples. Use of this technique may depend on whether the treatment goal is to reduce pain generally, or pain during certain activities.

- A patient reporting pain intensity during walking of 3/10, and during running of 4/10, could be assigned an average NRS-11 score of 3.5.
- Following initial assessment, a patient records the following NRS-11 scores daily for one week to give the clinician a picture of pain experienced over time (see below). An average score of 3.6 is then assigned as a baseline prior to commencing treatment.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
2	3	8	3	2	4	3

Limitations

If a patient is unable for any reason to rate pain using the NRS-11, other scales such as the VAS or descriptive pain scales may be considered. Desai and Albrecht discuss the use of MCID values with the NRS-11, supporting their use, but note that patients with a higher initial score are more likely to be seen to respond to treatment.[30]

Use and interpretation summary

When using the NRS-11, the patient should be asked "On a scale of 0–10, where 0 is no pain and 10 is the worst pain imaginable, how much pain have you experienced during [timeframe]". Example timeframes may include over the last 24 hours, while running or while wearing your device.

To ensure meaningful comparison over time, clinicians should use consistent wording. A change of 1–2.7 points (or 15-36%) may represent a clinically meaningful change, but scores for individuals should always be interpreted alongside function, activity level and patient goals.

Case study

Numeric Rating Scale (NRS-11)

Patient background

A new patient attends for assessment. The diagnosis is midfoot osteoarthritis. She reports that the pain in her left midfoot is relatively constant during weightbearing, and during the last month has been 2/10 at minimum and 6/10 at maximum.

Intervention

A foot orthosis (FO) is prescribed, and the patient is reviewed after 6 weeks.

Outcome measure employed

The NRS-11 is appropriate to use where the treatment goal is to reduce pain intensity. It most closely relates the ICF framework body functions: Sensation of pain (b280).

Recording results

To record OM results, standard tables may be used (see below). Alternatively the results may be written into the clinical notes. In any case, details of the prosthetic/orthotic device, any walking aids, and OM must be included. For example "NRS-11 following 6 weeks FO use = 1/10 minimum, 3/10 maximum".

Interpretation

In this case, the NRS-11 scores are averaged to account for the variability of the pain, giving a mean pre-intervention score of 4/10 (2+6/2) and a post-intervention score of 2/10 (1+3/2). This represents a reduction of 2 points, or 50%. 2 points is at the upper range of published MCID values, and 50% exceeds the upper range of published % MCID values (see measure review tables). As a result, we could conclude that the intervention has resulted in a clinically significant improvement. This approach may be more useful when used to evaluate grouped results, for example data from a service review.

Use of results

Clinical – these results support the intervention and provide a reference against which any future change in status might be compared.
Patient – these results may help the patient to communicate their current and future experience of pain with their orthotist.
Audit and research – These results may be used for clinical audit, service review or retrospective research.

Date	1/7/2025	12/8/2025
	Assessment	**Review appointment**
Prescription	None	Pre-fabricated foot orthosis
NRS-11	2/10 minimum during weight bearing 6/10 maximum during weight bearing	1/10 minimum during weight bearing 3/10 maximum during weight bearing

Numeric Rating Scale (NRS-11) reference tables

Prosthetics/orthotics	Adult/children	Conditions/ populations	Anatomical region	ICF Domains	NHS Outcomes framework
Orthotics (could apply to prosthetics in some instances)	Adults[2,4,8,10,11,14,15,17,22,26] Children[1,3,5,18,21,29]	Acute pain[2] Acute pain in children[1,3,5,18,21,29] Amputees[10] Arthritis[22] Chronic pain[8,14,22] Older people[11] Spinal cord injury[10]	Lower limb[22,26] Upper limb[17,22,26] Spinal[4,8,22,26]	Body functions: Sensation of pain (b280)	2: Health related quality of life for people with long-term conditions

Table 2 – Relevant populations and links with other frameworks

Standard error of measurement	Minimal detectable change	Minimal clinically important difference	Normative data	Ceiling and floor effects	Inter-rater/Intra-rater Reliability
1.02[4]	Overall ranges are 1-3 points or 27%. 2 points in low back pain[4] 3 points or 27% in neck, upper limb or lower limb pain[26] 1 point in acute paediatric pain[1]	Overall ranges are 1-2.17 points or 15-36% reductions. 1.3-1.39 points in acute pain[2,15] 1.5 points after 1 week or 2.2 points after 4 weeks in low back pain[4] 1-1.7 points or 15-27.9% in chronic musculoskeletal pain including osteoarthritis and low back pain[8,22] 2.17 points when using mean NRS-11 score for 3 conditions of pain,in shoulder pain[17] 1.8 points or 36% in spinal cord injury and amputees[10]	Not available	Unknown	100% inter-rater agreement with a written NRS[11]

Table 3 – Reference values

Numeric Rating Scale (NRS-11) references

1 Bailey B, Daoust R, Doyon-Trottier E, et al. Validation and properties of the verbal numeric scale in children with acute pain. Pain 2010; 149:216-221

2 Bijur PE, Latimer CT and Gallagher EJ.Validation of a verbally administered numerical rating scale of acute pain for use in the emergency department. Acad Emerg Med 2003; 10(4): 390-392.

3 Castarlenas E,Miro J,Sanchez-rodriguez E,2013.Is the Verbal Numerical Rating Scale a Valid Tool for Assessing Pain Intensity in Children Below 8 Years of Age? The Journal of Pain, 14:3, pp 297-304

4 Childs JD, Piva SR and Fritz JM. Responsiveness of the Numeric Pain Rating Scale in patients with low back pain. Spine 2005; 30(11): 1331-1334.

5 Connelly M and Neville K. Comparative prospective evaluation of the responsiveness of single-item pediatric pain intensity self-report scales and their uniqueness from negative affect in a hospital setting. J Pain 2010; 11:1451- 1460.

6 DeLoach LJ, Higgins MS, Caplan AB, et al. The visual analog scale in the immediate postoperative period: intrasubjective variability and correlation with a numeric scale. Anesth Analg 1998;86:102-6.

7 Downie WW, Leatham PA, Rhind VM, et al. Studies with pain rating scales. Ann Rheum Dis 1978;37:378-381

8 Farrar JT, Young JP, Lamoreaux L, et al. Clinical importance of changes in chronic pain intensity measured on an 11- point numerical pain rating scale. Pain 2001; 94(2): 149-158.

9 Grossman SA, Sheidler VR, Swedeen K, et al. Correlation of patient and caregiver ratings of cancer pain.J Pain Symptom Manage 1991; 6, 53-57.

10 Hanley MA, Jensen MP, Ehde DM, et al. Clinically significant change in pain intensity ratings in persons with spinal cord injury or amputation. Clin J Pain 2006; 22(1): 25-31.

11 Herr KA, Spratt K, Mobily PR, et al. Pain intensity assessment in older adults: use of experimental pain to compare psychometric properties and usability of selected pain scales with younger adults. Clin J Pain 2004; 20(4): 207-219.

12 Hjermstad MJ, Fayers PM, Haugen DF, et al. Studies comparing Numerical Rating Scales, Verbal Rating Scales, and Visual Analogue Scales for assessment of pain intensity in adults: a systematic literature review. J Pain Symptom Manage. 2011 Jun;41(6):1073-93.

13 Holdgate A, Asha S, Craig J, et al. Comparison of a verbal Numeric Pain Rating Scale with the visual analog scale for the measurement of acute pain. Emerg Med (Fremantle). 2003; 15:441–6.

14 Jensen MP and McFarland CA. Increasing the reliability and validity of pain intensity measurement in chronic pain patients. Pain 1993; 55(2): 195-203.

15 Kendrick D and Strout T.The minimum clinically significant difference in patient-assigned numeric scores for pain. Am J Emerg Med 2005; 23: 828 – 832.

16 McCaffery M, Beebe A. Pain: Clinical Manual for Nursing Practice. London: Mosby; 1994.

17 Michener LA, Snyder AR, Leggin BG. Responsiveness of the numeric pain rating scale in patients with shoulder pain and the effect of surgical status. J Sport Rehabil. 2011; 20:1, 115-128.

18 Miro J, Castarlenas E and Huguet A. Evidence for the use of a numerical rating scale to assess the intensity of pediatric pain. Eur J Pain 2009; 13:1089-1095.

19 Murphy DF, McDonald A, Power C, et al. Measurement of pain: a comparison of the visual analogue with a nonvisual analogue scale. Clin J Pain 1988;3:197-9.

20 Ohnhaus E, Adler R. Methodological problems in the measurement of pain: A comparison between the verbal rating scale and the visual analogue scale. Pain. 1975; 1:4, 379–384.

21 Pagé MG, Katz J, Stinson J, et al. Validation of the numerical rating scale for pain intensity and unpleasantness in pediatric acute postoperative pain: Sensitivity to change over time. J Pain 2012; 13:359-369.

22 Salaffi F, Stancati A, Silvestri CA, et al. Minimal clinically important changes in chronic musculoskeletal pain intensity measured on a numerical rating scale. Eur J Pain 2004; 8(4): 283-291.

23 Singer AJ, Gulla J, Thode HC Jr. Parents and practitioners are poor judges of young children's pain severity. Acad Emerg Med. 2002; 9:609–12.

24 Singer AJ, Richman PB, Kowalska A, et al. Comparison of patient and practitioner assessments of pain from commonly performed emergency department procedures. Ann Emerg Med. 1999; 33:652–8.

25 Sloman R, Rosen G, Rom M, et al. Nurses'assessment of pain in surgical patients. Journal of Advanced Nursing 2005; 52(2), 125-132.

26 Stratford PW, Spadoni G. FEATURE ARTICLES-The reliability, consistency,and clinical application of a Numeric Pain Rating Scale. Physiotherapy Canada 2001; 53(2): 88-91.

27 Sutherland JE, Wesley RM, Cole PM, et al. Differences and similarities between patient and physician perceptions of patient pain. Fam Med. 1988; 20:343–6.

28 Thomas SH, Borczuk P, Shackelford J, et al. Patient and physician agreement on abdominal pain severity and need for opioid analgesia. Am J Emerg Med. 1999; 17:586–90.

29 Von Baeyer CL, Spagrud LJ, McCormick JC, et al. Three new datasets supporting use of the Numerical Rating Scale (NRS-11) for children's self reports of pain intensity. Pain 2009: 143:223-227.

30 Desai N, Albrecht E. Minimal clinically important difference: Bridging the gap between statistical significance and clinical meaningfulness. J Clin Anesth. 2024; 94:111366.

4 Socket Comfort Score (SCS)

Introduction

The fit and resultant comfort of a prosthetic socket are important aspects of both the prosthesis function, and user experience. Socket fit is a common concern in prosthetic research[1,5,6] and has been identified as an important issue to prosthesis users.[4] The Socket Comfort Score (SCS) is commonly used to assess current socket comfort. The tool may be used to evaluate change, for example by asking the patient to score their socket comfort before and after a socket alteration.

Format	Instructions	Equipment and space needed	Time to complete	Cost/license requirements
Patient reported outcome measure	'On a 0 – 10 scale, if 0 represents the most uncomfortable socket fit you can imagine, and 10 represents the most comfortable socket fit, how would you score the comfort of the socket fit of your artificial limb at the moment?'[3] Consider adding values for 'best', 'worst' and 'average' socket comfort	None	< 5 minutes	Free

Table 1 – General information

Reasons for selecting the SCS

Some general information is summarised below in table 1. The SCS is quick and easy to administer and has been validated for use with lower limb amputees (see table 2).

Normative data

No normative data is available in the published literature; however, unpublished study[7] are presented below for context.

Limitations

The SCS is extremely relevant to prosthetic practice. However, current validation is limited; to the authors' knowledge, it has not yet been evaluated for use with children or in upper limb prosthetics. Additionally, a 2016 PhD study reported poor overall reliability for the SCS.[2] Rather than taking a single measure (current comfort), one study reports that taking three measurements of best, worst, and average socket comfort improves reliability.[7]

As an alternative, other more detailed measures of socket comfort may be used, such as the Comprehensive Lower limb Amputee Socket Survey (CLASS) questionnaire.

Use and interpretation summary

When using the SCS, the patient should be asked: "On a scale of 0–10, where 0 represents the most uncomfortable socket fit you can imagine and 10 represents the most comfortable socket fit you can imagine, how would you rate the comfort of your socket at the moment?" Clinicians may also consider recording 'best', 'worst' and 'average' socket comfort to better capture variation.

Although the SCS is commonly used and highly relevant to prosthetic care, evidence supporting its reliability and validity is limited.

Case study

Socket Comfort Score (SCS)

Patient background
An existing prosthetic patient attends the clinic reporting pain in her residual limb, and poor fit of the socket following recent changes in her weight.

Intervention
A temporary adjustment to the socket can be made to accommodate the change in limb volume and optimise distribution of pressure.

Outcome measure employed
The SCS is designed specifically to measure socket comfort, which relates to the patient's goal for this episode of care. It is unclear where socket comfort sits in the ICF framework; the closest concept may be Body functions: Sensation of pain (b280). In this case the SCS can be used before and after the socket adjustment, and also compared to previous SCS scores.

Recording results
To record OM results, standard tables may be used (see below). Alternatively the results may be written into the clinical notes. In any case, details of the prosthetic/orthotic device, any walking aids, and OM must be included. For example "Initial SCS in socket #1 while walking unaided = 5/10".

Interpretation
In this case, the previous SCS score was 9/10. At presentation, the comfort had reduced to 5/10. Following the adjustment, the SCS improved to 8/10. Clearly when soft tissues have been subjected to increased stress, it will take time to see what the lasting effects of an alteration to the prosthetic socket are. Although no MCID value is available for the SCS, the improvement in score supports and quantifies the conclusion that the prosthetic episode of care has been successful. Ongoing review will be necessary to confirm this.

Use of results
Clinical – these results support the intervention and provide a reference against which any future change in status might be compared.
Patient – these results may help the patient to communicate their current and future experience as a prosthetic user with their prosthetist.
Audit and research – These results may be used for clinical audit, service review or retrospective research.

Date	03/09/2025	01/11/2025	01/11/2025
	Previous review	**Review appointment - pre-intervention**	**Review appointment - post-intervention**
Prescription	PTB socket, no walking aid	PTB socket, no walking aid	PTB socket, no walking aid
SCS	9/10	5/10	8/10

Socket Comfort Score (SCS) reference tables

Prosthetics/orthotics	Adult/children	Conditions/populations	Anatomical region	ICF Domains	NHS Outcomes framework
Prosthetics[3]	Adults[3]	Lower limb amputation[3]	Lower limb[3]	Unclear. Perhaps Body functions: Sensation of pain (b280) is the closest concept	2: Health related quality of life for people with long-term conditions

Table 2 – Relevant populations and links with other frameworks

Standard error of measurement	Minimal detectable change	Minimal clinically important difference	Normative data	Ceiling and floor effects	Inter-rater/Intra-rater Reliability
Unknown	Unknown	Unknown	Some unpublished data available – see below	Unknown	Mixed reports: Good inter-rater reliability[3], poor overall reliability[2]

Table 3 – Reference values

Population	Mean SCS – primary patients	Mean SCS – pre episode of care	Mean SCS – post episode of care
Prosthetic Centre 1	7.0	6.0	8.1
Prosthetic Centre 2	7.3	5.2	8.3
Prosthetic Centre 3	8.3	4.8	7.7
All centres	7.2	5.6	8.0

Table 4 – Normative data[9]

Socket Comfort Score (SCS) references

1 Åström I, Stenström A. Effect on gait and socket comfort in unilateral trans-tibial amputees after exchange to a polyurethane concept. Prosthet Orthot Int. 2004; 28:1, 28-36.

2 Scopes, J. (2016) Outcome measures of physical function in adult unilateral lower limb amputees during prosthetic rehabilitation: use in clinical practice and psychometric properties, Queen Margaret University Edinburgh.

3 Hanspal RS, Fisher K, Nieveen R. Prosthetics socket fit comfort score. Dis Rehabil. 2003;25(22):1278-80.

4 Legro MW, Reiber G, del Aguila M, et al. Issues of importance reported by persons with lower limb amputations and prostheses. J Rehabil Res Dev. 1999 Jul;36(3):155-63.

5 Polliack AA, Sieh RC, Craig DD, et al. Scientific validation of two commercial pressure sensor systems for prosthetic socket fit. Prosthet Orthot Int. 2000; 24:1, 63-73.

6 Sewell P, Noroozi S, Vinney J et al. Developments in the trans-tibial prosthetic socket fitting process: A review of past and present research. Prosthet Orthot Int. 2000;24(2):97-107.

7 Morgan S, Askew R, Hafner B. Measurements of Best, Worst, and Average Socket Comfort Are More Reliable Than Current Socket Comfort in Established Lower Limb Prosthesis Users. Arch Phys Med Rehabil. 2022; 103(6):1201-1204.

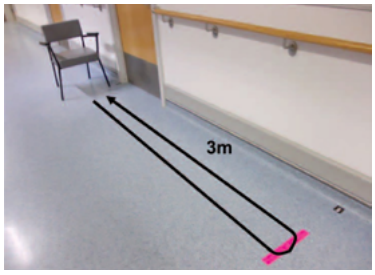
8 Gailey R, Kristal A, Lucarevic J, et al. The development and internal consistency of the comprehensive lower limb amputee socket survey in active lower limb amputees. Prosthet Orthot Int 2019; 43: 80–87.

9 Ward C. National Review of Socket Comfort Scoring. Opcare Annual Scientific Meeting. Thursday 18 September 2014, Manchester.

5 Timed Up and Go (TUG)

Introduction

Assessing an individual's balance and mobility objectively may be done as part of an assessment and to establish a baseline from which to measure change. Mobility is frequently correlated with other aspects of health, while poor balance may predict falls. The Timed Up and Go (TUG) is commonly used to assess balance and mobility. The TUG was developed as an extension of the Get Up and Go (GUG) measure originally developed by Mathias et al.[27] by adding a time component via Podsiadlo and Richardson.[35]



Format	Instructions	Equipment and space needed	Time to complete	Cost/license requirements
Clinician reported outcome measure	Patient starts sat in standard armchair (approximate seat height of 46cm) with arms on the arm rests, and any walking aid nearby. The patient is timed while standing, walking forwards 3 metres, turning, then returning to the chair and sitting down again. The patient is asked to walk at a comfortable and safe pace. No physical assistance is given, and the subject can use their normal footwear and walking aid as applicable (based on[35])	Standard armchair (approximately 46 cm in height) and a stopwatch. Space for a 3 metre walkway	< 5 minutes	Free

Table 1 – General information

Reasons for selecting the TUG

Some general information is summarised in table 1. The TUG is quick and easy to administer and has been validated with a broad range of conditions including adult and paediatric populations (see table 2). It has been used in research to demonstrate improvements in ability following the use of orthotic devices, and when changing prosthetic prescription.[9]

Assessing mobility which is variable

It is recommended that at any administration the TUG is repeated three times and an average score is calculated to maximise accuracy. This is especially important in patients whose walking ability is variable. Repeating the measure on multiple occasions even when the prosthetic/orthotic prescription has not changed may also be useful for the same reason.

Use and interpretation summary

When using the TUG, the patient should be seated in standard armchair (approximate seat height of 46cm) with arms on the arm rests, and any walking aid nearby. The test should then be explained and demonstrated, before timing the time taken for the patient to stand, walk forwards 3 metres at a comfortable pace, turn, and then return to the chair and sit down again. No physical assistance is given, and the subject can use their normal footwear and walking aid as applicable.

For a change in score to be considered significant, it should be a change of between 2.9-11 seconds or 23-30%.

Case study

Timed Up and Go (TUG)

Patient background

A 40 year old male with a trans-femoral amputation is attending a prosthetic clinic to trial a new prosthetic knee. The patient is mainly a limited community ambulator but sometimes feels unstable with his current prosthetic knee. His goal is to increase knee stability to improve his walking.

Prosthetic prescription

A prosthetic knee ('Knee 2') with microprocessor control is being trialled in the clinic today. The patient will then take the device home for a 1 week trial prior to any change in prescription.

Outcome measure employed

To measure the stated goal of improving walking ability (ICF activities domain), the TUG may be appropriate, although other measures including the 10MWT could also be used. In this case the measure is used at assessment, fitting, and review.

Recording results

To record OM results, standard tables may be used (see below). Alternatively the results may be written into the clinical notes. In any case, details of the prosthetic/orthotic device, any walking aids, and OM must be included. For example at assessment "TUG with Knee 1 = 15.0 seconds".

Interpretation

In this case, a score for the established knee 1 can be calculated from an average of the assessment and fitting scores (15.0 + 14.7 / 2 = 14.85). If this is compared to the score for the new knee 2 following one week of acclimatisation (11.1) then a decrease in time of 3.75s is concluded. This is more than the minimal detectable change of 3.6s for lower limb amputation (see measure review tables) meaning that we can conclude that this is a genuine change which has been observed.

Use of results

Clinical – these results support the proposed change to the new prosthetic knee and provide a reference against which any future change in status might be compared.

Patient – these results can demonstrate the effects of treatment to the patient, enabling them to make a more informed decision. The positive results may also be encouraging to the patient.

Funding issues – demonstrating the results of expensive prosthetic components is sometimes necessary to secure funding for them. In addition to literature which may show the benefit of a specific intervention to general patient groups, these results indicate that the prescription is also beneficial in this individual case.

Audit and research – These results may be used for clinical audit, service review or retrospective research.

Date	01/08/2025		18/08/2025		25/08/2025	
	Assessment		**Fitting**		**Review**	
Prescription: Old knee – Knee 1 New knee – Knee 2	Knee 1	-	Knee 1	Knee 2	Knee 1	Knee 2
TUG (seconds)	**15.0s**	**-**	**14.7s**	**13.2s**	**-**	**11.1s**

Timed Up and Go (TUG) reference tables

Prosthetics/orthotics	Adult/children	Conditions/populations	Anatomical region	ICF Domains	NHS Outcomes framework
Prosthetics[14,36,41] & Orthotics[(various)]	Adults[1-18, 20-50,52] Children[19,51]	Acute medical patients[1,6,12] Alzheimer's disease[37] Cerebral palsy[51] Older people[5,6,12,21,24, 27,29,33,35,42,45,47,49,53] Children[51] Lower limb amputation[14,36,41] Multiple Sclerosis[31] Osteoarthritis[34,52] Parkinson's[3,8,11,13,16,18, 20,25,28,32,38-40,44,46] Rheumatoid Arthritis[34,52] Spinal cord injury[22,23,48] Stroke[1,15,21,30] Vestibular disorders[4,7,10,17,26,50]	Not applicable	Activities: Standing (d4104) Walking short distances (d4500) Sitting (d4103)	2: Health related quality of life for people with long-term conditions

Table 2 – Relevant populations and links with other frameworks

Standard error of measurement	Minimal detectable change	Minimal clinically important difference	Normative data	Ceiling and floor effects	Inter-rater/Intra-rater Reliability	Cut-off scores
1.14s in Stroke[15] 1.75s in Parkinson's[11] 3.9s in Spinal cord injury[22]	Overall ranges are 2.9-11 seconds or 23-30%. 4.09s in Alzheimer's[37] 3.60s in Lower limb amputation[36] 2.9s in Stroke[15] Smallest Real Difference (SRD) = 23% 3.5-11s in Parkinson's Disease[11,18,44] Smallest Real Difference (SRD) = 10.8 seconds, or 30% in Spinal Cord Injury[2]	Unknown	Not available	Poor floor effects in older people (25-29.3%)[12,38]	Excellent[5,28,33,34,39,43,47,50]	Increased falls risk: >13.5s in older adults[42] >14s in older stroke patients[54] >19s in lower limb amputees[55]

Table 3 – Reference values

Timed Up and Go references

1 Andersson AG, Kamwendo K, Seiger A, et al. How to identify potential fallers in a stroke unit: validity indexes of 4 test methods. J Rehabil Med. 2006; 38(3): 186-191.

2 Bohannon RW. Reference Values for the Timed Up and Go Test: A Descriptive Meta Analysis. Journal of geriatric physical therapy 2006; 29:2, 64-68.

3 Balash Y,Peretz C,Leibovich G,et al.Falls in outpatients with Parkinson's disease: frequency, impact and identifying factors. J Neurol. 2005; 252:11, 1310-1315.

4 Bennie S, Bruner K, et al. Measurements of balance: comparison of the Timed" Up and Go" test and Functional Reach test with the Berg Balance Scale. Journal of Physical Therapy Science, 2003;15:2, 93-97.

5 Bhatt T, Espy D, Yang F, et al. Dynamic gait stability, clinical correlates, and prognosis of falls among community- dwelling older adults. Arch Phys Med Rehabil. 2011; 92:5, 799-805.

6 Brooks D, Davis AM, Naglie G. Validity of 3 physical performance measures in inpatient geriatric rehabilitation. Arch Phys Med Rehabil. 2006; 87:1, 105-110.

7 Brown KE, Whitney SL, Wrisley DM, et al. Physical therapy outcomes for persons with bilateral vestibular loss. Laryngoscope. 2001; 111:10, 1812-1817.

8 Brusse KJ, Zimdars S, Zalewski KR, et al. Testing functional performance in people with Parkinson disease. Phys Ther. 2005; 85(2): 134-141.

9 Burnfield JM, Eberly VJ, Gronely JK, et al. Impact of stance phase microprocessor-controlled knee prosthesis on ramp negotiation and community walking function in K2 level transfemoral amputees. Prosthet Orthot Int. 2012;36:95.

10 Caixeta GC, Doná F, Gazzola JM. Cognitive processing and bodybalance in elderlysubjects with vestibular dysfunction. Braz J Otorhinolaryngol. 2012;78:2, 87-95.

11 Dal Bello-Haas V, Klassen L, Sheppard MS, et al. Psychometric Properties of Activity, Self-Efficacy, and Quality-of-Life Measures in Individuals with Parkinson Disease. Physiother Can. 2011; 63:1, 47-57.

12 de Morton NA, Berlowitz DJ, Keating JL.A systematic review of mobility instruments and their measurement properties for older acute medical patients.Health Qual Life Outcomes. 2008;6:44.

13 Dibble LE, Lange M. Predicting falls in individuals with Parkinson disease: a reconsideration of clinical balance measures. J Neurol Phys Ther. 2006; 30:2, 60-67.

14 Dite W, Connor HJ, Curtis HC. Clinical identification of multiple fall risk earlyafter unilateral transtibial amputation. Arch Phys Med Rehabil. 2007; 88:1, 109-114.

15 Flansbjer UB, Holmback AM, Downham D, et al. Reliability of gait performance tests in men and women with hemiparesis after stroke. J Rehabil Med. 2005; 37:2, 75-82.

16 Foreman KB, Addison O, Kim HS, et al. Testing balance and fall risk in persons with Parkinson disease, an argument for ecologically valid testing. Parkinsonism Relat Disord. 2011;17:3, 166-171.

17 Gill-Body KM, Beninato M, Krebs DE. Relationship among balance impairments,functional performance,and disability in people with peripheral vestibular hypofunction. Phys Ther. 2000; 80:8, 748-758.

18 Huang SL, Hsieh CL, Wu RM, et al. Minimal detectable change of the timed "up & go" test and the dynamic gait index in people with Parkinson disease. Phys Ther. 2011; 91:1, 114-121.

19 Katz-Leurer M, Rotem H, Lewitus H, et al. Functional balance tests for children with traumatic brain injury: within-session reliability. Pediatr Phys Ther. 2008;20:3, 254-258.

20 Kerr G, Worringham C, Cole MH, et al. Predictors of future falls in Parkinson disease. Neurology. 2010;75:2, 116-124.

21 Knorr S, Brouwer B, Garland SJ. Validity of the Community Balance and Mobility Scale in community-dwelling persons after stroke. Arch Phys Med Rehabil. 2010; 91;6, 890-896.

22 Lam T, Noonan VK, Eng JJ. A systematic review of functional ambulation outcome measures in spinal cord injury. Spinal Cord. 2008;46:4, 246-254.

23 Lemay JF, Nadeau S. Standing balance assessment in ASIA D paraplegic and tetraplegic participants: concurrent validity of the Berg Balance Scale. Spinal Cord. 2010; 48:3, 245-250.

24 Lin MR, Hwang HF, Hu MH, et al. Psychometric comparisons of the timed up and go, one-leg stand, functional reach, and Tinetti balance measures in community-dwelling older people. J Am Ger Soc. 2004; 52:8, 1343-1348.

25 Mak MK, Pang MY. Balance confidence and functional mobility are independently associated with falls in people with Parkinson's disease. Journal of neurology. 2009; 256:5, 742-749.

26 Marchetti GF, Whitney SL, Redfern MS, et al. Factors associated with balance confidence in older adults with health conditions affecting the balance and vestibular system. Arch Phys Med Rehabil. 2011; 92:11, 1884-1891.

27 Mathias S,Nayak U,Isaacs B.Balance in elderlypatients: the" get-up and go" test. Arch Phys Med Rehabil. 1986;67:6, 387.

28 Morris S, Morris ME, Lansek R. Reliability of measurements obtained with the Timed "Up & Go" test in people with Parkinson disease. Phys Ther. 2001;81:2, 810-818.

29 Nemmers TM, Miller JW. Factors influencing balance in healthy community-dwelling women age 60 and older. J Geriatr Phys Ther. 2008;31:3, 93-100.

30 Ng SS, Hui-Chan CW. The timed up & go test: its reliability and association with lower-limb impairments and locomotor capacities in people with chronic stroke. Arch Phys Med Rehabil. 2005;86:8, 1641-1647.

31 Nilsagard Y, Lundholm C, Gunnarsson G, et al. Clinical relevance using timed walk tests and 'timed up and go'testing in persons with multiple sclerosis. Physiotherapy Research International. 2007; 12:2, 105-114.

32 Nocera J, Stegemöller EL, et al. Using the Timed Up and Go Test in a Clinical Setting to Predict Falling in Parkinson's Disease. Arch Phys Med Rehabil. 2013.

33 Nordin E, Rosendahl E, Lundin-Olsson L. Timed "Up & Go" test: reliability in older people dependent in activities of daily living-focus on cognitive state. Phys Ther. 2006; 86:5,646-655.

34 Norén AM, Bogren U, Bolin J, et al. Balance assessment in patients with peripheral arthritis: applicability and reliability of some clinical assessments. Physiotherapy Research International 6.4 (2001): 193-204.

35 Podsiadlo D, Richardson S. The timed "Up & Go": a test of basic functional mobility for frail elderly persons. J Am Geriatr Soc. 1991;39:2,142-148.

36 Resnik L, Borgia M. Reliability of outcome measures for people with lower-limb amputation: distinguishing true change from statistical error. Phys Ther. 2011; 91:4, 1–11.

37 Ries J,Echternach J,Gagnon Blodgett M.Test-retest reliability and minimal detectable change scores for the timed "up & go" test, the six-minute walk test, and gait speed in people with Alzheimer disease. Phys Ther. 2009; 89:6,569-79.

38 Rockwood K, Awalt E, Carver D, et al. Feasibility and measurement properties of the functional reach and the timed up and go tests in the Canadian study of health and aging. J Gerontol A Biol Med Sci. 2000;55A:M70-3.

39 Schenkman M, Cutson TM, Kuchibhatla M, et al.Application of the continuous scale physical functional performance test to people with Parkinson disease. Journal of Neurologic Physical Therapy. 2002; 26:3, 130.

40 Schenkman M, Ellis T, Christiansen C, et al. Profile of functional limitations and task performance among people with early-and middle-stage Parkinson disease. Physical therapy. 2011; 91:9, 1339-1354.

41 Schoppen T, Boonstra A, Groothoff JW, et al. The Timed "up and go"test: reliability and validity in persons with unilateral lower limb amputation. Arch Phys Med Rehabil. 1999; 80:7, 825-828.

42 Shumway-Cook A, Brauer S, Woollacott M. Predicting the probability for falls in community-dwelling older adults using the Timed Up & Go Test. Phys Ther. 2000; 80:9, 896- 903.

43 Siggeirsdottir K, Jonsson BY, Jónsson H Jr, et al. The timed 'Up & Go' is dependent on chair type. Clin Rehabil. 2002;16:6, 609-616.

44 Steffen T, Seney M. Test-retest reliability and minimal detectable change on balance and ambulation tests,the 36- item short-form health survey, and the unified Parkinson disease rating scale in people with parkinsonism. Phys Ther. 2008; 88:6, 733-746.

45 Steffen TM, Hacker TA, Mollinger L.Age and gender-related test performance in community-dwelling elderly people: Six-Minute Walk Test, Berg Balance Scale, Timed Up & Go Test, and gait speeds. Phys Ther. 2002; 82:2, 128-137.

46 Tanji H, Gruber-Baldini AL,Anderson KE, et al.Acomparative study of physical performance measures in Parkinson's disease. Mov Disord. 2008; 23:13, 1897-1905.

47 Thomas JI, Lane JV. A pilot study to explore the predictive validity of 4 measures of falls risk in frail elderly patients. Arch Phys Med Rehabil. 2005; 86:8, 1636-1640.

48 van Hedel HJ, Wirz M, Dietz V. Assessing walking ability in subjects with spinal cord injury: validity and reliability of 3 walking tests. Arch Phys Med Rehabil. 2005; 86:2, 190-196.

49 Whitney JC, Lord SR, Close JC. Streamlining assessment and intervention in a falls clinic using the Timed Up and Go Test and Physiological Profile Assessments. Age Ageing. 2005;34:6, 567-571.

50 Whitney SL,Marchetti GF,Schade A,et al.The sensitivity and specificity of the Timed "Up & Go" and the Dynamic Gait Index for self-reported falls in persons with vestibular disorders. J Vestib Res. 2004; 14:5, 397-409.

51 Williams EN, Carroll SG, Reddihough DS, et al. Investigation of the timed'up & go'test in children.Dev Med Child Neurol. 2005; 47:08, 518-524.

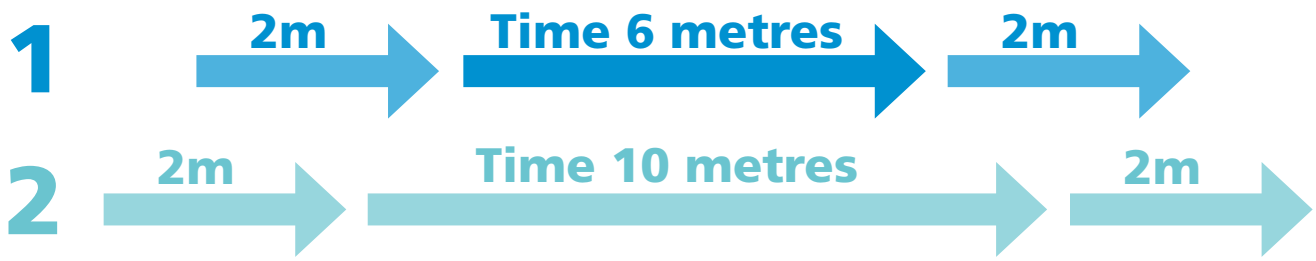
52 Wright AA, Cook CE, Baxter GD, et al. A comparison of 3 methodological approaches to defining major clinically important improvement of 4 performance measures in patients with hip osteoarthritis. J Orthop Sports Phys Ther. 2011; 41:5, 319-327.

53 Wrisley DM, Kumar NA. Functional gait assessment: concurrent, discriminative, and predictive validity in community-dwelling older adults. Phys Ther. 2010; 90:5, 761-773.

54 Andersson A, Kamwendo K, Seiger A, et al. How to identify potential fallers in a stroke unit: validity indexes of 4 test methods. J Rehabil Med. 2006; 38(3): 186-191.

55 Dite W, Connor H, Curtis H. Clinical identification of multiple fall risk early after unilateral transtibial amputation. Arch Phys Med Rehabil. 2007;88(1): 109-114.

6 10 Metre Walk Test (10MWT)



Introduction

Assessing an individual's walking speed objectively may be done as part of an assessment, as well as for forming a baseline from which to measure change. In populations such as older people and people with neurological conditions, walking speed can be predictive of general mobility.[8,9,22] Increasing walking velocity can also be associated with improved function and quality of life.[27] The 10 Metre Walk Test (10MWT) is commonly used to assess walking speed. The 10MWT has been used in various formats by different authors, but always essentially measures walking velocity over a short distance. Self-selected walking speed is usually measured, but fastest safely possible speed may also be measured.

Format	Instructions	Equipment and space needed	Time to complete	Cost/license requirements
Clinician reported outcome measure	The 10MWT can be performed at preferred walking speed or fastest speed possible. Assistive devices can be used and must be documented from test to test. **Method 1:** Subject walks 10 metres and the time is measured for the central 6 meters to allow for acceleration and deceleration. Timing starts when the toes of the leading foot cross the 2 metre mark. Timing is stopped when the toes of the leading foot cross the 8 meter mark. Velocity is calculated for the 6 metre distance.[24] **Method 2:** Subject walks 14 meters. A 2m 'flying start' is used. Timing starts when the toes of the leading foot cross the 2 meter mark. Timing is stopped when the toes of the leading foot cross the 12 metre mark. The walking speed is calculated for the central 10 metres.	A walkway of at least 10 metres (method 1) or 14 metres (method 2) Stopwatch	< 5 minutes	Free

Table 1 – General information

Reasons for selecting the 10MWT

Some general information is summarised below in table 1. The 10MWT is quick and easy to administer and has been validated with a broad range of conditions including adult and paediatric populations (see table 2).

Association between 10MWT and ambulatory status

Walking speed has been used to predict ambulatory status in post stroke patients using cut-off scores as follows: <0.4 m/s = household ambulator, 0.4-0.8 m/s = limited community ambulator, and >0.8 m/s community ambulator.[3]

Assessing mobility which is variable

It is recommended that the 10MWT is repeated three times and an average score is calculated to maximise accuracy. This is especially important in patients whose walking ability is variable. It is also preferable to repeat the test at every patient contact where possible which may reveal variation due to factors such as fatigue or condition status.

Use and interpretation summary

When using the 10MWT, the patient should be instructed to walk at their own comfortable pace (or alternatively as fast as safely possible). A 2 metre 'run up' is allowed and the time taken to walk 6 metres (method 1) or 10 metres (method 2) is then timed, using the times at which the toes cross the start and end lines. The walking speed (metres per second) should then be calculated by dividing the distance travelled by the time.

For a post treatment reduction in score to be considered clinically important, it should be a change of between 0.06-0.25 m/s.

Case study

10 Metre Walk Test (10MWT)

Patient background
50 year old female, currently an inpatient following a cerebrovascular accident (CVA) 6 weeks ago, resulting in left hemiplegia. She can currently walk approximately 10-15 metres with the aid of a single quad stick and assistance of one person. Her main goal for orthotic treatment is to improve her walking ability.

Orthotic prescription
Custom rigid/solid Ankle Foot Orthosis (AFO).

Outcome measure employed
To measure the stated goal of improving walking ability (ICF activities domain), the 10MWT may be appropriate, although other measures including the TUG could also be used. In this case the measure is used at assessment, fitting, and review.

Recording results
To record OM results, standard tables may be used (see below). Alternatively, the results may be written into the clinical notes. In any case, details of the prosthetic/orthotic device, any walking aids, and OM must be included. For example, "10MWT barefoot with quad stick = 24.0 seconds (speed = 0.42 m/s)". Note that for the 10MWT, it is important to state speed rather than time only as different methods of administering the test will require different calculation to get the speed.
For method 1 the calculation would be "6/24.0", as 6 metres is timed, while for method 2 the calculation would be "10/24.0" as 10 metres is timed. In this case, method 2 has been used.

Interpretation
In this case, interpreting the results is potentially complex as both recovery and orthotic treatment may influence the outcome. We can see that between assessment and review the barefoot 10MWT changes from 24.0s (0.42m/s) to 19.2s (0.52m/s). This represents an increase in velocity of 0.10m/s. We would conclude that this is a clinically important change, as MCID is reported as 0.06-0.14 m/s for CVA. This change may be attributable to recovery and the inpatient rehabilitation programme. In this case there is a larger increase in velocity of 0.37m/s associated with AFO use, looking at velocity with (10/11.2 = 0.89m/s) and without (10/19.2 = 0.52m/s) at review. We would again conclude that this is a clinically important change. In fact, as velocity increases beyond 0.8m/s, this potentially represents a change from being a limited community ambulator to a community ambulator given published cut-off scores (see measure review).

Use of results
Clinical – these results support the orthotic intervention and provide a reference against which any future change in status might be compared.
Patient – these results can demonstrate the effects of treatment to the patient, enabling them to make a more informed choice concerning their use of the orthoses. The positive results may also be encouraging to the patient.
Multidisciplinary team – results can be included in communication with referrers and the wider team, giving them better information on the outcome of treatment.
Audit and research – These results may be used for clinical audit, service review or retrospective research.

Date	01/08/2025		18/08/2025		29/09/2025	
	Assessment		**Fitting**		**Review/Discharge**	
Prescription: Rigid AFO, quad stick	Without	With	Without	With	Without	With
10 MWT (seconds)	**24.0s (0.42m/s)**		**22.8s (0.44m/s)**	**19.3s (0.52m/s)**	**19.2s (0.52m/s)**	**11.2s (0.89m/s)**

10 Metre Walk Test (10MWT) reference tables

Prosthetics/orthotics	Adult/children	Conditions/populations	Anatomical region	ICF Domains	NHS Outcomes framework
Prosthetics[1,34] & Orthotics[40]	Adults[1-22,26-41] Children[23,25,34]	Children with neurological conditions[23,34] Older people[8,21] Neurological conditions[25,34,38] Hip fracture[10,13] Lower limb amputation[1,32] Multiple Sclerosis[20] Parkinson's disease[26,31] Spinal cord injury[4,5,11-14,18,19,28,35-38] Stroke[3,6,7,15,22,27,29,30,33,42] Traumatic brain injury[16,39]	Lower limb[1-42]	Activities: Walking short distances (d4500)	2: Health related quality of life for people with long-term conditions

Table 2 – Relevant populations and links with other frameworks

Standard error of measurement	Minimal detectable change	Minimal clinically important difference	Normative data	Ceiling and floor effects	Inter-rater/ Intra-rater Reliability	Cut-off scores
Overall range 0.03-0.06 m/ 0.06 m/s in Older people[21] 0.03 m/s in Hip fracture[10] 0.05m/s in SCI[4,7,17,37] 0.04m/s in Stroke[21]	Overall range 0.05-0.18 m/s 0.17 m/s in Hip fracture[10,13] 0.18 m/s in Parkinson's disease[31] 0.13 m/s in Spinal cord injury[5] 0.05 m/s in Traumatic brain injury[41]	Overall range 0.06-0.25 m/s 0.13 m/s in Older people[21] 0.06 m/s in SCI[12,18] 0.06-0.14 m/s in Stroke[21,33] 0.15-0.25 m/s in TBI[39,41]	0.97m/s–1.40 m/s comfortable walking in healthy adults, varying by age and sex[25] (see table 4 below). 1.93–2.53 fast walking in healthy adults[2] (see table 5 below). 1.04-1.11m/s normal speed in children aged 5-17[26] (see table 6 below). 1.3 m/s for unilateral trans-tibial amputees, 1.0 m/s for bilateral trans-tibial amputees[1]	None identified	Excellent[6,28,34,37,42]	<0.4 m/s = household ambulator 0.4-0.8 m/s = limited community ambulator >0.8 m/s = community ambulator[3]

Table 3 – Reference values

10 Metre Walk Test (10MWT) reference tables

Age	Men Self selected speed (m/s)	Women Self selected speed (m/s)
18-29	1.36	1.38
30-39	1.39	1.38
40-49	1.40	1.34
50-59	1.34	1.25
60-69	1.26	1.21
70-79	1.20	1.13
80+	1.05	0.97

Table 4 – Normative data for healthy adults[25]

Age	Men Fast speed (m/s)	Women Fast speed (m/s)
20-29	2.53	2.47
30-39	2.45	2.34
40-49	2.46	2.12
50-59	2.07	2.01
60-69	1.93	1.77
70-79	2.08	1.74

Table 5 – Normative data for healthy adults – fast speed[2]

Age	Self selected speed (m/s)
5	1.04
6	1.06
7	1.07
8	1.10
9	1.10
10	1.08
11	1.09
12	1.12
13	1.07
14	1.11
15	1.12
16	1.13
17	1.11

Table 6 – Normative data for healthy children[26]

10 Metre Walk Test references

1 Akarsu S, Tekin L, Safaz I, et al. Quality of life and functionality after lower limb amputations: comparison between uni vs. bilateral amputee patients. Prosthet Orthot Int. 2013; 37:1, 9-13.

2 Bonhannon RW. Comfortable and maximum walking speed of adults aged 20-79 years: reference values and determinants. Age Ageing. 1997; 26:1, 15-19.

3 Bowden M, Balasubramanian C, Behrman AL.Validation of a speed-based classification system using quantitative measures of walking performance poststroke. Neurorehabil Neural Repair. 2008; 22:6, 672.

4 Bowden MG, Behrman AL. Step Activity Monitor: accuracy and test-retest reliability in persons with incomplete spinal cord injury. J Rehabil Res Dev. 2007; 44:3, 355-362.

5 Burns AS, Delparte JJ, Patrick M. The reproducibility and convergent validity of the walking index for spinal cord injury (WISCI) in chronic spinal cord injury. Neurorehabil Neural Repair. 2011; 25:2, 149-157.

6 Collen F, Wade D, Bradshaw CM. Mobility after stroke: reliability of measures of impairment and disability. Int Disabil Stud. 1990;12:1, 6-9.

7 Flansbjer UB, Holmback AM, Downham D, et al. Reliability of gait performance tests in men and women with hemiparesis after stroke. J Rehabil Med. 2005; 37:2, 75-82.

8 Fritz S, Lusardi M.White paper:"walking speed: the sixth vital sign". Journal of geriatric physical therapy. 2009; 32:2, 2-5.

9 Guralnik JM, Ferrucci L, Pieper CF, et al. Lower Extremity Function and Subsequent Disability: Consistency Across Studies, Predictive Models, and Value of Gait Speed Alone Compared With the Short Physical Performance Battery. J Gerontol A Biol Sci Med Sci. 2000; 55:4, 221- 231.

10 Hollman JH, Beckman BA, Brandt RA, et al. Minimum detectable change in gait velocity during acute rehabilitation following hip fracture. J Geriatr Phys Ther. 2008; 31:2, 53-56.

11 Jackson AB, Carnel CT, Ditunno JF, et al. Outcome measures for gait and ambulation in the spinal cord injury population. J Spinal Cord Med. 2008; 31:5, 487-499.

12 Lam T,Noonan V,Eng JJ.A systematic review of functional ambulation outcome measures in spinal cord injury. Spinal Cord. 2007; 46:4, 246-254.

13 Latham N,Mehta V,Nguyen AM,et al.Performance-based or self-report measures of physical function: which should be used in clinical trials of hip fracture patients? Arch Phys Med Rehabil. 2008; 89:11, 2146-2155.

14 Lemay JF, Nadeau S. Standing balance assessment in ASIA D paraplegic and tetraplegic participants: concurrent validity of the Berg Balance Scale. Spinal Cord. 2010; 48:3, 245-250.

15 Lin JH, Hsu MJ, et al. Psychometric comparisons of 3 functional ambulation measures for patients with stroke. Stroke. 2010; 41:9, 2021-2025.

16 Moseley AM, Lanzarone S, Bosman JM, et al. Ecological validity of walking speed assessment after traumatic brain injury: a pilot study. J Head Trauma Rehabil. 2004; 19:4, 341-348.

17 Musselman K. Clinical significance testing in rehabilitation research: what, why, and how? Physical Therapy Reviews. 2007; 12:4, 287-296.

18 Musselman KE, Fouad K, Misiaszek JE, et al. Training of walking skills overground and on the treadmill: case series on individuals with incomplete spinal cord injury. Phys Ther. 2009; 89:6, 601-611.

19 Olmos LE, Freixes O, Gatti MA, et al. Comparison of gait performance on different environmental settings for patients with chronic spinal cord injury. Spinal Cord. 2008; 46:5, 331-334.

20 Paltamaa J, Sarasoja T, Leskinen E, et al. Measures of physical functioning predict self-reported performance in self-care, mobility, and domestic life in ambulatory persons with multiple sclerosis.Arch Phys Med Rehabil. 2007; 88:12, 1649-1657.

21 Perera S,Mody S,Woodman RC,et al.Meaningful change and responsiveness in common physical performance measures in older adults. J Am Geriatr Soc. 2006; 54:5, 743-749.

22 Perry J, Garrett M, Gronley JK, et al. Classification of walking handicap in the stroke population.Stroke.1995; 26:6, 982.

23 Pirpiris M, Wilkinson AJ, Rodda J, et al. Walking speed in children and young adults with neuromuscular disease: comparison between two assessment methods.J Pediatr Orthop. 2003; 23:3, 302.

24 Rehabilitation measures database. 10 Meter Walk Test. www.sralab.org/rehabilitation-measures/10-meter-walk-test

25 Andrews A, Vallabhhajosula S, Boise S, et al. Normal gait speed varies by age and sex but not by geographical region: a systematic review. Physiotherapy 2023; 69:1, 47-52.

26 NIH Toolbox. 2012 http://www.healthmeasures.net/images/nihtoolbox/Technical_Manuals/Motor/Toolbox_4-Meter_Walk_Gait_Speed_Test_Technical_Manual.pdf

27 Reuben DB, Magasi S, McCreath HE, et al. Motor assessment using the NIH Toolbox. Neurology. 2013; 80:11, S65-S75.

28 Schenkman M, Cutson TM, Kuchibhatla M, et al. Reliability of impairment and physical performance measures for persons with Parkinson's disease. Phys Ther. 1997; 77:1, 19-27.

29 Schmid A, Duncan P, Studenski S, et al. Improvements in speed-based gait classifications are meaningful. Stroke. 2007; 38:7, 2096.

30 Scivoletto G,Tamburella F, Laurenza L. et al.Validity and reliability of the 10-m walk test and the 6-min walk test in spinal cord injury patients. Spinal Cord. 2011; 49:6, 736-740.

31 Severinsen K, Jakobsen JK, et al. Normalized muscle strength, aerobic capacity, and walking performance in chronic stroke: a population-based study on the potential for endurance and resistance training. Arch Phys Med Rehabil. 2011; 92:10, 1663-1668.

32 Smania N, Picelli A, Gandolfi M, et al. Rehabilitation of sensorimotor integration deficits in balance impairment of patients with stroke hemiparesis: a before/after pilot study. Neurol Sci. 2008; 29:5, 313-9

33 Steffen T, Seney M. Test-retest reliability and minimal detectable change on balance and ambulation tests,the 36-item short-form health survey, and the unified Parkinson disease rating scale in people with parkinsonism. Phys Ther. 2008; 88:6, 733-746.

34 Tekin L, Safaz Y, Göktepe AS, et al. Comparison of quality of life and functionality in patients with traumatic unilateral below knee amputation and salvage surgery. Prosthet Orthot Int. 2009; 33:1, 17-24.

35 Tilson JK,Sullivan KJ,Cen SY,et al.Meaningful gait speed improvement during the first 60 days poststroke: minimal clinically important difference.Phys Ther.2010; 90:2, 196-208.

36 Tyson S, Connell L. The psychometric properties and clinical utility of measures of walking and mobility in neurological conditions: a systematic review. Clin Rehabil. 2009; 23:11, 1018-1033.

37 van Hedel H, Wirz M, Curt A. Improving walking assessment in subjects with an incomplete spinal cord injury: responsiveness. Spinal Cord. 2006; 44:6, 352-356.

38 van Hedel HJ, Dietz V, Curt A. Assessment of walking speed and distance in subjects with an incomplete spinal cord injury.Neurorehabil Neural Repair.2007;21:4, 295-301.

39 van Hedel HJ, Wirz M, Dietz V. Assessing walking ability in subjects with spinal cord injury: validity and reliability of 3 walking tests. Arch Phys Med Rehabil. 2005:86:2, 190-196.

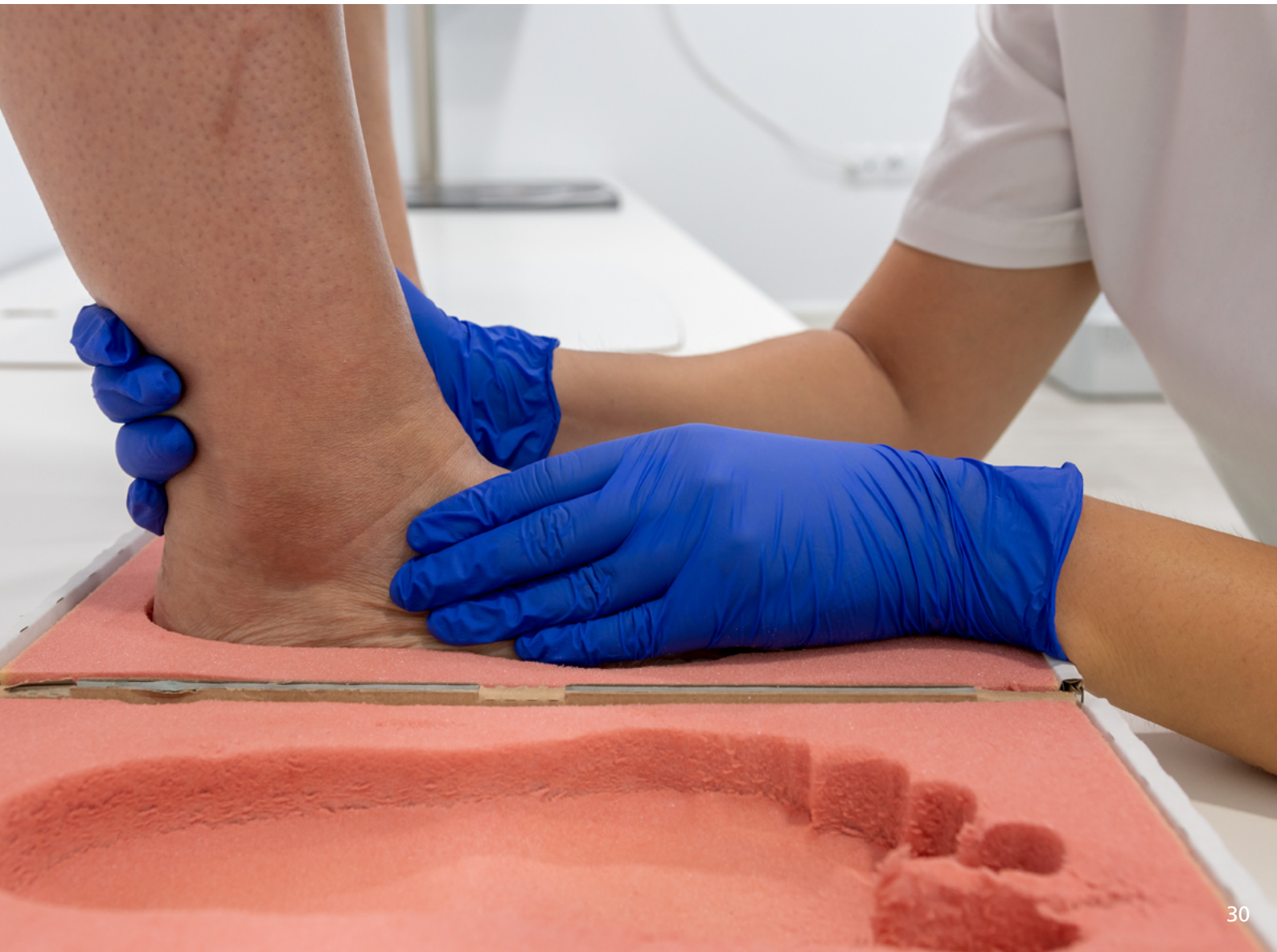
40 van Hedel HJ, Wirz M, Dietz V. Standardized assessment of walking capacity after spinal cord injury: the European network approach. Neurol Res. 2008; 30:1, 61- 73.

41 van Loo MA, Moseley AM, Bosman JM, et al. Test-re-test reliability of walking speed, step length and step width measurement after traumatic brain injury: a pilot study. Brain Inj. 2004; 18:10, 1041-1048.

42 Wang RY, Yen L, Lee CC, et al. Effects of an ankle foot orthosis on balance performance in patients with hemiparesis of different durations. Clin Rehabil. 2005; 19:1, 37-44

43 Watson MJ. Refining the ten-metre walking test for use with neurologically impaired people. Physiotherapy. 2002; 88:7, 386-397.

44 Wolf SL, Catlin PA, Gage K, et al. Establishing the reliability and validity of measurements of walking time using the Emory Functional Ambulation Profile. Phys Ther. 1999; 79:12, 1122-1133.



7 Clinical reference sheet

Walking speed (10MWT)

- Important change (MCID): 0.06-0.25m/s+
- Normal self selected adult gait speed:

Age	Men Self selected speed (m/s)	Women Self selected speed (m/s)
18-29	1.36	1.38
30-39	1.39	1.38
40-49	1.40	1.34
50-59	1.34	1.25
60-69	1.26	1.21
70-79	1.20	1.13
80+	1.05	0.97

Timed Up and Go (TUG)

- Important change (MDC): At least 2.9s, or 23-30%+
- Increased falls risk:
  - >13.5s in older adults.
  - >19s in lower limb amputees.

0-10 pain scale (NRS-11)

- Important change (MCID): 1 point or more

0-10 Socket Comfort Score (SCS)

- (0=least comfortable, 10=most comfortable)

8 Example outcome measures audit form

Various audit, service evaluation or research projects may review and use clinical data such as OMs data. A general approach to this will not be described here. This example form may be used to audit clinical notes to establish how often OMs are being used within a service. This could be completed as part of routine clinical notes audits. Evaluating how often OMs are used may support teams to increase their use over time.

Method:

- Select clinic/s to review.
- Review clinical records for all patients seen during the given clinic/s.
- For each patient, record whether an outcome measure has been used, within the most recent episode of care (i.e. during any stage of the assessment / treatment / review process).
- For the clinic/s being reviewed, give a percentage use rate; for example, when reviewing notes for 30 patients, 20 uses of OMs indicates a 67% use rate.

Patient/record identifier	Use of outcome measure in most recent episode of care? (Yes/No)	Type of OM used (optional)	Change in OM score, if applicable (optional)
X123abc	Yes	NRS-11	Reduction of 2 points following treatment.

Further reading and resources

- Sackett, D., Rosenberg, W., Gray, J., Haynes, R., Richardson, W., 1996. Evidence based medicine: what it is and what it isn't. BMJ;312:71
- World Health Organization. International Classification of functioning, disability and health. 2001, World Health Organization, Geneva.
- Stokes EK. Rehabilitation outcome measures. London: Churchill Livingstone Elsevier; 2010.
- Robinson C, Fatone S. You've heard about outcome measures, so how do you use them? Integrating clinically relevant outcome measures in orthotic management of stroke. Prosthet Orthot Int. 2013 Feb;37(1):30-42.
- Atkin K, Cole MJ, Cumming J, et al. BACPAR Toolbox of Outcome Measures: Version 2. (2014) http://bacpar.csp.org.uk/publications/bacpar-outcome-measure-toolbox- version-2 [Accessed 10:20 26th November 2014]
- British Society of Rehabilitation Medicine. Amputee and Prosthetic Rehabilitation – Standards and Guidelines (3rd Edition). (2018) www.bsprm.org.uk/resources/guideline-documents/
- Rehabilitation Measures Database https://www.sralab.org/rehabilitation-measures
- Physiopedia page on outcome measures http://www.physio-pedia.com/Outcome_ Measures
- NHS Outcomes Framework https://digital.nhs.uk/data-and-information/publications/statistical/nhs-outcomes-framework/february-2025
- National PROMs Network https://promsnetwork.co.uk/

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