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Functional Outcome in Stroke Rehabilitation

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FUNCTIONAL OUTCOME IN STROKE REHABILITATION

by

Meridee S. Green
Bachelor of Science in Physical Therapy
University of North Dakota, 1983

An Independent Study
Submitted to the Graduate Faculty of the
Department of Physical Therapy
School of Medicine
University of North Dakota
in partial fulfillment of the requirements
for the degree of
Master of Physical Therapy

Grand Forks, North Dakota
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1993
This Independent Study, submitted by Meridee S. Green in partial fulfillment of the requirements for the Degree of Master of Physical Therapy from the University of North Dakota, has been read by the Chairperson of Physical Therapy under whom the work has been done is hereby approved.

(Chairperson, Physical Therapy)
PERMISSION

Title Functional Outcome in Stroke Rehabilitation

Department Physical Therapy

Degree Master of Physical Therapy

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ABSTRACT

Stroke is the number one source of adult disability in the United States, with approximately 400,000 new stroke survivors each year. The cost of care and the loss of earnings as a result of stroke is considerable. Stroke rehabilitation is a health service provided to try to decrease the disability and the socioeconomic costs. The purpose of this paper is to conduct a literature search to provide a review of stroke epidemiology, outline four functional outcome measures used in stroke assessment (Fugl-Meyer Assessment, Motor Assessment Scale, Barthel Index, and the Functional Independence Measure), identify predictive factors in functional outcomes of stroke survivors, and address the effectiveness of stroke rehabilitation on functional outcomes. The review of the literature indicated the following areas of concern in stroke rehabilitation: lack of standard functional measures, methodological flaws in stroke research, and underestimation of psychosocial ability to accurately predict functional outcomes.
CHAPTER I
INTRODUCTION

Stroke is the third leading cause of death in the United States, after heart disease and cancer, and the number one source of adult disability.\(^1\) Despite the death of one-third of new stroke victims, the incidence of approximately 400,000 remaining survivors in one year outnumbers by tenfold the incidence of both spinal cord injury and multiple sclerosis in the country. These, added to the number of stroke survivors from previous years, indicate approximately three million people living with stroke.\(^2\) The cost of care and the loss of earnings as a result of stroke have been estimated to be 7.5 to 11.2 billion dollars a year.\(^3\) Stroke, therefore, is a major social and economic burden, which will continue to increase because of the improved survival rate and the growing size of the elderly population. Stroke rehabilitation is a health service intended to decrease the disability and to decrease the social and economic costs associated with this disability.

Studies show that 90% of stroke survivors can benefit from some type of rehabilitation therapy.\(^2\) The goal of stroke rehabilitation is to improve the patient’s independence despite impairment. A number of stroke survivors receive expensive and intensive rehabilitation in an attempt to improve
functional independence and motor recovery. Recent concerns regarding allocation of health care resources and cost effectiveness have challenged rehabilitation specialists to critically analyze the present methods of assessing progress, the accuracy in predicting functional outcomes, and the efficacy of treatment interventions.

The purpose of this paper is to conduct a literature search to:

1. Provide a basic review of stroke epidemiology.
2. Review four available standardized clinical measurements for assessing impairment and/or disability following stroke. They include: Fugl-Meyer Assessment (FMA), Motor Assessment Scale (MAS), Barthel Index (BI), and the Functional Independence Measure (FIM).
3. Identify predictive factors in functional outcomes of stroke patients.
CHAPTER II

EPIDEMIOLOGY OF STROKE

Stroke, also known as cerebrovascular accident (CVA), is defined as a stoppage of the blood supply to part of the brain secondary to atherosclerotic disease, hypertension, or a combination of both. The blockage can have one of three specific causes: (1) embolus, a clot which lodges into an artery of the brain (most often from the left side of the heart), (2) a cerebral thrombosis or clotting within an artery (most common cause of stroke), or (3) a cerebral hemorrhage, the bursting of a blood vessel. "Stroke" is no more definitive a diagnosis than "epilepsy"; developments in brain and cerebrovascular imaging over the last 20 years have revealed that there are many subdivisions of stroke, with differing etiologies and outcomes. It is, therefore, not enough to say that a person has had a stroke. The cause, type, and contributing conditions must also be specified. Symptoms of a stroke vary depending on what area of the brain is damaged; any human function, whether motor, sensory, cognitive, or emotional, can be affected.

Although stroke can occur at any age, the incidence increases with age and doubles in each successive decade. In 1988, 87% of all deaths from, and 74% of all hospitalizations for, cerebrovascular disease occurred among
persons aged greater than or equal to 65 years.\textsuperscript{11} Men are 1.5 times more susceptible to stroke, especially noted in middle age and reducing with age. Blacks and Japanese have a higher incidence of CVA death rates and hospitalization secondary to higher incidence of hypertension.\textsuperscript{12} Modan and Wagener\textsuperscript{13} found an inverse correlation between death rates and socioeconomic status, which was particularly marked in blacks. This suggests that the stroke is related to a strong environmental or social factor amenable to change rather than to a genetic component. Several studies show a higher rate of stroke occurring in the southeastern United States. Although specific factors contributing to this pattern are unclear, it has been documented for both blacks and whites and, therefore, cannot be attributed to the higher concentration of blacks in that area.\textsuperscript{14}

Mortality and prevalence rates vary greatly with the type of stroke. Cerebral infarction has a 15\% thirty-day mortality. Intracerebral hemorrhage stroke has an 82\% mortality at thirty days.\textsuperscript{14} Once the initial period of high mortality is over (first 30 days), survival is good, with 50\% of patients with stroke alive in seven years.\textsuperscript{2} The five-year survival rate has increased 10\%, and morality has decreased by 35\% in the last 30 years.\textsuperscript{12} Survival rate improvement is likely due to improved medical management of acute complications.

Modan and Wagener\textsuperscript{13} report the observed decrease in stroke morality rates result from an improved survival rather than from a decline in morbidity.
The morbidity rates will also vary by type and location of lesion. Approximately three-fourths of hemorrhagic stroke survivors recover fully, though they may remain ill longer. Of cerebral infarction survivors, only 10% fully recover their pre-morbid status, 10% will require 24-hour care in a nursing home, 40% will end up with mild disability with independence, and 40% will have moderate to severe disabilities requiring some type of special services and/or assistance.\textsuperscript{14}

The clinical picture of a stroke varies within the widest limits, from a violent assault to only a slight defect. The pattern of recovery after stroke is very variable, depending on the patients considered, the criteria used to define independence, and the time at which observations are made. Dombovy\textsuperscript{15} reviewed studies and found of the patients seen within the first week post-onset stroke, 68% to 88% are dependent in some aspect of activities of daily living (ADLs), 73% to 88% have some degree of hemiparesis, 71% to 77% have impaired ambulation, 47% are unable to sit unsupported, 23% to 33% have language dysfunction, 44% have impaired proprioception, 16% to 37% suffer from neglect, 67% to 84% have visual-perceptual disturbances, 13% to 32% suffer from dysphagia, 57% have dysarthria, and 29% are incontinent. Memory and cognition, when assessed at three months, is impaired in 35% to 60%.

The rate of neurological recovery is by no means a constant predictable process.\textsuperscript{16} Ninety percent of recovery is most rapid during the early weeks to three months following onset of stroke, with statistically significant recovery occurring up to six months. Although some survivors continue to recover after
six months to one year (especially with hemorrhagic type or very severely involved type of stroke), this does not reach statistical significance for the group as a whole. From three to five years post-stroke, more survivors experience increasing disability than improvement, perhaps due to the effects of co-morbidity and increasing age.\textsuperscript{15}

Motor recovery tends to plateau more quickly than functional recovery. The earlier the beginning of return of motor function, the more amount of that function there will be, especially true with the upper limb.\textsuperscript{15} Gowland\textsuperscript{17} found recovery of the upper limb to be a more dismal picture than the lower limb, as 40\% achieve return of full voluntary movement, but only 4\% to 5\% regain full functional return of the upper limb. This proves the functional hand is dependent on more than just voluntary motion and strength. However, stroke patients are able to achieve independence in ADLs without a corresponding improvement in arm recovery through compensation by performing ADLs with one-handed techniques.

At six months post onset of stroke, Ebrahim\textsuperscript{18} found that 25\% to 60\% of survivors suffer from depression, 12\% have cognitive impairments, 11\% incontinence, <10\% dysphagia, and 10\% to 16\% dysphasia. Dombovy\textsuperscript{15} found 50\% to 62\% still had some type of hemiparesis, but only 9\% were severe. Regarding ambulation, Gowland\textsuperscript{17} found 61\% to 85\% regained independence post-rehabilitation, only 17\% remained dependent at one year; however, only less than one-fourth regained normal speed by one year.
In recent years, efforts to reduce incidence of stroke have focused on identification of those with greatest susceptibility to the disease, and on modifiable environmental influences. Of the risk factors that increase the chance of stroke, hypertension may account for 70% of all strokes. Hypertension may directly cause vasculopathy leading to infarction or hemorrhage, and/or it may accelerate the extent of atherosclerosis in larger vessels. The observed decline of stroke in the last decade has been attributed to a greater role in hypertension detection and treatment. Other risk factors of stroke that can be medically influenced are cardiac disease (cardiac enlargement or electrocardiographic changes, particularly with left ventricular hypertrophy), obesity, and transient ischemic attacks (TIAs). Approximately 10% of survivors suffer a recurrent stroke each year; this is especially true of persons with cardiac disease.

Risk factors that can be changed by lifestyle are elevated blood cholesterol and lipids, cigarette and alcohol use, and lack of activity (obesity). Improvement in standard of living in the United States and elsewhere also further reduces mortality. There is a ninefold increase in risk of stroke when oral contraceptives are combined with cigarette smoking as women get older. There is no evidence for increased risk with estrogen supplement in post-menopausal women.

Folger reports advancing age is perhaps the most potent of all risk factors, accompanying degeneration of the vascular system. Stroke, however,
is not the inevitable consequence of aging as there is a great variation in development of atherosclerosis among individuals.

On the basis of risk factors, a stroke-prone profile can be developed to identify approximately 10% of patients who will suffer as many as 50% of the strokes. Stroke registry or data banks are an important tool for use in specific stroke research and epidemiological investigations. Further development of these systems will improve future research.
CHAPTER III

CLINICAL MEASUREMENTS FOR ASSESSING STROKE OUTCOME

Standardized measurements for classification of stroke pathology and objective measurements with appropriate psychometric properties are essential in stroke. Such measurements serve to enhance therapists' judgment about the presence and severity of problems that will respond to intervention, predict recovery and outcome, and determine effectiveness of therapy. Many organizations still prefer to construct measures to fit their particular situation. Since these ad hoc methods have not been well developed, many assessment instruments have uncertain validity for clinical research or program evaluation.

Outcome measures need to monitor the progress of an individual patient in an objective, reliable manner. In order to demonstrate the effectiveness of therapeutic intervention and programs, clinicians are best advised to choose from the standardized tests available that meet their purpose, while at the same time considering the appropriateness of the psychometric properties of these measures. Several measures for assessing stroke patients are now in existence with completeness of evaluation varying from test to test.

The objective functional scales are useful in measuring a patient's independence in ADLs, but such scales do not specifically test hemiplegic
recovery because patients learn to compensate for their disability by using one-sided techniques. Some outcome measures are designed to be used in conjunction with specific treatment approaches. As new models of therapy based on motor control and learning are developed, they will influence the future direction that measurement development takes.

The Fugl-Meyer Assessment (FMA)\textsuperscript{4} was developed by Fugl-Meyer and associates. It was designed to evaluate change in motor impairment and to provide useful descriptive information for purposes of treatment planning. The measure assesses six dimensions of impairment; joint range of motion, pain, sensation, upper and lower extremity motor performance, and sitting/standing balance. The data are gathered on a three-point ordinal scale ($0 = \text{cannot perform}$, $1 = \text{performed partly}$, $2 = \text{performs fully}$) applied to each item, and the item scores are summed to a maximal score of 226. Testing takes an average 30 to 40 minutes.\textsuperscript{20}

The Fugl-Meyer Assessment has been extensively evaluated and has established reliability and validity.\textsuperscript{4} The advantage of the Fugl-Meyer Assessment is that it is reliable and has a quantifiable means of documenting motor abilities relatively quickly in terms of function.\textsuperscript{21} A disadvantage is that the Fugl-Meyer Assessment is aimed at the assessment of motor impairment and does not include items on motor function in the context of disability. The reliability on a sample of changing subjects has not been reported.\textsuperscript{20}
The Motor Assessment Scale (MAS), developed by Carr and Shepherd, is designed to be a quick, easy, and inexpensive measure of progress in physical function over time. The scale provides for the evaluation of a broad range of motor activities and functional tasks, specific scoring criteria, and the use of objective measure of time and distance in conjunction with completion or noncompletion of task. A six-point ordinal scale is used, with precise definition for each point (6 indicating optimal motor behavior) and a maximal score of 48. The test takes 15 to 30 minutes and has general rules for administration.

The MAS was designed to accompany Carr and Shepherd motor relearning treatment approach. It has proven to be a time efficient, worthwhile measure for assessing motor function and its reliability and validity have been established. Problems with this assessment relate to the small component of assessment of tone and its inability to measure impairment, with resultant methodological weakness in the reliability study. A modified MAS established by Loewen increases the assessment sensitivity to changes in patient status and deletes tone.

The Barthel Index is based on direct observation, patient/family interview, and the medical record. It provides an index of a person's ability to function independently, measuring self-care and mobility. Developed by Barthel and Mahoney in 1965, the values of each item are based on the time and amount of assistance needed by the patient to perform the activity. Items are rated 0-5, 0-5-10, or 0-1-10-15, depending on the item. The higher the score,
the higher degree of independence, with zero indicating complete dependence (another person performing greater than 50% of task). The maximum score attainable is 100, indicating most independent. The Barthel Index includes 11 items: feeding, various transfers, hygiene, walking, wheelchair propulsion, stair climbing, dressing, and bowel/bladder control. Time to perform the assessment is approximately 30 minutes.

The Barthel Index has been used in a variety of stroke outcome studies in the last two decades. It was the first summary scale of independence in personal tasks of daily function to qualify results in a single score. It has been widely used and is easily understood applied in the clinical setting. Intrarater and interrater reliability has been proven. Resistance to its universal use is based on clinical perceptions that not enough domains are covered to account for the potential impact of rehabilitation interviews, and that the grading system of three to four levels is not sufficiently sensitive to reflect change over a short period of time. Shah developed a modified scoring of the Barthel Index which allows greater sensitivity to change and improved reliability than original, without any additional difficulty or increased time.

The Functional Independence Measure (FIM) was developed by the Task Force to Develop a Uniform Data System for Medical Rehabilitation in 1983. Derived from the Barthel Index, though more sensitive, the FIM has seven levels of function, two without a human helper and five progressive degrees of help from another person. The Task Force reviewed 36 published
and unpublished functional assessment instruments to help identify items and rating scales that measure function. The goal was to find a national consensus instrument that represented a minimum data set, was easy to apply, and did not require specialized clinical skills.

The FIM is set up to assess 18 items, defined in six areas of function: self-care, sphincter control, mobility, locomotion, communication, and social cognition. FIM measures disability (what the subject actually does), not impairment and can be used as a basic indicator of severity of disability and of outcome of care required. It is designed to be discipline-free; that is, a measure usable by any trained clinician, regardless of discipline. Length of time to administer varies on the number of clinicians involved in the evaluation process.

Studies of the FIM have been carried out since 1984, with validity and reliability being established in more than 50 facilities in the United States. The FIM has been found to have face validity and to be reliable. Further work is underway to confirm the underlying principle that disability, as measured by FIM, represents "burden of care," which can be measured as the equivalent use of human and economic resources that must be substituted in the absence of independent functioning of the person with a disability. Brott indicates a disadvantage of FIM is that it does not address intellect, personality, and/or affect. The scores that relate to these uniquely human qualities are dwarfed by scores from measurements of elementary sensori-motor abilities. Like all
functional scales, it measures only disability, whether or not this is caused by the stroke.\textsuperscript{28}

There are numerous other functional measures available that have not been discussed in this paper. Keith\textsuperscript{29} suggests rehabilitation professions should select a few of the better scales and improve their technical characteristics, such as reliability, validity, sensitivity, and scalability.

Overall, medical rehabilitation lacks a set of measure with widespread utility. In general, the unacceptable amount of methodological heterogeneity and widespread tendency to ignore time interval after stroke has prevented useful comparisons of aggregate data from different studies. As recovery is a time-dependent function, it is essential that observations be made at points after onset, if the observations are to be of any use.\textsuperscript{18} Keith\textsuperscript{29} recommends development of standards for measure and to apply these standards to publications, so that only devices with a minimum level of technical development will be added to rehabilitation literature. Subsequent research should be directed toward establishing measurement properties and relationships to external criteria, which would result in improved communication among professionals and make it easier to relay the benefits of rehabilitation to the public.\textsuperscript{30}

Brott\textsuperscript{27} encourages stroke investigators to move neuropsychologic assessment tools into mainstream, following acute phase, of stroke patient assessment as it would allow a more meaningful assessment of impairment and
function. Seale and Davies\textsuperscript{31} recommend greater use of subjective evaluations of health status, family involvement in rehabilitation, patient satisfaction, and quality of life. Osberg\textsuperscript{32} reports that quality of life is a rarely measured, but important, outcome among stroke patients and indicates that it is not only the length of survival, but the quality of survival that is important.
CHAPTER IV
EARLY INDICATORS USED IN PREDICTING STROKE OUTCOME

Since considerable resources are allocated to the rehabilitation of stroke survivors, it is important to identify factors that predict subgroups of the stroke population who are likely to have better prognoses than others. Many studies have analyzed the biological and environmental factors that may influence recovery after stroke.\textsuperscript{15} Hier and Edelstein\textsuperscript{23} tried to determine whether clinical prediction rules could be derived from current stroke outcome research; they reviewed 92 articles (27 being multi-variate studies) and found most had methodological problems. Many were flawed by failure to describe patient demographics or too precisely defined predictive and outcome measures.

With the advent of computers and availability of statistical packages for performing multi-variate analyses, research on predictors of stroke outcome had progressed markedly and is expected to continue to do so. In order to improve research, future studies involving predictors should include the following:

1. Patient demographics recorded, including race, gender, age, and socioeconomic status.

2. Studies should report precise definitions of both the predictor and outcome measures, including variable coding schemes.
3. Patient's should be stratified by stroke mechanism (CT scan, MRI). Predictor variables may vary according to stroke mechanism.

4. Sample size should be adequate for the number of predictor measures evaluated.

5. Methods should be described in sufficient detail to allow implementation by other investigators.

6. Base or apriori probabilities should be given for all outcomes.

7. The predictive power of the predictive mode, including classification rates and odd ratios, should be reported.

8. Attempts to validate the predictive mode should be reported.\textsuperscript{33}

A review by Gordon et al\textsuperscript{34} of all sophisticated studies of stroke found no one factor that emerged to definitely predict rehabilitation outcomes, though some valuable information has been provided by these as guidelines for estimating rehabilitation potentials for patients with recent onset of stroke. Although rehabilitation potentials are meant to be used in prognosis, they differ from the usual prognostic signs in the morbidity sense because they relate to behavioral outcomes rather than cure of neurologic deficits.\textsuperscript{35}

Some authors\textsuperscript{32,35,46} have found that predictors of functional outcome differed according to initial severity of stroke; that is, predictors of functional outcome for mildly affected stroke patients differed from predictors of stroke for severely affected patients. Duncan and Goldstein\textsuperscript{36} state the magnitude of the initial deficit is an excellent predictor of outcome later during the recovery
process, indicating the survival rate for severe stroke at one year is 36%, with only 13% of these survivors independent in function.

Reding and Potes\textsuperscript{37} study subdivided stroke patients into three groups: motor deficit only (M), motor and sensory deficit (MS), and motor, sensory, and visual deficit (MSV). They found approximately 65% of the M and MS groups attained complete independence in ADLs, but that the mean time to reach this goal was significantly longer in the MS group. Patients in this MSV group had less than 10% chance of ever reaching this goal. Independent ambulation was attained by greater than 90% of the M group but only 35% of the MS group and 3% of the MSV group when followed for 30 weeks post-onset. Walking 150 feet with assistance was attained by greater than 90% of all groups, but the mean time after stroke at which this was achieved differed (M = 14 weeks, MS = 22 weeks, MSV = 28 weeks).

In determining cases for stroke rehabilitation potentials, there are definitive negative prognostic signs that are found quite consistently in reviewed studies.\textsuperscript{17,18,35,38,39,40,46} These include the inability to maintain sitting balance, persistent bowel and/or bladder incontinence, persistent lower level of consciousness, inability to follow two-step commands, history of prior stroke, pre-stroke functional status, extended time since stroke onset, and the number of other medical complications present. The positive affects in predicting functional outcomes are good family support and financial status, higher economic levels, early rehabilitation referral, and type of rehabilitation center.\textsuperscript{41}
Those having no effect on stroke rehabilitation potentials are gender, side of brain involved, place of residence at time of stroke, amount of paralysis, and artery involved.\textsuperscript{42}

Controversy exists between authors concerning the influence of age on the functional outcome of stroke patients. Older patients are more likely to have one or more coexisting disorders, impairing functional ability. Rusin et al\textsuperscript{10} reviewed various studies that included age as a predictive variable; fifteen of the studies found that older patients had a less favorable outcome than younger. However, the review demonstrated that if the investigators looked at the amount of improvement from the time of admission to the time of discharge, an age relationship was not found. Age did not predict how much improvement a patient might expect during a rehabilitation stay. The final functional level may be worse for a patient who has improved a lot than a patient who was less seriously affected by the stroke and, thus, improves only a little. This pair of findings points to a dilemma in evaluating the degree to which patient groups benefit from rehabilitation. When trying to predict age influence on stroke outcome, one must look at the stroke type, likelihood of generalized vascular problems, existence of other disorders, and lifestyle of patient prior to stroke.

Anderson\textsuperscript{42} found age did not emerge as a significant prognostic factor though improvement was noted to be slightly slower with increasing age. Age appears to affect recovery time secondary to decreased endurance and previous decrease in functional levels.\textsuperscript{43}
Granger's results indicate that age is not inversely related to clinical outcome of stroke, though it does affect levels of independence. In patients who were greater than 74 years, only 30% returned home compared to 73% of those patients less than 65. Also, of those greater than 65, only 53% were independent in ADLs, whereas of those less than 65, 84% were independent. Age has not been found as an important indicator of life satisfaction but is associated with health services utilization, shorter length of stay (secondary to lower Medicare reimbursement), and less intensive therapy (due to possible negative stereotypes and decreased endurance). It has been reported that every 10 years of age reduces average length of stay by seven days.

Functional admission scores have been found to be a strong predictor of discharge functional status. Loewen, though, feels that one-week post-onset scores correlated with outcome better than initial scores. Patients exhibiting the most improvement are those with initial Barthel Index scores of 40 to 80 and that every 10 years of age reduced the BI discharge score by six points. Anderson indicated that initial BI scores of greater than 40 defined a population of stroke with greater proportion of discharge to home, greater than 60 had a shorter length of stay, and those less than 40 had no independence in mobility skills and less than 50% were independent in self-care skills at discharge. Barthel Index score of 60 seems to be pivotal between dependency and assisted independence.
Friedman describes a new system of stroke patient management based on the Barthel Index ADL scores. The use of the BI scores in patient management decisions has appeared to reduce the length of stay and hasten functional recovery without greatly influencing the final functional status. Subjects with a BI score of 0 to 1 seven days after stroke are too impaired to participate or benefit from rehabilitation, whereas those with scores of 19 to 20 are generally suitable for early discharge home.

The influence of psychosocial factors on stroke outcome should not be underestimated. Patients must be interested in improving function, despite the problem of significant loss of neurological function. It has been reported that one-third of all stroke patients are depressed at one year post-stroke and only 5% are treated for it. A greater length of stay for depressed patients has been noted during active rehabilitation. McDowell used controlled treatment trails using anti-depressants and found that, if depression is treated, patients improve more rapidly and often have better outcomes than those who were not treated. Psychosocial problems are not restricted to the patient, but also affect the spouse and close family. The support people carry much of the burden of care and have to cope with changes in behavior, sexual functioning, and other aspects of the patient's personality.

One of the major aims of rehabilitation is to improve a patient's "quality of life," which may be equated with reducing handicap. Surprisingly, indicators of quality of life have not been used as outcomes of effectiveness of specific
interventions, and yet may be more relevant than improvement in impairments, of physical disability, and morality.\textsuperscript{18} It has been found that 83% of patients felt that their quality of life was less than their pre-stroke status, with contributors being depression, dependence on ADLs, and inability to return to work.\textsuperscript{15}

Recently, clinical trials have been conducted to determine the role of family function, social support, and caregiver relationships in promoting post-stroke adjustment and other health care outcomes. Evaluation of the effects of relationships on stroke outcome is warranted because the patient's support system 1) is ultimately responsible for long-term care and 2) may influence post-stroke psychosocial outcome dramatically.\textsuperscript{41}

Several family variables have proven to be significant predictors of psychosocial adjustment and in rehospitalization time. Family function is a better predictor of duration of hospital stay than age, functional level, or site of lesion. While family variables predict some clinical variable, clinical variable do not predict family functioning. Thus, if rehabilitation can impact family behavior early in the course of stroke recovery, there may be a positive effect on other outcomes. Research studies do show that patients without supportive family undergo physical and emotional deterioration and have a poorer rehabilitation outcome. One explanation of this phenomenon is that families who function poorly cannot adhere to a treatment program.\textsuperscript{41}

A major goal of many psychosocial treatments after stroke is satisfactory return to the home after hospitalization. Worsening health is the single most
likely precipitating factor for institutionalization in the elderly; other factors include marital status, gender, ADLs, and age. The best predictors of nursing home placement or hospital readmission after stroke are chronic conditions, poor mental status, and psychiatric comorbidity. Psychiatric comorbidity was a unique factor influencing hospital readmission rates for stroke patients but not for other medical conditions. Stroke has important consequences for the patient's social function. About 25% of hospital-admitted stroke patients are permanently institutionalized. Those who are able to manage at home may become socially isolated, as may their families. Osberg et al indicated persons with more in-house support had better 12-month outcome and higher life satisfaction, bolstering the emphasis in rehabilitation on promoting family involvement. Persons with out-of-house social supports also had higher life satisfaction as well as lower discharge charges.

Efforts directed at problems in psychosocial areas may be among the most important in terms of improving the quality of life of stroke survivors, and it is unfortunate that psychosocial consequences of stroke are frequently underestimated or ignored. Advice, explanation, and support may be far more effective in improving the stroke survivor's quality of life than many of the medical and surgical treatments.

The knowledge gained from accurately predicting various aspects of post-stroke recovery could be applied to the design of more effective and efficient
treatment programs. Costly programs with little to no rehabilitative effect would be recognized as poor rehabilitative practices.\textsuperscript{17}
CHAPTER V
EFFECTIVENESS OF STROKE REHABILITATION

The clinical course of recovery following stroke is relatively well defined. However, the neurophysiologic interventions in facilitating this recovery process remain less well understood.\textsuperscript{15} Two factors contribute to functional recovery of the stroke patient. First, the neurologic deficit lessens. The mechanisms that may account for neurologic recovery include resolution of the acute pathology and longer-term neuronal and glial changes. There is evidence that environmental factors, including active rehabilitation, may affect neurological recovery. Second is the improvement in the patient's capacity to function in his environment through education and adaptation. Although functional recovery partly depends on neurological recovery, the two processes are separate.\textsuperscript{39}

Rehabilitation is defined as the combined and coordinated use of medical, social, educational, and vocational measures for retraining an individual to the highest possible level of functional ability. The rehabilitation approach involves a multidisciplinary team which includes the patient, family, therapists, nurses, social workers, and doctors. Team members assess the disease, in terms of impairments (the physical or psychological lesion), disabilities (the functional consequence of the impairment), and handicaps (the
consequence of disability given an individual's and the community's social, psychological, and health resources), together with the burden on the family and local services.¹⁸

Rehabilitation programs rely heavily on the principles of learning theory and the proposed mechanisms of recovery in its understanding of how change in performance can be produced by specific training and environmental modification.¹⁸ Specific techniques in the area of motor retraining, cognitive remediation, and reduction of visual-perceptual deficits hold much promise for practical application and a resultant improvement in self-care ability and return to work.¹⁵ The major goal of rehabilitation is not merely to improve function and to foster independence while in rehabilitation, but to help patients learn to be independent in the post-rehabilitation period.³⁷

Not every post-stroke individual is a candidate for rehabilitative therapy. A number of investigations have been conducted as to who is most likely to benefit from stroke rehabilitation. Third-party reimbursers in the United States have made determinations on this issue and have set guidelines for admission criteria for inpatient rehabilitation. Admission criteria include that the patient must (a) be medically stable, (b) be responsive to verbal or visual stimuli, (c) have sufficient mental alertness to participate in a program, and (d) have a condition that indicates a potential for rehabilitation with reasonable expectation of improvement. Exceptions in these criteria are made for time-limited evaluation admissions, when trying to determine rehabilitation potential. The
patient must be able to enter a program that requires at least three hours of
active participation per day, involving physical therapy, occupational therapy,
speech, and/or rehabilitation nursing. Average duration in rehabilitation centers
varies from two to six weeks with criteria for admission varying and the cost of
care being considerable.49

Although rehabilitation services have been provided for stroke patients for
several decades, no well-designed controlled studies have actually correlated
statistically significant outcomes with a set of therapeutic guidelines.50
Research assessing efficacy of rehabilitation is difficult because of multiple
variables, varying methodology, nonuniform measures, selected populations,
and variability between onset of stroke.15 There is a great scope for more
research to answer many unresolved stroke rehabilitation issues using
standardized prognostic factors and outcomes with comparison between
different functioning groups.51 The nature of therapy itself must be better
defined, so that the effects of standardized types and amounts of treatment can
be compared.

It is clear that the specialized inpatient unit for restorative care to the
stroke survivor remains an unproven tool. The most persuasive studies have
prospectively randomized patients to either rehabilitation or routine care
groups.52 One study, based in Scotland, that compared a "stroke unit" to a
regular medical ward, found independence in ADLs to be significantly greater at
time of discharge in patients on the stroke unit.15 Strand et al53 found
decreased length of stay and greater percentage of patients independent with walking, personal hygiene, and dressing on the stroke ward as compared to the medical ward. Also, in patients with major deficits and older than 75, the stroke unit care enhanced the percentage of patients able to return home. Sivenius et al\textsuperscript{54} show a similar increase in patient independence in ADLs in the first three months with those receiving intensive therapy, although they found no significant differences by 12 months. Harris\textsuperscript{50} identified four studies that advocated benefit from added rehabilitation and found the greatest effects came with a shorter interval between CVA onset and therapy initiation, with 90 days being the outer time limit for noticeable effects. Even so, the importance of beginning active, comprehensive rehabilitation early still remains controversial.\textsuperscript{54}

Costs for comprehensive inpatient rehabilitation vary depending on facility and geographic location. Rehabilitation early after stroke has been suggested to decrease long-term social and economic costs.\textsuperscript{15} Few studies have approached the problem of cost benefits of stroke rehabilitation, probably because these studies are difficult to conduct.\textsuperscript{40} Mackey's\textsuperscript{55} study showed that 72% of rehabilitated patients were discharged home, whereas only 54% of the control group were. At one year follow-up, 69% of the rehabilitation group were still at home, while only 43% of the control group were.

In rehabilitation, a small proportion of individuals account for disproportionate amount of health care expenditures in the United States. Osberg et al\textsuperscript{56} recommend the need to identify rehabilitation cost outliers and
apparent rehabilitation "failures." Their study of several Boston hospitals found 57.6% of the total costs were accrued by only 33% of the patients. Feigenson\textsuperscript{57} has presented some guidelines for improving outcome while simultaneously decreasing the cost of stroke rehabilitation by (a) beginning rehabilitation in the acute care hospital as soon as the patient is medically stable, (b) initiating rapid referral to regional rehabilitation facilities, if available, (c) establishing disability oriented units in both acute care and rehabilitation facilities, (d) basing treatment and duration of hospitalization on the functional and neurological deficits rather than diagnostic category, (e) enlisting and educating interested friends and family members to help provide rehabilitation services during all phases of the stroke treatment, and (f) providing better acceptance of the handicapped, more enlightened health care legislation, and more educational/vocational and avocational opportunities for people with complete stroke. In conducting cost benefit studies, they should not just include financial savings, but those factors that are important to the quality of life of the patient with a stroke.
CHAPTER VI

CONCLUSION AND RECOMMENDATIONS

Two-thirds of all strokes occur in persons beyond 65. Stroke survivors are living longer as a result of advances over the last 30 years in medical management, with 400,000 new stroke survivors each year. As this country faces increased numbers of elderly, in addition to its overburdened Medicare program, a more accurate assessment of stroke care needs may curtail unnecessary costs, make better use of our limited paramedical services, and better determine what types and time frame of therapy will best benefit stroke victims.

The most important overall conclusion from scientific studies of predictors of stroke rehabilitation outcome is that the identified predictors were not accurate enough to predict gains in the rehabilitation process of the disposition of the patients at the time of discharge. Instead, these predictors can only be used in a statistical sample to describe the general criteria of these patients who do better versus those who do worse in rehabilitation. The majority of literature found that age did not predict how much improvement a patient might expect post-stroke, though greater incidence of comorbidity, decrease of
functional status prior to stroke, and limited endurance were factors that may affect final functional status.

The determinants of outcome depend to a great extent on factors other than the nature and extent of the impairments. It seems that the patient's subjective perception may be a major determinant of subsequent behavior in terms of functional dependence (disability). An index of "quality of life" is needed to evaluate the role and function of people in the community. Most studies fail to cite psychosocial factors as primary problems that afflict stroke survivors, as well as family members and caregivers. It is evident that psychosocial problems need to be evaluated and addressed during the rehabilitative process. Good family and social support and active treatment of post-stroke depression have all been shown to have positive effects on functional outcomes and discharge home of stroke survivors. Further research is needed to determine if psychosocial treatment can impact changes in health care patterns after stroke.

Overall, medical rehabilitation lacks a set of measures with widespread utility. There are a number of established functional outcome measures used frequently in the literature. Of these, a few must be selected as standard measures used to allow comparison of results or data across settings. The measures need to be both reliable and valid. Recommended, also, is established methods of presenting and analyzing data to enhance the understanding of clinical problems.
Research assessing the efficacy of stroke rehabilitation is difficult because of multiple variables, varying methodology, non-uniform measures, selected populations, and variability between onset of stroke. Future research must be undertaken to further elucidate the multiple and interacting factors that underlie recovery from brain injury. This will allow the development of rational therapeutic strategies for recovering and restoring function following stroke. These strategies, whether they are pharmacologic, physical therapeutic, cognitive of other techniques, must then be studied in rigorously controlled trials.\textsuperscript{15} Harris\textsuperscript{50} recommends a prospective, randomized, and blinded controlled trial with large numbers of people over an extended period of time. The ability to perform a study of this type would be greatly assisted by the establishment of a national stroke registry. A stroke registry would be a starting point for analyzing stroke care needs and advancement of epidemiological investigations. Such research will provide the scientific information necessary to further the development and delivery of rehabilitation services, resulting in approved patient care and reduced cost.
REFERENCES


