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SPECIAL COMMUNICATION

Rehabilitation Treatment Taxonomy: Implications and Continuations

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Abstract

In relation to the conceptual framework for a rehabilitation treatment taxonomy (RTT), which has been proposed in other articles in this supplement, this article discusses a number of issues relevant to its further development, including creating distinctions within the major target classes; the nature and quantity of allowable targets of treatment; and bracketing as a way of specifying (1) the skill or knowledge taught; (2) the nature of compensation afforded by changes in the environment, assistive technology, and orthotics/prosthetics; and (3) the ingredients in homework a clinician assigns. Clarification is provided regarding the role of the *International Classification of Functioning, Disability and Health*, focusing a taxonomy on ingredients versus other observable aspects of treatment, and regarding our lack of knowledge and its impact on taxonomy development. Finally, this article discusses the immediate implications of the work to date and presents the need for rehabilitation stakeholders of all disciplines to be involved in further RTT development.

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Rehabilitation is effective some of the time, for some problems of some patients, and that is the reason that patients return and third-party payers keep paying the not inconsequential fees that the rehabilitation enterprise charges. The third party payers, however, increasingly ask for evidence that what they pay for works and have started to refuse to pay for those interventions for which no evidence of effectiveness exists. Unfortunately, we have such evidence of effectiveness for only a very limited number of treatments, a position not much different from that of the rest of health care. Even in those limited instances, we may only know that a particular treatment or group of treatments being delivered under a particular label (for instance, "inpatient spinal cord injury [SCI] occupational therapy") has better effects than the absence of any treatment, but we do not necessarily know the active ingredients comprised under those labels, and which one(s) is beneficial or even essential for which outcomes. Generally, we do not know what is being offered as part of multidisciplinary rehabilitation interventions, with what ingredients, and with what direct and indirect causal effects, only some of which may coincide with the clinical goals and targets that were intended to be addressed by treatment.[1] It has probably been more than 4 decades since someone first used the term "black box" to describe the nature of multidisciplinary rehabilitation; and in the years since, the sides of the box have not become less opaque.

In short, we have limited insight into what our treatments are, and what are feasible ways of operationalizing and quantifying them for dosing in clinical practice, or for research on treatments. As a field, we (clinicians, researchers, educators, and other stakeholders, collectively) have largely focused our research on the measurement of inputs (admission deficits and other patient characteristics) and outcomes, rather than treatments.[2,3] The way out of this problem is often seen to be the creation of a taxonomy of rehabilitation interventions, and in the literature, there are quite a few ad hoc classifications of medical rehabilitation interventions in particular areas and/or for particular diagnostic groups.[4-10] They tend to have many shortcomings, a major one of which is

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"goal-oriented language"[11]: a tendency to name an intervention or group of interventions based on the deficit selected for treatment (for instance, "gait therapy"), and assuming that what goes under that particular label is known and is the same from one facility to the next and from one clinician to the next.

In the other articles included in this supplement,[12-15] the following points have been argued:

- A comprehensive **taxonomy* or similar classification of rehabilitation **treatment* is needed to assist researchers, clinicians and educators, and other stakeholders in describing comprehensively and precisely what happens in the black box of rehabilitation and to help create the evidence base needed to improve treatments.[12] (Words and phrases that are specifically defined in supplemental appendix S1 [available on page A9 of this supplement and online at http://www.archives-pmr.org/] are marked with an asterisk and italicized when initially used.)
- Any classification of rehabilitation interventions should be based on the **active ingredients* that are used in them, specifically the **essential ingredients* that characterize those interventions, rather than the patient deficit selected for treatment or other even more incidental aspects of the treatment.[12,13]
- Active ingredients are only identified when one has a tripartite **treatment theory* that links **treatment ingredients* through a **mechanism of action* to the **target of treatment*, a specific aspect of functioning that the clinician wants to change.[15] (This is illustrated in fig 1.) Note, however, that the clinician, starting with the need for change, reasons in the opposite direction of the causal chain in order to put it into play.[15] The clinician typically takes the patient's strengths and weaknesses into account when making ingredient selection(s).
- Changes in the target of treatment can have repercussions for other aspects of functioning (as specified by **enablement theory*), which may be a clinical **aim(s)* downstream from the target of treatment.[14]
- Rehabilitation treatments ranging from drugs to training of personal aides, and from assistive devices to instruction in activities of daily living (ADL), can be classified in groups and subgroups based on their shared active ingredients, which, as postulated in their treatment theories, tend to have characteristic targets (see fig 1).[15]
- Four major such **treatment groupings* may be distinguished, broad classes of treatments that are similar in their essential ingredients, and that therefore (as postulated by their tripartite treatment theory) are able to act on a class of similar treatment targets[15]: (1) treatments that alter the structural qualities of tissue, (2) treatments that alter or replace the functions of organs or organ systems, (3) treatments that facilitate the learning-by-doing necessary for skilled performances, and (4) treatments that facilitate the acquisition and interpretation of information in both cognitive and affective realms.

The major treatment groupings are so defined because we expect that different classes of targets will be impacted by different types of essential ingredients (and different mechanisms of action), such that treatments within each grouping will be similar to each other and will differ from treatments found in other treatment groupings. Furthermore, we expect that defining the major treatment groupings in terms of target classes will align well with clinical decision-making, which typically begins by identifying the aspect of functioning to be changed.

Taken together, the concepts and frames of thinking that we have developed thus far offer the prologue to a rehabilitation treatment taxonomy (RTT), rather than the taxonomy itself. A number of issues still need to be addressed before an RTT can be created and used by various stakeholder groups in their work in rehabilitation. The objective of this article is to describe some of the important challenges remaining for this effort and point at possible fruitful ways of looking for solutions, based on our preliminary explorations and, where applicable, the existing literature.

List of abbreviations:

ADL	**activities of daily living**
ICF	***International Classification of Functioning, Disability and Health***
RTT	**rehabilitation treatment taxonomy**
SCI	**spinal cord injury**

Further Development of the Classification: Distinctions Within the Major Treatment Groupings

A central question for the future of the RTT involves how to further subdivide the 4 groupings. As noted in Hart et al,[15] the first grouping, treatments that alter the shape and size of organs or tissues, typically involve the delivery of different forms of energy. In many cases, this is mechanical energy in the form of prolonged forces that lead to tissue elongation. Other forms of energy (eg, heat) may alter the viscoelastic properties of tissues. Moreover, there may be instances where the schedule of energy delivery alters the impact on tissues, as when brief high-energy mechanical impulses lead to the tearing of tissues (eg, manipulation of a joint under anesthesia), whereas prolonged low energy impulses lead to tissue elongation. It seems likely, therefore, that treatments in this grouping can be subdivided into more specific categories that involve certain forms of energy, delivered with exact patterns, to alter particular tissues in specific ways.

Treatments that alter organ functions typically involve delivery of some patterned input to up- or down-regulate an organ system's output, or they may be devices that substitute for a missing organ function in terms of their downstream effects. We anticipate that treatments in this group may be subdivided into more specific categories that pertain to the modality through which the organ is stimulated, and the patterning of that stimulation, because different organ systems are responsive to categorically different forms of input. Thus, for example, exposure to increasing doses of gravity may help regulate baroreceptors, exposure to certain forms of vibration or mechanical energy may regulate muscle stretch receptors, and production of specific patterns of electrical output from a cochlear implant can signal downstream acoustic processors. Further work is necessary to determine whether this approach to subdivide by input would add more than splitting according to the organs/organ systems that are changed by the treatment, which is probably a more intuitively appealing model.

In the treatment groupings where volitional learning encompasses the mechanisms of action, further distinctions will be more complicated. Indeed, in the skilled performances category we have already attempted (and discarded) subdivisions based on (1) training in *International Classification of Functioning, Disability and Health* (ICF) functions versus activities, (2) implicit versus explicit learning, (3) mental versus physical skills, (4) continuous versus sequenced movement, and (5) other splits. We realized that