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From outcome measurement to improving health outcomes following lower limb amputation - making outcome measurement work from a clinical practice perspective

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Abstract

Background: Outcome measurement is essential to understand the impact of clinical interventions and the performance of services. Despite national and professional encouragement outcome measurement has failed to become embedded in clinical practice and its value continues to be questioned.

Objectives: To address the outcome measurement debate within lower limb prosthetic rehabilitation and provide a critical synthesis of the evidence surrounding the discussion applied within the clinical context of the UK National Health Service (NHS).

Study Design: Narrative review

Methods: The authors drew on over 20 years clinical experience in prosthetic rehabilitation to synthesise and critique the outcome literature across a breadth of healthcare services. A narrative review methodology was selected to give voice to the clinical narrative thread.

Results: This review addresses why we should measure health outcomes, the health care delivery and organisational scenarios in which outcome measurement can be beneficial and explores where lessons can be learnt for prosthetic rehabilitation from approaches in different specialities. The current outcome measurement literature within prosthetic rehabilitation is critiqued and we discuss the issues facing this field in the future.

Conclusions: The dilemma of successful outcome measurement in clinical practice is multifaceted. Understanding and embedding value at every step is key to success. Addressing the questions of `why', `what' and `how' we measure outcome will move us closer to a national consensus. Routine outcome measurement implementation at the clinical level must ensure data collection is valuable to clinical practice, makes use of IT solutions and has all important organisational buy in.

Key words: Outcome measurement, Prosthetic limbs, Amputation, Rehabilitation, Meaningful measurement, Clinical practice

Background

Outcome measurement is a controversial topic in prosthetic rehabilitation. It is a source of discussion within clinical meetings and specialist interest groups and can often be found as a specific topic stream on the programmes of national and international conferences. However, despite professional body [1,2] and national health policy encouragement,[3] outcome measures (OMs) are still not routinely used and have not become embedded in clinical practice.[4]

Outcome measurement can be better understood by breaking the term down into the outcome being measured and the measurement tool used for the task. A health outcome can be defined as a change in a person's health status as a result of an intervention [5] and a measurement tool as a standardised instrument used in research and clinical practice to capture and evaluate this change.[6]

The inherent usefulness of information concerning health outcomes in understanding the effectiveness and value of costly health care interventions might go some way to explaining why, despite implementation issues, these authors often hear clinicians working in prosthetic rehabilitation discussing `What OMs do you use?' `When do you use them?' and `What do you do with all the data you have collected?'. These questions alongside the wealth of published literature exploring, reviewing and critiquing the many OMs available in this field,[7–13] demonstrate an appetite for outcome measurement in both academia and clinical practice, and raises questions as to why it has not worked so far. This narrative review paper therefore addresses the outcome measurement debate within prosthetic rehabilitation and provides a critical synthesis of the evidence surrounding the discussion applied within the clinical context of the UK National Health Service (NHS).

Methods

Following initial scoping searches of the literature the authors drew on over 20 years' experience in prosthetic clinical practice, service design, policymaking, outcome measurement development, data collection and research to examine the published literature. A narrative review methodology was selected to allow for wider consideration of the outcome literature across a breadth of healthcare services to inform the development of the concepts proposed. This approach considers what has been accomplished previously, synthesizing and critiquing evidence to assess its value within the debate.[14] This review seeks to address why we should measure health outcomes, the health care delivery and organisational scenarios in which outcome measurement can be beneficial and explores where lessons can be learnt for prosthetic rehabilitation from approaches in different specialities. We then move on to synthesise and critique the outcome measurement literature within prosthetic rehabilitation and consider the issues facing our profession in the future. This review approach was selected to give voice to the clinical narrative thread, which may have been lost within the constraints of a systematic review approach.[15]

Results

The findings have been presented to address key points that have emerged from the review of the literature.

Why measure outcome?

A report by Devlin et al.[16] from the Kings Fund presents the rationale for outcome measurement within the UK NHS. They describe an organisation, which in times of austerity and increased demand, needs to consistently demonstrate the value and impact of the ever-increasing funding it receives. Outcome measurement can contribute to this process by providing an understanding of the impact health services and interventions have on the health and wellbeing of patients.

Historically, the NHS has evidenced its impact by focusing on measuring process data (for example, waiting times, numbers of referrals or clinical contacts) as a way to demonstrate the performance of the system. However, this information only provides insight into the production of `health care' rather than the production of `health'. Devlin et al.[16] also highlighted that as the NHS attempts to measure `health' it often focuses on measuring the negative impacts (i.e. re-admissions, mortality and hospital acquired infections), rather than the successes the NHS is striving for. By using outcome measurement, we can work towards capturing information on more than just avoidable harms and attempt to capture the outputs that are meaningful to individual patients and society as a whole; thus understanding how to translate service provision into social impact.

How is outcome measurement useful?

Within prosthetic clinical practice, OMs in the form of observed performance measures or self-reported measures, can be used in a number of different ways. On an individual basis, the use of an OM can be helpful to capture changes in a patient's status following a particular intervention or when monitoring patients over longer periods of time, such as follow ups or annual reviews.[6] This information can be shared with the patient to demonstrate progress throughout rehabilitation, and increase motivation, or can be used by the clinician to direct treatment planning or inform funding requests.[4]

A more organised approach to outcome measurement along a pathway of care can be described as routine outcome measurement (ROM). ROM is defined as "the systematic use of a standardised OM(s) in clinical practice with every patient as a part of a standardised assessment practice guideline".[17] This systematic approach to outcome measurement can provide individual services with a wealth of information on the quality of care and interventions they are delivering.[18] Data can be used to direct and inform improvement work, and evaluate the change of introducing new ways of working. When co-ordinated ROM is undertaken in a number of services, benchmarking is a possibility[19] and a system-wide approach can be adopted.

This system-level approach to ROM can be useful on several levels, especially if widely accessible. It allows comparison of the performance of different health care providers and gives patients valuable information on the best performing trusts, enabling

informed decisions on where to receive care.[20] Benchmarking exercises can also help to identify services where outcomes are good and use those as exemplars to raise standards across the NHS, therefore reducing variation in the system. The collation of large datasets concerning a specific population, such as those who have undergone a lower limb amputation, can also be useful for research purposes to strive to understand, and ultimately influence, the factors that may have an impact on clinical outcome.

Ultimately, outcome measurement is crucial to informing and improving clinical decision-making daily. If health care services want to ensure they are delivering the most effective care, and wish to develop a meaningful culture of improvement they need information, specifically information about the outcome of care, that can direct the focus of potential improvements and also evaluate the impact of these programmes.[21]

Routine outcome measurement in UK practice

Although many clinicians might attest to using OMs measures with their patients on an individual basis, the use of ROM across a pathway or health care system is less common. This paper critically reviewed the evidence base concerning ROM in UK practice and found key examples which are described and critiqued below. These examples highlighted greater historical focus on ROM within mental health services.

During the 1990s, UK mental health services undertook a programme of widespread, organised collection of the clinician-reported Health of the Nation Outcome Scales (HoNOS). The programme was centrally mandated with associated financial penalties as the UK Department of Health launched the idea of payment by results. However, it was questionable whether services were reporting the outcome of their interventions or their ability to collect outcome measurements. This was evidenced by high collection rates of initial HoNOS scores which fell dramatically at follow-up leading to a reduced number of pairs of results to assess change over time, and questioning the usefulness of completing the measure at all.[22]

The next key step discussed in the mental health literature was the development of 'Improving Access to Psychological Therapies' (IAPT) services in the UK (2000s) which revolutionised the provision of mental health services in primary care. As IAPT services were developed, ROM was designed into the fabric of the new programmes with a view to commissioning a service that could demonstrate significant client improvement and use a system of payment by outcome in a more meaningful way.[22,23] importantly within the IAPT programme the type of measure chosen to capture the outcome of interventions shifted. Traditionally secondary care mental health services had focused on clinician-reported measures (CROMs) (i.e. HoNOS scores). Evaluation of the new IAPT programmes centred around the use of patient-reported outcome measures (PROMs),[24] signifying a shift towards a more patient-centred approach to outcome measurement and the importance of capturing the person's view of their own recovery.

Routine outcome measurement (ROM) is not only described within the mental health literature. Within physical health services, the most significant example of ROM is the NHS PROMs programme.[25] The programme is run centrally by NHS England and

includes all of England's acute hospital trusts. Provider trusts routinely collect PROMs data for elective hip and knee replacements, before and after surgery. Up until 2017 the programme also included varicose vein surgery and hernia repairs.

Crucially this programme and its data were linked to the National Joint Registry (NJR) in 2010. The NJR has been in operation since 2002 and collects data from across the UK on all hip, knee, ankle, elbow and shoulder replacement surgeries, monitoring the safety and effectiveness of different implants and types of surgery.[26] Prior to incorporating the NHS PROMS programme the main outcome focus for the NJR was the need for revision surgery. The PROMs programme added data on the value of hip and knee replacement to patients, such as the reduction of their pain, restoration of function and improved quality of life, reflecting the shift in health care to a more patient-centred model.[27] The granular nature of the implant data recorded in the NJR also allowed comparison of the performance of different implant componentry, providing evidence for patient safety and component selection.[28] This nationwide approach was the first of its kind internationally at the system level. By using PROMs, the NHS put the patient's views on their outcome at the centre of the evaluation process and used outcome data to capture the production of health rather than measuring the production of health care.[20]

The NHS PROMS programme began in 2009 and despite well documented aims the programme has failed to expand across different health conditions and is smaller than it was when it started, having reduced the number of surgical procedures included. This poses the questions: why have these examples of system-level outcome measurement not developed further or spread within the NHS? What can we learn from their implementation, and did they achieve their goals of measuring the associated health gains of different interventions?

Barriers and facilitators for outcome measurement in clinical settings

This narrative review identified a wealth of published literature seeking to understand why outcome measurement has failed to become embedded into clinical practice. Despite the common views that it is due to ambivalence of clinicians [29] and a resistance to change and innovation amongst service providers,[30] a systematic review by Duncan and Murray[4] suggests this is not necessarily the case and that successful implementation is multifactorial and requires organisational support.

Many of the factors identified in the wider literature are evident in both the mental and physical health examples discussed previously. In 2017, NHS England undertook a multi-stakeholder consultation of their PROMS programme and found feedback around the success of the project to be mixed.[31] Issues discussed within this consultation, and reviewed within the current evidence base, focus around four main factors: time, the measures themselves, organisational buy-in and perhaps, most importantly, the perceived value of outcome measurement for all those involved.

Time, or a perceived lack of it, appeared to impact the successful completion of outcome measurement for a number of reasons. The process of completing, and scoring measures can be lengthy, limiting use in time-pressured clinical consultations,[4,32]

especially if cognitive or health literacy concerns arise.[33,34] As well as measurement burden for clinicians, there is also a significant burden on patients as the use of PROMS adds to the many satisfaction questionnaires already used by health service providers to evaluate the patients experience of the care they had received (i.e. Friends and Family Test[35]).[36,37]

This plethora of measures is also described in the literature as a barrier to successful implementation. Challenges include choosing a measure that is meaningful, responsive to change, accessible, feasible to complete, score and interpret within a clinical session, and these challenges are reportedly particularly difficult for many clinicians who lack knowledge and understanding in this highly technical field.[4,30,32,34,37]

The most significant feedback from the NHS PROMS programme consultation was that many clinicians and managers felt that it was not worth continuing with the programme.[31] The consultation reported that the data collection was not useful to clinical practice, could not be used during clinical consultations and reports took too long to be published, so findings were out of date.[31] This lack of perceived value was also evident in the mental health service examples, where clinicians felt that the process was bureaucratic, only concerned with performance management, lacked feedback and presented no relative meaning for their role.[38] Establishing the value of outcome measurement to stakeholders is key for success.[39–42] There appears to be a need for access to outcome data in real-time during the patient consultation that can be used clinically to inform treatment, but also be reported in an accessible format that is easy to understand and can direct and inform improvements in a meaningful way.

Many of these issues could be addressed with greater organisational buy-in. Prioritising time for collecting outcomes, digitised measures that are integrated within electronic systems and promotion of a co-ordinated culture of improvement which integrates patient experience and outcome data, rather than a punitive approach, could help to realise the potential of ROM and improve care provided to patients.[32,39,43]

Outcome measurement in prosthetic services

Barriers to implementing ROM have also been documented in the prosthetic rehabilitation literature, both in the UK in a national survey by the British Association of Prosthetists and Orthotists (BAPO),[1] and internationally.[44–46] To address some of these barriers, a number of studies have been carried out exploring the impact of educational training programmes for prosthetic staff to increase knowledge and confidence in the use of outcome measurement in clinical practice[44] and to facilitate improvement programmes using outcome data.[36] Although these programmes demonstrated some success, particularly where prioritised at an organisational level or integrated into electronic records,[36] overall clinicians still struggled to integrate outcome measurement into their clinical routines. Interestingly, in Hafner et al's [45] study, prosthetists were reported more likely to use the Amputee Mobility Predictor (AMP) measure than the quicker-to-administer Timed Up and Go (TUG). The authors discussed that this may be

because the AMP can be used to justify functional outcome and therefore prescription of prosthetic componentry to insurance companies, demonstrating the importance of perceived value in engaging clinicians in the measurement of outcome.

The measurement tools themselves also provide challenges within prosthetic rehabilitation. In 2014, Heinemann et al.[8] reported finding 43 unique measurement instruments for use following lower limb amputation. Despite a huge variety of tools, a number of authors have highlighted that there is no consensus around which OMs should be used.[7,47,48] This is also evident in current UK Health Policy, where comprehensive lists of OMs are suggested in both the Prosthetic National Service Specification [49] and the NHS Microprocessor Knee Policy.[50]

This lack of consensus is a major barrier to system wide ROM and raises two important unanswered questions within the field of prosthetic rehabilitation: *what* outcomes should be measured and *how* should they be measured? One approach taken by a number of authors is to identify and explore possible outcome constructs related to health using a framework like the International Classification of Functioning.[6,13] These studies have yielded large numbers of constructs which may be impractical to measure clinically, and do not give an indication of which constructs could be most meaningful to prosthetic users themselves.

A more patient-centred approach was adopted by two studies that sought to use qualitative methods to explore the outcomes that matter to patients. McDonald and colleagues [51] used focus groups to explore meaningful outcomes when prescribing prosthetic feet, and Schaffalitzky[52,53] explored user, clinician and wider stakeholder views on the outcome of prosthetic prescription via interviews, focus groups and a Delphi consensus process. Both studies focused on the prescription of components rather than a more holistic approach to rehabilitation post amputation, however they found that qualitative methodologies work well to explore successful prosthetic prescription and highlighted outcome domains that were important to users such as balance and safety, independence, and importantly the need to capture psychosocial outcomes.[52]

Despite this valuable exploratory work consensus remains elusive in prosthetic rehabilitation. A few organisations exist to help build consensus around both the '*what'* and the *'how'* questions. Initiatives such as Core Outcome Measurement in Effectiveness Trials (COMET) seek to develop consensus around *what* to measure through core outcome sets (COS) to be recorded in all clinical trials of a specific condition.[54] They adopt a multi-stakeholder approach to identify outcomes of importance and seek to build consensus that can then be championed by the stakeholders involved. Importantly COMET advocate the inclusion of patients at the centre of this process, ensuring that a COS is measuring what matters most to the people affected by the outcome of an intervention.[55] COMET have also defined 'Consensus-based standards for the selection of health Measurement Instruments', which is an initiative that sets out a systematic approach to identifying, selecting and assessing the quality of relevant tools,[56,57] thus defining a framework for *how* to measure a COS.

Currently within the prosthetic rehabilitation literature, ten systematic reviews have been published relating to measurement tools designed for, or for use, following amputation (Table 1). The many OMs included in these reviews vary widely. Measures focus on different outcome domains, i.e. mobility, quality of life or prosthetic use, and vary in the methodological quality of their

development and their psychometric properties (i.e. the level of measurement, validity, reliability and responsiveness)[58] The tools also vary in length and format, some paper-based and others available digitally via apps. Some measures are free to use whereas others have cost implications and this in itself can be a significant barrier in some healthcare settings. Many measures have been developed in English and have now been translated and validated in other languages, which is important for use in today's diverse society and across the world. However, the challenges of using outcome measures in different languages is not just about translation. Ensuring the measure is meaningful in different social and cultural settings is often overlooked. Considering all these different approaches when attempting to make an informed choice of OM, as well as understanding and evaluating the many different psychometric properties of the tools, can make the process of tool selection almost unnavigable for clinicians. [Insert table 1 here]

Despite the many measures available the quest for new measures continues and the future is unsurprisingly focused on the digital arena. Development of `item banks' consisting of many questions exploring a particular trait i.e. pain, physical function etc. is seen as a way to improve the precision and flexibility of PROMs.[62] Compiled of individually validated items, each calibrated on a single scale, item banks can be used to develop specific short forms or be administered via Computer Adaptive Testing (CAT). CAT uses algorithms to select items from the bank for each individual patient based on their responses to previous questions.[62] This tailored approach has been able achieve the same reliability with far fewer questions therefore reducing the measurement burden on patients.[63] Despite the use of different combinations of questions with each patient the results are comparable as all items in the bank are drawn from the same scale. Notable examples relevant to limb loss are the PLUS M which allows comparison of scores to a large development sample,[64] or the PROMIS tools.[65]

Despite the many advantages of this approach consideration must be given, as with all OMs, to the population used to develop, prioritise and select items for the bank, especially in limb loss research which can over sample people with traumatic limb loss.[66] This may raise questions about how transferrable item banks are to different populations and subgroups who were not well-represented by the development sample i.e. older dysvascular patients, or from different social and cultural backgrounds.

However, the use of electronic platforms does allow for less burdensome OM completion and valued real time feedback of scores to clinicians. Successful clinical uptake is likely to lie in the cost of the system as well as the accessibility of both the electronic measure during data collection with patients, and the mode of presenting information to clinicians for interpretation. These issues should be explored fully with key stakeholders.

Whatever the measure the key concern from this literature focuses on responsiveness, or the ability of current OMs to detect a change when it has occurred [8,9,12] which is a priority when using OMs to evaluate rehabilitation interventions in clinical settings.[67] Many OMs for use following amputation lack data regarding ceiling or flooring effects[10,12] and only three include a Minimal Clinically Important Difference (MCID) value.[68–70] The MCID is the smallest change in the score that indicates an important change for the patient.[71] Without these values, clinicians and patients do not know if the change they have recorded represents a

meaningful improvement to patients' lives, whether clinical interventions were effective and, importantly, whether the investment in rehabilitation to make this change was justified.

Despite the many barriers identified here there are two examples of system-wide outcome measurement programmes in prosthetic settings. Both are in the style of registries and as with the NJR they attempt to link surgical information, interventions and outcome to understand the impact of lower limb amputation on patients, health care providers and society. The first is the Scottish Physiotherapy Amputee Research Group (SPARG) which collects data on all patients undergoing amputation in Scotland,[72] and the second is SwedeAmp, the national lower limb amputation quality registry from Sweden.[73] Both registries attempt to evaluate the whole medical process concerning lower limb amputation collecting demographic details, surgical and rehabilitation interventions, prosthetic supply and outcome. For SwedeAmp, uptake across the country has been slow and after 9 years the registry captures 62% of amputations,[73] illustrating again the challenges related to system level data collection. Despite these challenges huge amounts of data are now available for analysis and these projects demonstrate what is possible. Further publications regarding the implementation of these registries will be invaluable learning for the development of similar projects elsewhere, including how outcomes were selected, how the data are linked to clinical practice, how data security was addressed in the post GDPR era, and how the barriers described in this review were overcome.

Discussion

Despite well-documented barriers to outcome measurement in clinical practice, there remains an appetite to address these challenges in the UK at all levels. Nationally, the UK NHS PROMs consultation[31] highlights the opportunity to expand ROM into services managing different health conditions with a particular focus on chronic, long-term conditions.[31]

At a clinical level, both the British Association of Chartered Physiotherapists in Amputee Rehabilitation (BACPAR) and BAPO have published guidance on the use of OMs in clinical practice.[1,2] However, both sets of recommendations focus on the selection of outcome measurement tools, listing up to 11 different measures, and do not base this advice on an understanding of what outcomes are important to capture following prosthetic rehabilitation and why. Although these clinically useful documents take steps towards addressing the well documented lack of consensus, widespread use remains an issue.

Establishing value in outcome measurement sits at the centre of this debate and is key to addressing the barriers to implementation. Value is a multifaceted issue and has been highlighted by authors both working in prosthetic rehabilitation[36,45] and wider health care.[6,31,32,74] In order to demonstrate and embed much needed value in ROM to clinicians and organisations involved in prosthetic rehabilitation, understanding 'what is successful prosthetic rehabilitation?' is a vital first step in choosing what outcomes to measure.

Exploring this from a multi stakeholder perspective as recommended by COMET is key, placing at the centre of the process the prosthetic users, for whom the outcome has the most significant impact. This needs to go beyond selecting PROMs simply as a way to capture the patient's perspective and should consider that if the PROM focuses on an outcome domain that patients do not think is important it will not capture a meaningful outcome just because it measures it from the patient's perspective. This review highlights the need for a greater understating of what outcome domains are important to patients following prosthetic rehab, so they can inform a consensus throughout the field of what outcomes should be measured. Schaffalitzky and McDonald have made some progress towards understanding successful prosthetic prescription from a user's perspective and also highlight the differences in how clinicians and patients view outcome with a prosthesis. Care must therefore be taken when seeking to build consensus around important outcomes for measurement that the voice of the patient is not drowned out and is properly represented, especially in commonly used consensus building techniques such as Delphi.

A rigorous foundation of understanding could lead to a national consensus and would direct the recommendation, or development of, user-centred outcome measurement tools that would play their part in addressing some of the barriers to measurement described here. Such tools should be able to address calls in the literature and clinical need,[8,9] to capture meaningful changes over time, must be feasible to use and interpret in busy clinics and should not overburden patients themselves.

Once consensus agreement on the tools for the job are in place ROM practice needs to be developed. This practice must go beyond facilitating the collection of data by making outcome measurement of value to the people undertaking it.[6]

The ability to use outcome measurement data in real time is key with clinicians prioritising access to the data so it can be used as part of usual care to inform treatment planning and monitor the progress of long term conditions,[31] such as lower limb amputation. The use of electronic records systems is increasing rapidly throughout health care organisations and presents opportunities to develop IT that integrates outcome measurement with clinical records in a timely way for real time use, as well as for locally owned reporting.[75] Patients may also like to access outcome data themselves allowing them to compare their progress with others, understand what outcomes they can expect by comparing to data representing equivalent groups where available, or compare the performance of provider organisations. Further development of a system level, user centred approach to consent models could also allow data to be used for wider research and improvement purposes avoiding the existence of data silos and promoting sharing of good prosthetic practice.[76]

A key part of the value of using aggregated outcome measurement data is understanding what the data is telling us.[6,74] The BAPO OMs report found that only 9.2% of the clinicians surveyed had received any pre-registration training on outcome measurement.[1] A number of studies have sought to assess the efficacy of education and training on the uptake and utilisation of outcome measurement with varying degrees of success.[36,44] However, in today's busy clinical environment there is often little time for anything other than treating patients.

Developing partnerships with academic institutions or NHS quality improvement teams may help with the interpretation of findings and provide education through joint working. Academics often have highly developed data analysis skills and increasingly need to demonstrate the real-world impact of their work, for example in the UK's Research Excellence Framework and Knowledge Exchange Framework. Clinical academic roles, improvement fellowships or partnerships with Higher Education Institutes could bridge the expertise gap between clinical practice, academia and quality improvement.[77] This is critically important when attempting to translate outcome data into improvements in care. Outcome data itself does not tell providers what the underlying cause of poor outcomes could be, but provides an indicator of where a problem may lie. Further work is then required to investigate causes, implement change and evaluate its effectiveness.[77] Individuals with this valuable 'knowhow' are critical to making outcome measurement really work in clinical practice.

Conclusion

This narrative review takes a broad look at outcome measurement drawing in ideas and examples from across clinical practice and setting the scene for future systematic approaches. The dilemma of successful outcome measurement in clinical practice is complex and multifaceted. Understanding and embedding value at every step is key to success.

For clinicians reading this review, the take home message is that measuring the outcome of our interventions is important to understand their impact on our patients and the performance of our services, but it is more than just selecting an outcome measure. Clinically we need to understand the 'why', 'what' and 'how' of outcome measurement. 'Why' measure, i.e. to inform at the individual or system level, 'what' to measure i.e. capturing outcomes that are meaningful, and 'how' to measure it i.e. the best tools for the job used in a systematic way that adds value to our practice.

Future work must address the consensus issues of what to measure and how to measure it, ensuring outcomes are meaningful to patients and measurement tools are accessible to use and interpret. Clinician led outcome measurement practice can then be developed in partnership with HEIs or local quality improvement teams. For routine outcome measurement to work data collection should be valuable to prosthetic rehabilitation services and at the core of clinical practice from the individual level right up to the system level and beyond. Processes should be efficient, make use of IT solutions and have all important organisational buy in.

Future research and clinical initiatives must consider all barriers to implementation and engage with patients and stakeholders throughout to overcome them. Outcome measurement could provide accurate evaluation of the work done in clinical practice and lead to improvements in the effectiveness of prosthetic services, and there is endless value in making things better.

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List of tables

Authors	Outcome domains included	Key findings
Rommers et al 2001	• Mobility	• 19 different measurement tools are available that differ in method and measuring range • No consensus about measuring mobility is available in current literature
Condie et al 2006	• Mobility • Function • Quality of life	• 25 measurement tools identified from 28 different studies. • Complexity of studies makes it too difficult for clinicians to use the findings in the literature to inform their choice of outcome measure
Deathe et al 2009	• ICF domain of Activity	• 17 instruments were identified • Lack of evidence about the responsiveness of all measures included
Herbert et al. 2009	• ICF domain of Body Function and Structure	• 16 measurement tools identified • Not many validated tools exist to measure the domain of body function and structure • For all tools responsiveness to intervention has not been established
Xu et al. 2011	• All domains measured following limb loss	• 113 outcome measures were identified • 90% of the concepts measured could be linked to ICF categories • These categories could be used to develop an ICF core set for amputation
Heineman et al 2014	• Mobility • Function • Quality of life	• Replicated Condie et al 2006 review to update evidence base • Only a few of the measures included present minimal clinically important difference values which is vital for tools to be clinically useful • Significant work is required to develop these values and population norms.
Hawkins 2014	• Function • Quality of life	• 21 different assessment tools were identified from 40 studies • Only 5 tools were used in more than 3 studies • The heterogeneity of measures used makes it difficult to compare lower limb outcome studies
Scopes 2016	• Physical Function	• 37 measures were identified • There is a paucity of high quality studies exploring the psychometric qualities of outcome measures of physical function • Responsiveness of these measures is generally unknown and limits their use in evaluating the effectiveness of interventions
Resnick et al. 2017	• Participation	• 34 measures and 94 subscales were identified • Most measures had limited evidence around psychometric properties
Balk et al 2019	• Function • Ambulation • Quality of life	• 50 instruments were identified • The numerous instruments available have variable psychometric properties • There is no evidence as to whether pre-prescription tools are predictive of outcome