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FUNCTIONAL ASSESSMENT

A gerontologist in Philadelphia, M. Powell Lawton, wrote in 1971 the first definition of *functional assessment*. He said that functional assessment was any systematic attempt to objectively measure the level at which a person is functioning in a variety of domains. Functional assessment, as a scientific endeavor, was slow to develop in rehabilitation. In fact, during the 1970s, most clinicians regarded functional assessment as an effort to measure the unmeasurable.

Substantial progress has been made in the past 30 years and functional assessment, in combination with outcomes analysis, is now considered one of the "basic sciences" of rehabilitation. Measurement of function is essential to the goals of rehabilitation, particularly medical rehabilitation. These goals are to monitor, support, and facilitate human performance and behavior, while considering environmental, structural, physiological, or psychological limitations. Functional assessment is a method for describing a person's abilities and limitations.

The essence of functional assessment is the measurement of a person's use of skills included in performing tasks necessary to daily living, leisure activities, vocational pursuits, social interactions, and other required behaviors. Information obtained from functional assessment is used to help formulate judgments as to how well essential skills are being used and to gauge the degree to which tasks are accomplished and social role expectations are met. Performance-based functional assessments take into account the social and physical contexts of the person. Measurement of functional abilities and outcomes must relate to real-life situations and settings.

Commonly, the emphases of rehabilitation programs include improving the functional status of individuals through a system of interdisciplinary interventions. Outcomes are determined by periodic

reassessment of changes over time. The purposes of measurement are to make explicit the effectiveness, the efficiency, and the cost-effectiveness of the interventions. In this manner, outcomes of professional interventions of health care, rehabilitation, education, or psychological and social counseling may be described and monitored. Once outcomes become measurable, they become manageable.

The term *evidence-based practices* fits nicely with the idea of functional assessment and outcomes analysis as a basic science of rehabilitation. A scientific approach to assessing function and rehabilitation outcomes enhances national and international communications through use of a common language.

MEASURING FUNCTION AND ANALYZING OUTCOMES

Functional assessment and outcomes analysis require measurement. Measurement begins with understanding what is to be measured. This understanding must be grounded in theory and must be connected to a comprehensive model for identifying and then meeting the needs of the person being assessed. Each tool used in measurement must be designed and tested with respect to its purpose, practicality, construction, standardization, reliability, validity, responsiveness to change, feasibility for use, and meaningfulness in the clinical setting.

There are many difficulties in applying measurement principles to function and outcomes because the concepts to be evaluated relate to whole-person perceptions, attitudes, knowledge, or behaviors and are more often intangible (so-called latent traits) rather than tangible. For example, physical performance measured in terms of muscle strength, endurance, velocity of contraction, oxygen uptake, or even timed ambulation is much more tangible than measuring the ease or difficulty that a person as a whole experiences in tasks of daily living. Another example is the long-standing difficulty in measuring pain. Pain is a factor that often limits a person's ability to complete daily living activities, social interactions, and role participation.

Person variables are latent traits because they are hidden in the person; we can only infer them from observation of behaviors. These are just a sample because the person may generate a universe of behaviors, not simply mechanistic responses to external stimuli. One can infer that a person is "independent in daily life" by observing that he or she eats, dresses, or moves autonomously, but many other behaviors, if produced and observed or reported, might convey the same kind of information. This implies (a) discontinuity in the source data (we can only count discrete observations along a continuum); (b) nonlinearity of the counts (different behaviors do not represent the same amount of autonomy, despite being counted as "one more"); (c) more numerous behaviors replicate (and thus make more reliable) the observation that the variable is there, but do not necessarily reveal "more" of the variable; and (d) inhomogeneity of the error surrounding the observation (too easy or too difficult tasks for a given person provide very reproducible outcomes, whereas tasks "on target," despite being more informative, may end up in "pass" or "fail"). Thus, despite integer numbers, counts of observations represent a potentially poor surrogate of the intended measure. Recent developments of psychometrics, led by Rasch analysis (after the name of the Danish mathematician Georg Rasch), are at last shedding light on this fundamental challenge to functional assessment.

One technique for developing measures of tangible and intangible phenomena is through use of the Rasch mathematical model. Easily used software programs are now available to assist in the measurement process using the Rasch model. Rasch is described later, in the section titled "Uses of Functional Assessment."

Distinctions must be made between performance-based functional assessment, taking the social and physical contexts into account, and the conceptually simpler, more objective evaluation and measurement of functional capacity. Functional capacity assesses the person's performance under controlled circumstances, similar to judging optimal performance in laboratory conditions. These results may not reflect how the person performs in daily living activities in the "real world." Testing muscle strength and timed walking distance, as described above, are measures of functional capacity rather than of daily living activities.

There are many models for conceptualizing the attributes to be measured. Most emanate from the work of psychologist Abraham Maslow (1954), who evolved a hierarchy of needs to achieve self-actualization in

order to live a fulfilling life. He understood that life's work was to systematically overcome barriers. At the base of Maslow's hierarchy lie needs for physical survival, and at progressively higher levels are satisfaction of needs for security, social interaction, and self-esteem. One derivation considers that the concepts to be measured are challenges to quality of daily living. In this model, the goal of fulfillment is achieved through balancing one's choices, options, and expectations (functional opportunities) with one's physical, cognitive, and emotional constraints (functional demands/barriers).

When opportunities and demands are not directly measurable in quantitative terms, then the underlying factors that either support or form barriers to health and functioning are often chosen for measurement. For example, functional opportunities that are supported by good health may be described and measured by assessing physical status, mental/emotional status, social interactions, role participation, and general well-being. On the other hand, functional demands/barriers may be described and measured by assessing pathophysiology, impairment, functional limitations, disability, and societal limitations (see definitions below).

As another example, motivation is felt to be an important underlying determinant of how well a person may cope with adversity, for instance, a chronic disease or disability. While not directly measurable, inferences may be made by measuring variables related to motivation, such as self-esteem, mood, or by analyzing the steps one follows in solving a problem or in developing a plan of action.

The World Health Organization (WHO; 1980) originally proposed a series of definitions that have had a profound impact on the assessment of functional status and outcomes in rehabilitation. The original WHO framework was modified in a National Institutes of Health, National Center for Medical Rehabilitation Research report published in 1993. This report included the following definitions that are widely used within rehabilitation:

> *Pathophysiology* is any interruption of, or interference with, normal physiological and developmental processes or structures.

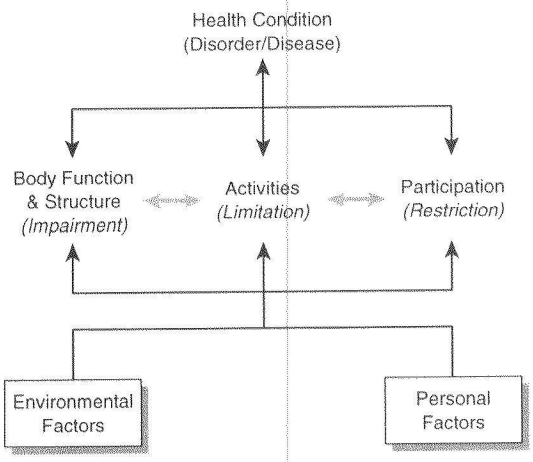

Figure 1 Interaction of Concepts
Source: World Health Organization (2001).

> *Impairment* is any loss or abnormality at the organ or organ system level of the body.

> *Functional limitation* is any restriction or lack of ability to perform an action in the manner or within a range consistent with the purpose of an organ or organ system.

> *Disability* is any limitation in performing tasks, activities, and roles to levels expected with physical and social contexts.

> *Societal limitation* is any restriction attributable to social policy or barriers (structural or attitudinal) that limits fulfillment of roles or denies access to services and opportunities associated with full participation in society.

Recently, the WHO (2001) proposed a revised model referred to as the International Classification of Functioning, Disability, and Health. The components of this model are presented in Figure 1.

The dynamic evolution of disablement models illustrates that measurement of functional abilities and rehabilitation outcomes is an ongoing challenge in which researchers and clinicians attempt to disentangle complex nonlinear interactions that occur in real life, across many different variables. Yet measurement of each variable, itself, must be linear, that is, proportional to the quantity it is claimed to represent. Rehabilitation outcomes are multiple rather than

singular. Assessment of "quality of life" requires use of measures that cover several aspects of functioning concurrently, yet cooperating in defining a unitary construct. This means that using a large number of instruments is not necessarily better than using a few well-chosen ones. As well, one must be vigilant that instruments are measuring accurately and succinctly. Johnston, Keith, and Hinderer (1992) have identified interdisciplinary standards and guidelines to foster improvement in development of functional assessment scales in rehabilitation. These standards and guidelines were compiled to counter the tendency to measure the "whole person" based on evaluation of severity of focal impairment alone.

The guidelines cover validity, reliability, clinical application, and program evaluation/quality improvement.

Validity includes three forms (content, predictive, and construct) and is the paramount criterion for choice and use of an instrument. Validity is regarded as the extent to which a test measures what it is intended to measure. Commonly, a "gold standard" is sought against which newer measures may be compared.

Reliability is the extent to which the data contain relevant information with a high signal-to-noise ratio versus irrelevant static and confusion, that is, sufficiently free of either random or systemic error. Repeatability indicates reliability. Agreement is the most stringent form of repeatability in which results of testing match across raters, time, or subjects. Agreement, however, may come also from the same bias affecting multiple observations (e.g., across raters or times). Internal consistency is another, perhaps even more stringent, form of reliability, demonstrating that all items are evaluating the same general construct. The more coherent the items are, the more they will be free from individual changes, independent from the shared construct, and thus, the scores will tend to be repeatable.

Clinical application means that users need to understand the scientific basis for the inferences they make from their clinical assessments and the boundaries of this knowledge.

Program evaluation/quality improvement involve application of measures to groups for purposes of ongoing review to systematically resolve identified problems and pursue opportunities to improve care and services, to accomplish accreditation, and to use evidence to support policy making. Wide variations in responses of individuals may reflect an instrument or measurement process that is not accurate or stable. Outcomes not only are dependent on the effectiveness of treatment but also depend on patterns of input, process, and conditions surrounding the treatment intervention. Good outcomes are the culmination of the combined effects of structure and process. Case-mix adjustments must be made to account for variations in severity or qualitative differences in the individuals being measured.

USES OF FUNCTIONAL ASSESSMENT

Using data from the Uniform Data System for Medical Rehabilitation, Margaret Stineman, associate professor, Rehabilitation Medicine, University of Pennsylvania, and colleagues (Stineman 1998; Stineman et al. 1994; Stineman et al. 1997) developed the FIM-FRG system to classify patients at the time of admission to inpatient rehabilitation. The FIM-FRG system was designed to facilitate prediction of length of stay and level of function that can be achieved during rehabilitation, and to compare outcomes between patients, having made case-mix adjustments. The classification system uses type of impairment, severity of disability using the FIMTM instrument (*Guide to the Uniform Data System* 1996) motor and cognitive measures, and for some groups, age. The IRF-PAI (Inpatient Rehabilitation Facility-Patient Assessment Instrument), developed for the U.S. Centers for Medicare and Medicaid Services (www.cms.hhs.gov) to use for prospective payment to rehabilitation hospitals, incorporates the FIMTM instrument, and has been used in the United States since January 2002.

In contrast to continuous linear measures (such as those for length and weight), item-response scales are most commonly used for functional assessment and outcome analysis. Scales are typically discontinuous-ordinal. The raw scores they provide are neither linear nor equal-interval, thus they should not be used in parametric statistical analyses. Interval measurement derived from raw scores through Rasch-based (Wright and Linacre 1989) transformation improves functional status analysis by providing unidimensionality and

additivity. Unidimensionality means that items cooperate with each other as they progress in difficulty across a common range of performance, with each item adding a level of difficulty for the subjects. Unidimensionality also means that the abilities of the subjects can be located along the continuum defined by the items, according to common standard units. Additivity means that adding one more unit always increases the pool by the same amount, whatever the overall level of the measure.

Together, these two concepts of item difficulty and person ability being measured on the same linear metric are referred to as conjoint additivity. Conjoint additivity is achieved only if the measure is independent of the particular sample being tested, and of the particular set of items adopted. Therefore, Rasch-transformed measures, complying with the requirement of conjoint additivity, permit statistical validity and generalizability in comparing individuals on the basis of results using an aggregate rating and in comparing changes in ratings over time. The Rasch measurement model offers opportunities for comparing standardized expected values both for aggregate ratings and item responses when persons have problems that are relevant to the latent trait being measured.

Measures of function and outcome analysis are classified according to questions that they are intended to answer: (1) discriminative, (2) evaluative, or (3) predictive. The first task in using a measure is to identify levels of severity from low to high. The second task is to identify whether the value of the measure changes with changing severity. The third is to predict another parameter that is either concurrent, such as the cost of the treatment program or the value of a variable in the future, such as the likelihood of recovery.

A challenge that remains for the medical rehabilitation field to solve is the predictable relationship between the "dose" of rehabilitative services and the "response" of the person. In fact, depending on the problem and the treatment, rehabilitation outcomes may follow teaching-learning paradigms (e.g., in therapeutic exercises), in the same way that chemical dose-response dynamics (e.g., in chemical treatments for pain or spasticity) do.

When functional assessment is performed by observation of activities, it is very important to assure accuracy or intrarater and interrater reliability. This may be accomplished through several methods that include (1) testing competence of the assessors with an examination, (2) testing the results of the assessments with standard statistical studies of variance, and (3) Rasch modeling of the data testing for separability of persons and items and the fit of item responses to expected rating patterns. Assessors who are performing ratings through observation or interview need to receive training and then be tested to ensure their knowledge of the criteria for rating.

CONCLUSION

Feedback of the results of functional assessment and outcome analysis is extremely important (1) for clinicians to know whether they are "on track" and (2) for administrators to perform program planning and program evaluation and to make policy decisions responsibly. Accrediting bodies require functional assessment and outcome analysis as evidence of quality assurance. Accreditation agencies are also increasingly sensitive to feedback from the consumers of rehabilitation services. In the effort to measure quality of daily living, it has become important to use patient-centered questionnaires that gather the person's perspective, rather than attempt to infer this perspective from objective testing of body functions. The patient-centered approach to functional assessment and the evaluation of rehabilitation outcomes is consistent with the goals of medical rehabilitation and reflected in the motto "As we function, so shall we live!"

—Carl V. Granger, Kenneth J. Ottenbacher, and Luigi Tesio

See also Evidence-Based Medicine; International Classification of Functioning, Disability, and Health (ICF/ICIDH).

Further Readings

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FUNCTIONAL MEASUREMENT

Functional measurement is a general term that describes the processes by which we collect information to evaluate disability and determine the need for vocational or rehabilitation services. On the surface, functional measurement may simply represent the act of determining a meaningful quantity of something. The term *functional* means purposeful or useful. Measurement refers to the process of determining a quantity or amount. However, the term takes on a special meaning in the context of disability and refers more specifically to the process of quantifying an individual's performance of particular tasks and activities in the context of specified social and physical environments. A preponderance of functional measurement is focused on the completion of tasks and activities that relate to work (specifically, to a particular job) or to caring for oneself. Thus, key tasks and environments that are most often the focus of functional measurement are *activities of daily living* (e.g., eating, dressing) completed in the home and specific job functions completed in the workplace. Another, though less emphasized, area of functional measurement involves getting around and using the community at large.