



## New horizons in stroke rehabilitation research

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**Abstract**—To promote health services research in stroke rehabilitation, we gathered information about stroke rehabilitation structures, processes, and outcomes (SPO), using extant databases and the Donabedian theoretical model of health services evaluation. We found that, in the United States, over \$3.6 billion was spent by third-party payers in 1992 on rehabilitation, including stroke. Total disability-related costs now amount to over \$170 billion per year. However, there are few studies identifying cost-effective stroke rehabilitation practices. Existing studies indicate that the organizational structure of rehabilitation influences stroke outcomes, but it is less clear exactly what organizational practices constitute optimal stroke rehabilitation. Data about specific, beneficial rehabilitation processes are scanty for stroke. There are a number of valid and reliable outcome measures pertinent to stroke rehabilitation health services research. We conclude that health services research in stroke rehabilitation is sparse. To be more informative, rehabilitation health services research should be guided by the SPO model.

**Key words:** conceptual model, health services research, physical therapy, rehabilitation, structure and process of care.

### INTRODUCTION

In an era of chronic disease management, rehabilitation takes on an increasingly prominent role in the clinical management of patients and, therefore, is a key area for research. In the United States, disability-related costs already total more than \$170 billion per year, and the number of persons with long-term disability is expected to double by the year 2020 (1,2). Appropriate rehabilitation practices should enhance functional recovery and minimize dysfunction, improving subsequent healthcare utilization while also promoting the quality of life of the individual; thus, rehabilitation is a particularly noteworthy area for health services research. Yet there are relatively few studies focused on identifying the most cost-effective rehabilitation practices or their preferred organization, and existing studies are limited by inadequate descriptions of the studied services (3).

A primary explanation for this neglect may be the high degree of complexity associated with rehabilitation. Rehabilitation is diverse in its interventions, in its providers, and in the ways it is

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provided; these diversities pose significant challenges for clinical research. Kane described the problems he encountered performing rehabilitation outcomes research: multiple different personnel simultaneously providing treatment, inconsistent documentation, and the difficulty of defining the treatment itself; that is, is the treatment a specific modality, a person with a specific kind of training, or a specific setting for care (4)?

Several factors exacerbate the difficulties with rehabilitation research. The terminology used in rehabilitation has distinct meanings in different contexts. For example, the term "rehabilitation" is used to refer to treatment in rehabilitation hospitals, treatment by rehabilitation therapists in any setting, and treatment at a specific time period in the recovery from an illness. A thorough literature search in rehabilitation must access several different databases, (PubMed®, Cinahl, HealthStar), and many journals not carried by smaller medical libraries. Third, in rehabilitation, such patient characteristics as baseline functional abilities probably have important indirect effects on clinical outcomes, in addition to their better-known direct effects. For example, patient functional abilities directly influence risk of institutionalization (5), but functional ability also influences the initial decision to provide rehabilitation, the specific interventions employed, and third-party reimbursement, each of which may influence clinical outcomes such as institutionalization.

The standard health services research framework of structure, process, and outcome (SPO) originally proposed by Donabedian may help reduce this complexity (6). Initially developed to assess the quality of healthcare, more recently the SPO Model has been used by health services researchers to examine outcomes related to differences in structure or process of care and the relationship of structure and process of care to one another. As an initial step in organizing thinking about health services research in rehabilitation, this paper provides a review of the SPO Model, presenting key components pertinent to rehabilitation within each of the three domains (see **Figure 1**). Stroke rehabilitation is used to provide exemplary applications of the model, because stroke accounted for 31 percent of admissions to rehabilitation hospitals in 1994, and persons with stroke have the highest annual charges for outpatient rehabilitation of any patient group (7,8).

## METHODS

A qualitative review of the literature was performed to identify studies of stroke rehabilitation that illustrate the applications of SPO to rehabilitation. For each dimension, specific components pertinent to rehabilitation are defined, a description of salient characteristics is provided, the current state of knowledge described, and representative literature is reviewed. References were selected on the basis of their pertinence to the model and the component being described. Sources included PubMed®, Cinahl, HealthStar, and Current Contents. A variety of search terms were used, including terms relative to the specific components being described (e.g., exercise), and generic search terms pertinent to rehabilitation health services research (physical therapy, outcome and process assessment). Published reviews of the rehabilitation literature were also examined, for example those edited by Fuhrer, a summary of cost-effectiveness studies by the American Occupational Therapy Association, and references in the AHCPR Stroke Guidelines (9-11).

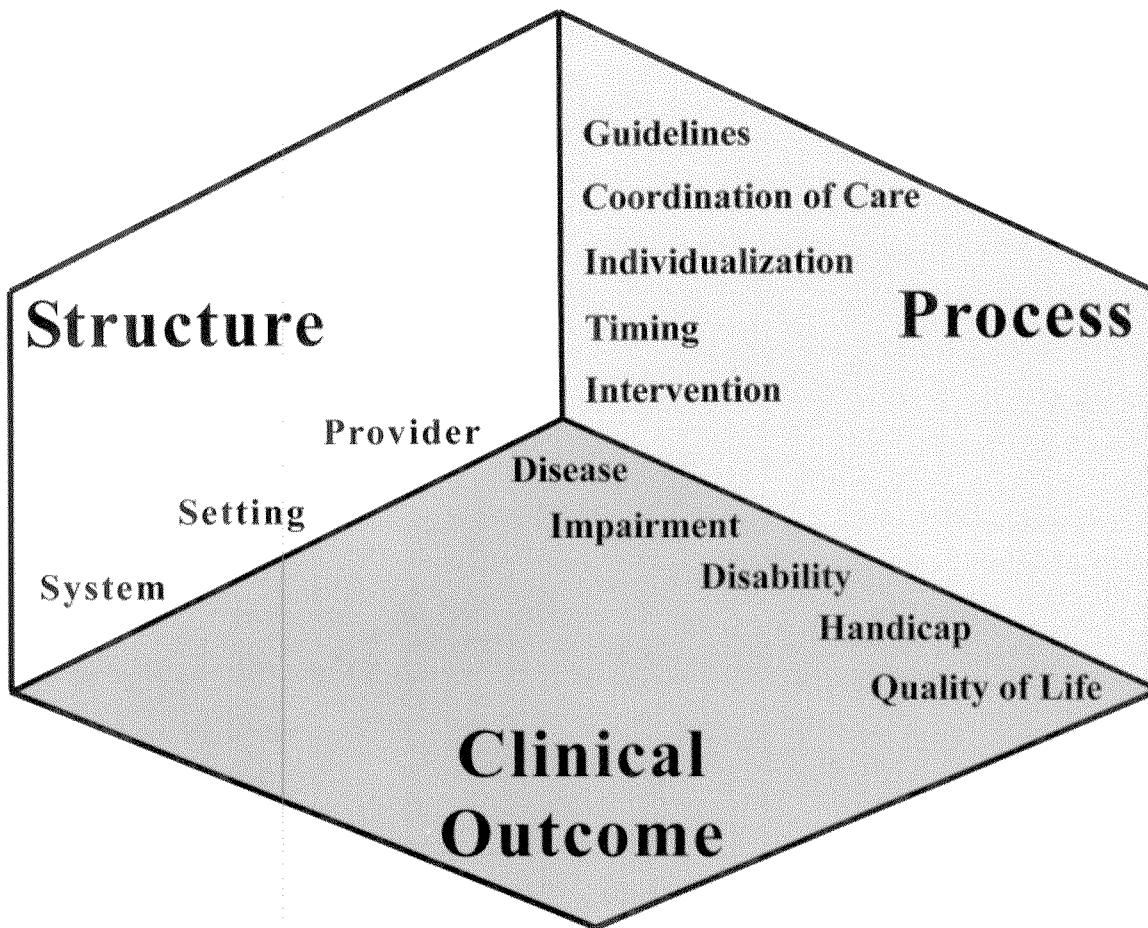
## RESULTS

### Overview

Referring to **Figure 1**, structure of care represents characteristics of medical care that are relatively unchanging, like the equipment and personnel used to provide care; process of care is what actually happens to and with the patient; and outcomes of care represent the results of medical care. The relationships between structure and process of care, and the relationship to outcomes, are active areas of health services research. Each of these domains, and each component in the domains applicable to rehabilitation, are reviewed in more detail in the sections that follow. Within each section, we first supply a general description and pertinent definitions, then we review representative studies and empirical data. The reader is encouraged to refer to the diagram while reading, placing pertinent aspects of the specific studies discussed onto the diagram.

### Overall Structure of Care

a) Description and definitions: Structure of care may be defined as "...the materials, equipment,



**Figure 1.**  
Graphical depiction of the SRO Model as applied to rehabilitation.

services, and manpower available for care and the credentials and qualifications of the health professionals involved" (12). The Commission on Accreditation of Rehabilitation Facilities (CARF), the main accrediting body for rehabilitation, is currently revising its definitions, but historically has defined three levels of inpatient medical rehabilitation (rehabilitation units in acute care hospitals or free-standing rehabilitation hospitals, and two levels of nursing home rehabilitation) as well as outpatient and home health rehabilitation (13). The differences in the levels of inpatient rehabilitation according to CARF were determined on the number of hours, the frequency of therapy, and the ability of the facility to meet complex nursing needs. The Health Care Financing Administration tied level of reimbursement to complexity of staffing and to intensity of therapy.

These accreditation and regulatory differences likely were a major factor influencing the structural organization of rehabilitation throughout the United States. More recently, the growth of health maintenance organizations has influenced the increasing prevalence and use of subacute rehabilitation facilities.

b) Empirical evidence: A large body of data indicates that outcomes for stroke patients are affected by the way rehabilitation is structured and organized. Two recent prospective studies showed better outcomes for stroke patients cared for in rehabilitation hospitals than for those in nursing homes, although at markedly higher costs of care: \$17,202 compared to \$8,336 (14,15). One meta-analysis of stroke studies found a 28 percent reduction in mortality for patients managed in stroke units compared to usual care (16). Overall

structure of care indeed appears to affect stroke outcomes. What is much less clear is what specific components of structure of care are responsible for these differences in outcomes, or if structure of care has its effect by altering the process of care.

Careful identification of the critical factors responsible for the different outcomes across different settings for stroke rehabilitation might allow improvement in care and cost-savings by eliminating unnecessary services. While Keith demonstrated remarkable similarities in care patterns within specific types of rehabilitation settings (17), others have shown significant disparities in care patterns across these settings (8,16,18-20). The Stroke Trialists' Collaboration used meta-analytic techniques to try to tease out specific aspects of stroke rehabilitation associated with better outcomes (21). They found more successful stroke care was characterized by coordinated multidisciplinary rehabilitation, programs of education in stroke, specialization of medical staff, and location in a geographically discrete ward. However, no one factor was uniquely associated with better outcomes. In this regard, it is useful to review individual studies of specific aspects of structure of care—the provider, the physical facilities, and broader, systemic factors.

### **Specific Components of Structure of Care**

#### *Rehabilitation Provider*

a) Description and definitions: Sainfort, Ramsey, and Monato (22) identified three commonly studied characteristics of healthcare providers: staff qualifications, composition, and effort/time (e.g., staffing intensity). In rehabilitation, there are often multiple differing kinds of providers interacting with the patient, and their qualifications vary according to their education (e.g., master's or bachelor's degree for a physical therapist (PT) versus an associate's degree for a PT assistant); their training in specific approaches to the patient or in unique therapeutic techniques (e.g., occupational therapist (OT) versus PT); and their licensure (unlicensed PT aide versus licensed PT assistant). While these differences are believed to confer distinct attributes, in reality very little is known about the relative merits of differing amounts and kinds of rehabilitation provider training. Moreover, there can be considerable

overlap in the actual services rendered by the different providers. For example, when treating stroke patients, OTs often focus more on self-care (bathing, toileting) and PTs more on mobility (walking, transfers). However, OTs often work on mobility during self-care training (transfers in the bathroom), PTs instruct patients in techniques for safely performing personal care, and nurses interact with patients for bathing and toileting. Similarly, OTs, nurses, speech therapists, and dieticians may all work with patients on self-feeding skills.

b) Empirical evidence: The use of multiple different providers in rehabilitation is based on the belief that the individual providers themselves and their group interaction offers significant benefits to patients; that is, that the combined expertise of multiple professionals results in better problem solving, and that mutual treatment of functional mobility by OT, PT, and Nursing acts to reinforce the newly learned techniques (23). However, the actual extent of these benefits is largely unknown. For stroke patients, one randomized trial found improved outcomes for patients placed in a geographically distinct ward where a higher proportion of the patients received occupational therapy beginning at a much shorter interval after admission (24). Rehabilitation hospitals have more diverse staff, they have higher staffing ratios, and they provide more therapy than nursing homes (15,16). On the other hand, a meta-analysis of stroke studies that attempted to identify the effect of provider type (25) did not show a significant difference in effect size between PTs and OTs.

The paucity of objective information about the benefits of specific types and amounts of provider training is stunning in view of the costs of providing rehabilitation and the anticipated occupational growth. In North Carolina, for example, salaries for PT Assistants range from \$18,000-37,000, and those for PTs from \$34,000-80,000 (26). The US Department of Labor predicts employment for PTs and PT Assistants will grow much faster than the average for all other occupations through the year 2005, and predicts 88-93 percent growth from 1992-2002 (27).

### **Physical Facilities**

a) Description and definitions: Structural attributes identified by Sainfort, Ramsey, and Monato included facility features and resources

other than staff (22). For rehabilitation, this would include the layout of the physical site where the patient receives care, and the specific kinds of equipment used to provide rehabilitation.

The goal of rehabilitation is to improve function and quality of life. As such, the fit between patients' abilities and environmental demands is very important (28). Consider toileting facilities: with a wheelchair-accessible bathroom and training in transfer techniques, someone paralyzed from a stroke may be independent in toileting; without them, that person is more likely to be handicapped. Furthermore, to the extent that those adaptive bathrooms allow patients to practice newly learned adaptive toileting techniques outside therapy sessions, toileting facilities are procedural equipment for rehabilitation. Thus, it is important to consider the influence of the environment of care on rehabilitation outcomes.

b) Empirical evidence: Although there is some evidence that the physical environment influences some aspects of the rehabilitation process of care (29) and that it may influence functional outcomes (30), there are limited data on the effect of environment of care on stroke rehabilitation outcomes. However, one investigation provides an example. Cummings et al. compared the effects of receiving rehabilitation while residing in the hospital versus receiving it on an ambulatory basis (31). Notably, functional outcomes were better in the group living at home, but at the price of greater caregiver burden (time spent preparing special foods, washing and grooming the patient, and providing medical care).

A variety of equipment, such as ultrasound and functional electrical stimulation, may be used to provide different kinds of treatment in rehabilitation. These are reviewed in the section on rehabilitation interventions, under process of care.

### **Systemic Milieu**

a) Description and definitions: Sainfort, Ramsey, and Monato differentiate structural characteristics that are relatively immutable and not under direct management control from those characteristics that are more likely to change over time (22). Similarly, Aiken, Sochalski, and Lake divide structural characteristics into hospital-level and unit-level features (32). Kramer, in a

framework based on the patient perspective, distinguishes the systemic domain (the broadest domain) from rehabilitation services, staff, and the decision process (33). In this article, the term "systemic milieu" is used to identify those organizational characteristics that either are not under direct control of the care providers or are pertinent to the level of the healthcare facility. For example, veterans with service-connected conditions are entitled to different benefits than are veterans whose medical conditions are not service-connected. Presence of a service-connected condition increases the amount of financial support available for home modifications, such as adapting the home to accommodate a wheelchair (34). As accessibility is an important determinant of functional outcomes for persons using a wheelchair, a national policy such as this may affect the rehabilitation outcomes of individual patients. From another perspective, some systemic policies speak more to process of care than to the structure of care. For example, the AHCPR stroke guidelines primarily address specific aspects of process of care (11) and the decision to implement these guidelines may be made at the individual provider, facility, regional, or national level. Data specific to guidelines and coordination of care at the systemic and the individual level are discussed under process of care.

b) Empirical evidence: Interprovider arrangements and financial factors have been shown to influence rehabilitation practices. For example, physician ownership of PT services, social acquaintance with PTs, institutional affiliations, and third-party reimbursement are associated with differences in use of rehabilitation (9,35-37). Use of contract therapists (i.e., providers who are self-employed or employed by an agency outside the facility where they provide care) is increasingly common, and is associated with lower frequency of therapy and lower likelihood of discharge to the community (38). This may be a statistical association (facilities using contract therapists accept different patients than other facilities), or it may be a causal association (if, for instance, contract therapists are not paid for time spent in team meetings, that important component of rehabilitative care may be lost, and this may adversely affect rehabilitation process and outcomes). Practice regulations vary across

rehabilitation disciplines, across states, and across settings for treatment. For example, in some states PTs may act as independent providers ("open access"), in other states physician or similar referral is required (39). Effects of state regulations for rehabilitation (e.g., open access) may be modulated by the effects of regulations from third-party agents, such as the requirement for physician referral for reimbursement (39). Even when physician referral is present, the degree of MD direction is highly variable. Stroke patients in a rehabilitation hospital usually have daily physician visits, and the physician is highly involved in the rehabilitation decisions; while stroke patients receiving sub-acute rehabilitation have fewer physician visits, and the physician involvement with the rehabilitation team is limited (20). Thus, in some respects, rehabilitation use is analogous to medication and laboratory utilization, which are largely influenced by physician practice patterns. However, the rehabilitation providers themselves also influence use, by extending or shortening treatment, or by altering the specific interventions provided.

In summary, while results of rehabilitation research suggest that structure of care may affect outcomes, interpretation of existing studies is limited by the methodological problems that hinder determination whether differences in outcomes seen in the studies were due to differences in structure of care, due to the effect of structure of care on process of care, or due to happenstance associations between structure and process of care. For example, one randomized stroke trial found better functional outcomes for experimental patients placed in a geographically distinct ward (a difference in structure of care); however, a higher proportion of the experimental patients received occupational therapy beginning at a much shorter interval after admission, which is a difference in process of care (24). It remains uncertain whether the positive results in stroke units are due to housing patients in a geographically distinct ward, due to access to uniquely trained therapy providers, or due to earlier and more intense therapy (i.e., the process of care).

### **Overall Process of Care**

a) Description and definitions: Process of care is defined as the "content of care, i.e., how the

patient was moved into, through, and out of the healthcare system, and the services that were provided during the care episode (12)." Sainfort, Ramsey, and Monato differentiate process into direct patient care, policy and procedures, process planning, medical and support services, patient activities, nutrition and diet (22). Direct patient care in rehabilitation may be described according to the intervention itself, the degree to which the intervention is individualized to the patient, and the timing with which the intervention is applied. Policy and procedures pertinent to rehabilitation include both the methods for coordination of care across provider, place, and time, and the guidelines and other systematically developed statements for guiding care.

b) Empirical evidence: Studies of overall process of stroke care typically have not included process of care pertinent to rehabilitation (40). Most studies pertinent to rehabilitation process of care focus on specific aspects of process of care.

### **Specific Components of Process of Care**

#### *Direct Patient Care*

Rehabilitation interventions have been categorized into exercise, adaptive techniques and assistive devices, education, physical modalities, and prosthetics and orthotics (41).

#### Exercise

a) Description and definitions: Exercise may be classified according to the physiology of the exercise (resistive, range of motion, aerobic, via electrical stimulation, neurofacilitatory exercises, and so forth), the condition being treated (exercises for stroke versus those for arthritis of the knee), or the mode of delivery, such as water exercise or treadmill walking. Within each of these categories there are further distinctions. For example, resistive exercise includes isometric, isotonic, isokinetic, open chain, closed chain, and progressive resistive exercise types.

b) Empirical evidence: We know little about the comparative merits of differing forms of exercise across conditions (e.g., the benefits of resistive exercise for stroke versus for osteoarthritis of the knee). There is more information about specific forms of exercise for specific conditions, such as the use of treadmill walking after stroke (42). A review by Duncan

provides an excellent summary of exercise studies in stroke (43).

#### Adaptive Techniques and Assistive Devices

a) Description and definitions: Many daily tasks can be made easier and stress on joints reduced by altering the way the tasks are performed. This is accomplished by reducing the force required for task performance, or by reducing task complexity and/or duration. To do so, therapists alter how the task is performed (e.g., dressing the weak arm first when donning a shirt); they provide equipment like canes; and they improve human assistance by training the caregivers.

b) Empirical evidence: Assistive device use is quite common. A 1990 national survey showed that 13 million Americans were using assistive devices of one sort or another, and 2.5 million persons indicated unmet needs for such equipment (44). Assistive device use appears to vary with the underlying condition: one study showed mobility-impaired persons used an average of 9.3 devices, compared to 2.3 devices by persons with impaired vision (45). Evidence for the effectiveness of adaptive techniques and devices is limited (46). Some preliminary data indicate that equipment may be more efficacious than personal assistance in reducing difficulty with functional tasks (47). One randomized controlled trial showed assistive devices reduce the difficulty and time needed to perform daily living tasks (48). Given its widespread use and potential health benefits, assistive technology is a key area for health services research.

#### Education

a) Description and definitions: Patient education is commonly used in rehabilitation. Therapists educate patients, families, and other caregivers verbally, through written or videotaped materials, and/or by demonstration.

b) Empirical evidence: Audio tapes show that PTs provide an average of 4.72 educational statements per treatment session about the illness itself, 3.98 about the therapy intervention, and 2.54 statements of general advice and information (49). Existing studies of stroke rehabilitation do not delineate the effects of patient education from other interventions.

#### Physical Agents

a) Description and definitions: Some interventions used in rehabilitation depend on a physical agent or modality to deliver the treatment. Physical agents may include water (whirlpool, pool exercises), methods to heat soft tissue (ultrasound, diathermy, hot packs, paraffin), methods for chilling soft tissue (icing, fluoromethane spray), techniques for soft tissue manipulation (massage), and electrical stimulation (TENS units). Many, but not all, of these techniques are used to decrease inflammation, muscle spasm, and/or pain, predominantly in persons with arthritic complaints.

b) Empirical evidence: There is ample anecdotal support for many of these interventions, particularly cold and heat, respectively, for relief of acute and chronic musculoskeletal pain. However, in a recent review, Puett and Griffen found little scientific data for or against the efficacy of most therapeutic modalities (50). One health services research approach has been to compare outcomes for different types of providers who use these modalities to a greater or lesser extent (51).

#### Prostheses and Orthoses

a) Description and definitions: These appliances are designed to provide external support to the musculoskeletal system, compensating for muscle weakness, incoordination, deformity, or deficiency. In contrast to assistive devices designed with a specific activity in mind (e.g., walking) and are integral to performance of that activity (a cane used while walking but not while putting on pants), orthoses and prostheses are designed with a specific body function in mind, like the use of a leg, and are integral to any use of that area of the body: a leg brace is used whenever the leg is moved. Orthoses commonly used with stroke patients include ankle foot orthoses (AFOs) and arm slings. AFOs may be either mass produced or custom designed and made for the patient; they differ from one another in the amount and kind of support they provide (solid plastic insert vs. metal uprights attached to a shoe). Arm supports for stroke patients differ from one another in the amount and kind of support provided (armrest on the wheelchair or a sling that supports elbow and shoulder).

b) Empirical evidence: In 1990 over 1 million

persons were using a leg or foot brace, an increase of 122 percent over 1980 (47). Despite widespread use, health services research in this area is limited. Outcomes research with AFOs has focused on the relationship of specific AFO characteristics to gait speed and the work of walking (52). Health services issues, such as the effects of using prefabricated AFOs versus individually fitted ones, have not been examined. Different arm supports purportedly result in important differences in stroke outcomes, such as shoulder pain and motor function; however, existing data are limited and focus on radiographic outcomes (53).

#### Individualization

a) Description and definitions: Individualization means the extent to which the therapy is tailored to the patient's unique needs. According to Liang, functional outcomes are determined by the patient's functional capacity, the environmental demands, and the patient's willingness to engage in the activity (54). Individualization may be beneficial in a number of respects. For example, individualization of therapy can take place through eliciting and responding to patient input. Bringing the patient into the process potentially increases the likelihood that the therapy will be directed to areas of concern to the patient and that it will be appropriate to the patient's needs, thus improving both compliance and effectiveness.

b) Empirical evidence: Studies of individualization of stroke rehabilitation, per se, are limited. The availability and increasing use of guidelines such as those of the AHCPR (11) for stroke rehabilitation may be a real boon to outcomes research in this area. Some rehabilitation investigators have developed a priori methods for individualization of the treatment (55,56). Qualitative methods have also been used to study individualization of rehabilitation, focusing on clinical reasoning and how therapists make decisions regarding treatment (57,58).

#### Amount and Timing of Care

a) Description and definitions: The relationship of rehabilitation use to time can be measured by how soon therapy is begun after illness onset, by its frequency (e.g., average number of sessions per day), and by its duration (number of minutes per session, number of days in

therapy). The total amount of therapy is the frequency times the duration.

b) Empirical evidence: There is somewhat more information about time-related aspects of rehabilitation than other aspects, with considerable national variation as to when and how much stroke rehabilitation is provided, and its use is affected by factors that seem to have little apparent clinical relevance (59,60). How soon rehabilitation is provided following the onset of the illness appears to be critical. A meta-analysis of stroke trials found that the improvement in performance in focused stroke rehabilitation appeared to be due to earlier initiation of treatment, but not to duration of intervention (25). However, the timing may vary with the underlying condition (e.g., stroke versus hip fracture) and in relationship to the natural history of the disease (acute versus post-acute phases of recovery). Kramer et al. found that hip fracture patients did not experience the same benefits as stroke patients from post-acute care in settings with high-frequency therapy (16). Other data indicate hip fracture patients appear to benefit from high-frequency therapy during acute hospitalization (61). There may be a critical window of time during recovery when more frequent therapy can improve outcomes, and this window may be earlier for hip fracture than for stroke. The amount of therapy may be another important aspect of rehabilitation timing. Kramer et al. showed stroke patients had better outcomes if they received post-acute rehabilitation in facilities providing more total therapy sessions (16). Another study showed long lasting improvement in function among stroke patients forced by constraint of the unaffected extremity to use the affected extremity for up to 6-8 hours per day (62). Little is known about the effect of treatment duration on rehabilitation outcomes.

#### *Policies and Procedures*

##### Coordination of Care

a) Description and definitions: Recovery of function after illness may occur over a prolonged period of time, during which patients may change locations several times (20,60). Multiple differing providers impact on the patients over the course of their recovery be it in one, or multiple, locations. Thus, coordination of rehabilitative care among providers and across the continuum of care may be

an important factor affecting the rehabilitation outcomes.

b) Empirical evidence: Although data outside the rehabilitation literature indicate that coordination of care has an independent effect on clinical outcomes (63,64) and many rehabilitation providers believe in its importance (23,65), most stroke rehabilitation studies do not isolate activities that affect coordination of care from other simultaneous interventions.

#### Guidelines and Other Systematically Developed Statements for Guiding Care

a) Description and definitions: As in other areas of medicine, rehabilitation is turning to guidelines, care maps, protocols, and other systematically developed statements to help with decisions about appropriate rehabilitation care for specific clinical conditions.

b) Empirical evidence: Forbes, Duncan, and Zimmerman recently published medical record review criteria based on the AHCPR stroke guidelines, including documentation of physical and psychological rehabilitation goals, family participation in therapy, and evidence of a discharge plan (66). However, we have little empirical data on the effects of guidelines in rehabilitation. One study found no benefit from use of a critical pathway for stroke rehabilitation compared to usual care (67), yet another showed that using a critical pathway reduced costs and lengths of stay for acute stroke patients (68). The first study may have had contamination of the control group; that is, the control group implemented elements of the critical pathway, while the second used a pre-post methodology and did not have a control group: thus, differences in methodology may account for the differences in results. However, these respective methodological problems preclude a conclusion about the efficacy of guidelines for acute stroke care.

#### **Overall Outcomes of Care**

a) Description and definitions: Outcomes are the "...results of care...[and] can encompass biological changes in disease, comfort, ability for self-care, physical function and mobility, emotional and intellectual performance, patient satisfaction and self-perception of health, health knowledge and compliance with medical care, and viability of

family, job, and social role functioning" (12). Sainfort, Ramsey, and Monato defined outcomes according to change in health status. Outcomes can also be categorized as clinical and nonclinical outcomes (22). The SPO model as applied here reflects clinical outcomes from the point of view of the goals of care and the deficits targeted for treatment.

b) Empirical evidence: Considerable work has been performed by the rehabilitation community to develop outcome measures for rehabilitation, as discussed below.

#### **Specific Components of Outcomes of Care**

##### *Clinical Outcomes*

a) Description and definitions: In contrast to medical treatment directed to the disease process, rehabilitation is directed to the disablement process and, as such, may target a variety of medical and nonmedical factors believed to contribute to disability. Thus, in rehabilitation research, it is useful to classify clinical outcomes according to the specific aspects of the disablement process targeted by the treatment. Using the model for disablement (69) proposed by the World Health Organization (WHO), rehabilitation interventions can be thought of as being directed at specific organ system impairments, as in exercise for muscle weakness; at specific disabilities, as in a wheelchair for walking difficulty; or at specific handicaps, as in enabling employment by remodeling the workplace to allow wheelchair access (41). Similarly, generic outcome measures for rehabilitation can be classified according to levels of the disablement process; these include measures for specific impairments (muscle strength, pain, coordination), specific disabilities (walking, performing self-care activities), and handicap (institutionalization, employment), as well as life quality (life satisfaction, health-related quality of life). It is more difficult to classify stroke-specific outcome measures by level of the disablement process, because disease specificity declines as one moves distally from disease to disability and handicap.

Nonclinical outcomes from rehabilitation can be measured by societal benefits and by direct and indirect costs of care. Societal benefits are those that may not be easily measured but that are socially valued, like humanitarian benefits. Dollar

costs, and the resources used in providing rehabilitation, reflect process of care as well as capital outlays for elements of structure of care. Cost-effectiveness links clinical outcomes with the resources used to produce those outcomes. On the other hand, reduction in cost of healthcare after completing rehabilitation may actually be a result of successful rehabilitation and could be used as another measure of rehabilitation outcomes. Non-healthcare costs are those resulting from illness but not related to direct medical purchases, such as costs incurred through loss of livelihood or the costs of informal caregiver burden. Studies measure direct rehabilitation costs by billed charges and by the resources (salaries and equipment) used to provide treatment (8). An example of measurement of indirect costs in rehabilitation can be found in a study by Cummings et al. that showed caregiver burden was greater for families caring for patients rehabilitated in a day hospital compared to caregiver burden for families of patients in inpatient rehabilitation (31).

b) Empirical evidence: Psychometric properties have been established for disease-specific and generic outcome measures at various levels of the disablement process. The AHCPR guidelines provide an excellent review of stroke-specific outcome measures (11). Dijkers, as well as McDowell and Newell, provide recent reviews of generic outcome measures pertinent to rehabilitation (73,74). The WHO model has received substantial critical appraisal (1), but empirical support for it is largely epidemiological. For example, Guralnick et al. showed that persons with lower extremity limitations have a four-fold increased risk of developing frank disability over the subsequent 4 years (70). Lawrence and Jette showed that frequency of walking in 1984 predicted development of lower body impairments in 1988, which, in turn, correlated with onset and progression of disability in 1990 (71). Randomized controlled trials showing improvement in function with disease-specific or impairment-specific treatment provide further evidence, such as improvement in vision-related functional activities after cataract surgery, improved gait with resistive exercise among deconditioned older persons and the like (72). Data specific to the disablement process for stroke are limited. Data are limited on the effectiveness of stroke rehabilitation in reducing future costs of care.

## DISCUSSION

Rehabilitation is a burgeoning business. In 1992, third-party payers of rehabilitation spent over \$3.6 billion (75). Total costs are likely even higher, because this figure includes costs only for cases where rehabilitation was the principal diagnostic related group (DRG codes V57.x); it misses rehabilitation costs incidental to other DRGs; for example, costs of physical therapy during initial acute-care hospitalization for a stroke. Research to optimize use of rehabilitation is greatly needed.

A number of researchers have proposed theoretical constructs pertinent to the study of rehabilitation health services (33,76-81), each of them explicating different and unique aspects of rehabilitation. For example, Strasser and Falconer focused on the central role of the rehabilitation team, while Kramer highlighted the patient perspective (33,79). Whyte proposes a conceptual hierarchy for measurement of rehabilitation outcomes, using the WHO disablement process to link interventions with outcomes (80). Henry and Holzemer reviewed factors promoting achievement of self-care using a 9-cell model that defines SPO at the systemic, provider, and patient levels (78). Duncan et al. suggest measuring SPO at the individual (micro) and at the group (macro) level (75). However, the traditional SPO schema of Donabedian offers the advantages of simplicity and widespread familiarity among health services researchers.

The SPO framework has several important uses in rehabilitation. It provides a common language for rehabilitation and health services researchers. It can be used to identify gaps in the literature. For example, this review shows considerable variability in types of providers delivering rehabilitation, contradictory findings from studies of the effect of provider type on stroke outcomes, and noteworthy cost implications from use of differing types and combinations of provider. This 3-D model also can be used to provide clear descriptions of the treatments studied. By describing rehabilitation treatment along all three axes, a more complete picture of the treatment may be obtained: one can identify the structural elements involved in it, the processes used to carry it out, and the specific aspects of the disablement process it targets. By so doing, interrelationships

between specific elements of SPOs can be systematically investigated.

## CONCLUSION

One fear mentioned by researchers is that the true effect of rehabilitation will be diminished or overlooked if its components are studied in isolation (54). In the case of rehabilitation, so to speak, the whole may be greater than the sum of the parts. While this is a possibility, it is also quite possible that examination of the specific components will reveal important opportunities for improvement. We believe that possibility alone is justification for further health services research in stroke rehabilitation. Use of consistent terminology and theoretical frameworks, such as the WHO and SPO models, will promote high quality, informative rehabilitation health services research.

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