

Innovative Outcome Measurement in Upper Limb Prosthetic Rehabilitation

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Introduction: Outcome measure development has long been recognized as a need in the field of upper limb prosthetic rehabilitation to map individual patient progress, highlight needs for component development and cost justification.¹ In response, several measures have been created and proven valid.²⁻¹⁰ However, gaps remain in the effort to capture the complex facets of prosthesis use that ultimately determine success—physical, psychological, social and environmental. This paper describes a suite of 3 measures developed over the past decade that together capture these complex facets more completely. These measures include the Capacity Assessment of Prosthesis Performance of the Upper Limb (CAPPFUL), the Comprehensive Arm Prosthesis and Rehabilitation Outcomes Questionnaire (CAPROQ) and the Wellness Inventory (WI). Each measure will be described individually, including validation data and their value and potential for guiding patient care, device selection and development and cost justification. All studies related to measure development were approved by the WIRB.

Outcome Measure Descriptions:

Capacity Assessment of Prosthesis Performance of the Upper Limb (CAPPFUL):

CAPPFUL is designed as a versatile, low-burden measure of prosthesis performance for any UL functional prosthetic device type and any UL amputation level. Unlike most measures of performance, CAPPFUL assesses overall performance and 5 functional performance domains during completion of 11 tasks. These require movement in all planes while manipulating everyday objects requiring multiple grasp patterns. Performance domains include control skill, adaptive and maladaptive compensatory movement, component utilization and time for task completion. Performance is scored relative to function of a sound upper limb, preventing ceiling effect. For the individual patient, scores within performance domains can target further training needs and assist the treatment team in focusing on optimal strategies to develop performance and function. Multiple administrations assist the team in objectively measuring improvement in performance with the prosthesis over time. Information gathered assists not only to guide therapeutic training but also to determine need for components and/or fit and design modifications. Cumulative data, across prosthetic options and levels of amputation, can establish expectations for current devices, provide reimbursement justification and set goals for future product development. Current administrations including validation study subjects exceeds 200.

Validation: Psychometric evaluation indicates good interrater reliability, internal consistency, known-group validity, and convergent and discriminant validity. Specifically, interrater reliability was excellent for scoring on the task, domain, and full-scale scores (intraclass correlation coefficients .88-.99). Internal consistency was good (α .79-.82). CAPPFUL demonstrated strong correlations with measures of hand dexterity or functioning (r .58 to .72) and moderate correlation with self-reported disability (r .35).¹¹

Comprehensive Arm Prosthesis and Rehabilitation Outcomes Questionnaire (CAPROQ):

The CAPROQ is designed to measure patient reported outcomes in key facets of rehabilitation for adults with UL absence or loss: perceived function, satisfaction and pain. It is a low burden measure to guide individual patient care, as well as assess and improve care models and inform future prosthesis selection and development for the UL loss community. Results inform the treatment team of current status and change of status through the continuum of care and assists with targeting of further training needs as well as providing valuable feedback regarding prosthesis fit and function. CAPROQ cumulative data, across prosthetic options and levels of amputation, provides patient perspectives regarding currently available devices, potential reimbursement justification and guidance for future product development. Original CAPROQ was administered 687 times and since validation study completion, over 100 administrations have been completed with more being added weekly.

Validation Study: Psychometric evaluation with 261 subjects demonstrated adequate-to-strong factor loading on each subscale, good-to-excellent internal consistencies for measure subscales and moderate-to-strong convergent validity. Specifically, confirmatory factor analysis indicated adequate-to-strong factor loading on each subscale: satisfaction (.623-.913), perceived function (.572-.860) and pain (.422-.834). Internal consistencies for the measure subscales were good-to-excellent (.89-.95) and convergent validity indicated moderate-to-strong statistically significant associations between the CAPROQ and the measures tested—Disabilities of Arm Shoulder and Hand questionnaire (DASH), Trinity Amputation and

Prosthesis Experience Scale Revised (TAPES-R) and Brief Pain Inventory (BPI). Currently this validation study is in submission process for peer review.

Wellness Inventory:

The wellness inventory screen was designed to inform prospective prosthesis recipients of how they compare to other people in areas such as coping style, perceived quality of life and other areas that have been shown in the rehabilitation research literature to have an impact on how people perform after acquiring a physical disability. It is a short battery of seven validated screening instruments that measures resilience¹², health-related quality of life (OPUS)¹³, pain (SF-36/12)¹⁴, depression¹⁵, alcohol use (AUDIT-C)¹⁶, drug use/misuse, and posttraumatic anxiety (PC-PTSD)¹⁷. In 2014, analysis of results from 123 patients was conducted confirming high prevalence of mental health concerns in this sample. The WI seeks to promote patient self-understanding during treatment and beyond and, if indicated, to mobilize provision of mental health services by appropriate providers. Re-administration of the WI 6-12 months post prosthesis fitting can determine change in status through the continuum of care. Since inception, over 500 WIs have been administered across seven centers in the US.

The WHO International classification of function¹⁸, identifies 3 domains (Body Functions/Structures, Activities, Participation) and 2 contextual factors (environmental and personal) in complex relationship with a health condition such as upper limb difference. The CAPPFUL addresses Body Structures and Function, and Activities through performance assessment. The CAPROQ, through patient report, addresses all three domains along with environmental factors. The WI, through structured interview, covers personal factors. However, not all of these assessments are appropriate for administration at all times in the continuum of care. The Wellness Inventory is most aptly used early in the rehabilitation process and can assist the patient in decision making regarding whether to pursue psychological care and provides insight for the treatment team in terms of factors that might impact rehabilitation. The WI can be re-administered subsequently to determine change in status or identify further needs. The CAPROQ can also be administered pre prosthesis fitting to obtain baseline data in areas of pain and perceived function. Re-administration post prosthesis fitting tracks changes in these areas as well as capturing satisfaction data. The CAPPFUL is strictly designed for post prosthesis fitting use; with initial administrations, training needs can be identified as well as potential design and component modifications needed. Subsequent administrations can demonstrate progress and further training opportunities, component/prosthesis effectiveness and overall return of function.

Conclusion: Goals for outcome measures vary from ensuring provision of excellent individual patient care to assessment of currently available devices to justification of cost related to both current of future products and more. When administered in concert, the measures described (CAPPFUL, CAPROQ and Wellness Inventory) provide complimentary data relevant to each stage of care and capture detailed information regarding psychological coping, physical performance with the prosthesis and patient perceptions across all areas of function. Furthermore, in aggregate, data from these measures has the potential to reveal trends in outcomes for different levels of amputation, different prosthetic options and provider care model effectiveness.

References:

1. Wright V. Prosthetic Outcome Measures for Use with Upper Limb Amputees: A Systematic Review of the Peer-Reviewed Literature, 1970-2009. *Journal of Prosthetic Orthot.* 2009; 21:P3-P63.
2. Hermansson LM, Fisher AG, Bernspång B, Eliasson AC. Assessment of capacity for myoelectric control: A new Rasch-built measure of prosthetic hand control. *J Rehabil Med.* 2005;37(3):166–71. [PMID: 16040474]

3. Resnik L, Baxter K, Morgia M, Mathewson K. Is the UNB test reliable and valid for use with adults with upper limb amputation? *Journal of Hand Therapy*. 2013; 26(4):353-359.
4. Resnik L, Borgia M. Reliability and Validity of Outcome Measures for Upper Limb Amputation. *Journal Prosthet Orthot*. 2012; 24:192-201.
5. Resnik L, Borgia M, Acluche F. Brief activity performance measure for upper limb amputees: BAM-ULA. *Prosthetics and Orthotics International*. 2017 Jan 1:0309364616684196.
6. Resnik L, Adams L, Borgia M, Delikat J, Disla R, Ebner C, Smurr L. Development and Evaluation of the Activities Measure for Upper Limb Amputees. *Archives of Physical Medicine and Rehabilitation*. 2013; 94:488-94.
7. Light C, Chappell P, Kyberd P. Establishing a Standardized Clinical Assessment Tool of Pathologic and Prosthetic Hand Function: Normative Data, Reliability, and Validity. *Arch Phys Med Rehabil*. 2002; 83: 776-783.
8. Desmond D, MacLachlan M. Factor structure of the Trinity Amputation and Prosthesis Experience Scales (TAPES) with individuals with acquired upper limb amputations. *Am J Phys Med Rehabil* 2005;84:506–13.
9. Baumann ML, Cancio JM, Yancosek KE. The suitcase packing activity: A new evaluation of hand function. *Journal of Hand Therapy*. 2017 Mar 22:1-7.
10. Burger H, Franchignoni F, Heinemann AW, Kotnik S, Gior-dano A. Validation of the orthotics and prosthetics user survey upper extremity functional status module in people with unilateral upper limb amputation. *J Rehabil Med*. 2008; 40(5):393–99. [PMID: 18461266] DOI:10.2340/16501977-0183
11. Kearns NT, Peterson JK, Smurr Walters L, Jackson WT, Miguelez JM, Ryan T, Development and Psychometric Validation of Capacity Assessment of Prosthetic Performance for the Upper Limb (CAPPFUL), *Archives of Physical Medicine and Rehabilitation*. 2018;99:1789-87.
12. Block, J., & Kremen, A. M. (1996). IQ and ego-resiliency: Conceptual and empirical connections and separateness. *Journal of Personality and Social Psychology*, 70(2), 349–361.
13. Heinemann AW, Bode RK, O'Reilly C. Development and measurement properties of the Orthotics and Prosthetics Users' Survey (OPUS): a comprehensive set of clinical outcome instruments. *Prosthetics and Orthotics International*. 2003, 27:191-206.
14. Ware J Jr1, Kosinski M, Keller SD. A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. *Med Care*. 1996 Mar;34(3):220-33.

15. Robert D. Kirkcaldy, L. Lee Tynes. Best Practices: Depression Screening in a VA Primary Care Clinic. Published Online:1 Dec 2006.
<https://ps.psychiatryonline.org/doi/full/10.1176/ps.2006.57.12.1694>
16. Kristen Bush, MPH; Daniel R. Kivlahan, PhD; Mary B. McDonell, MS et.al., The AUDIT Alcohol Consumption Questions (AUDIT-C) An Effective Brief Screening Test for Problem Drinking. Arch Intern Med. 1998;158(16):1789-1795.
17. Annabel Prins, Paige Ouimette, Rachel Kimerling, et.al., The primary care PTSD screen (PC-PTSD): development and operating characteristics. Primary Care Psychiatry. VOL. 9, NO. 1, 2003, 9-14.
18. World Health Organization. ICF training Beginner's Guide. 2002 [cited; Available from: <http://www.who.int/classifications/icf/training/icfbeginnersguide.pdf>