January 2013

Ability and Skill Retraining with Task-Oriented Intervention to Improve Functional Independence in Persons with Stroke

Trista Thacker
Eastern Kentucky University

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By

Trista Thacker

Thesis Approved:

Chair, Advisory Committee

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Member, Advisory Committee

Member, Advisory Committee

Dean, Graduate School

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By

Trista Thacker

Bachelor of Science
Eastern Kentucky University
Richmond, Kentucky
2012

Submitted to the Faculty of the Graduate School of
Eastern Kentucky University
in partial fulfillment of the requirements
for the degree of
MASTER OF SCIENCE
August, 2013

DEDICATION

This thesis is dedicated to my parents
Keith and Lesa Thacker
for their love and support.

ACKNOWLEDGMENTS

I would like to thank my thesis chair, Dr. Lynnda Emery, for her guidance and patience as I worked through all the wonders of writing a thesis. I would also like to thank the other members of the thesis committee, Dr. Cindy Hayden, Dr. Christine Privott, and Dr. Melba Custer, for their assistance. I would also like to thank all the members of my family who have stood behind me and for understanding why I had to miss several family events so that I could continue to work hard to complete my thesis.

ABSTRACT

The purpose of the study was to examine the difference that ability and skill retraining used with task-oriented intervention can make on functional independence (as measured by FIM subscales) in persons with stroke. The findings of this study can contribute to the body of literature to support occupational therapy. Review of related literature includes background support for the use of FIM with the stroke population through analysis of the psychometric properties of the instrument. Also, the review of related literature provides support for the use of ability and skill retraining and task-oriented interventions with the stroke population. This supports the use of FIM admission and discharge scores to measure functional improvement and the division of ability and skill retraining and task-oriented interventions used in this study. Part of a large data set of a retrospective study of medical records for persons in long term care with the primary diagnosis of stroke was reviewed for the current study. Baseline and discharge FIM subscale scores were examined for 50 patients. The FIM subscales used were eating, grooming, bathing, upper body dressing, lower body dressing, toileting, bed, chair, and wheelchair transfers, and walk/wheelchair locomotion. Means, standard deviations, and t-tests with post hoc testing were used to analyze the data and determine if there were significant differences between baseline and discharge mean scores of the FIM subscales. IBM SPSS Statistics Version 21 was used for analysis. Billing information was also gathered on the 50 patients to determine which interventions were billed for the most often.

The interventions were divided into ability and skill retraining or task-oriented/functional oriented interventions to allow for a comparison of which is used the most in a long term care setting. Major results of the study were improvement was seen on each of the eight FIM subscales used and statistically significant improvement was found in all of the measured FIM subscales, with the exception of eating. Other major findings of the study included that about two-thirds of the billed intervention was task-oriented/functional oriented interventions and the other one-third was ability and skill retraining interventions. Discussion and clinical implications of the results conclude the thesis.

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INTRODUCTION

Purpose of the Study

The purpose of the study was to examine the difference that ability and skill retraining used with task-oriented intervention can make on functional independence (as measured by FIM subscales) in persons with stroke. The findings of this study can contribute to the body of literature to support occupational therapy. Further, these results and clinical implications can support the profession's emphasis on evidence-based practice (Holm, 2000).

Overview of Stroke

A stroke is "a disease of the cerebral vasculature in which a failure to supply oxygen to brain cells, which are the most susceptible to ischemic damage, leads to their death" (Gillen, 2011, p. 2). Stroke is the leading cause of death in the United States (Centers for Disease Control and Prevention, 2011). It is estimated that 7,000,000 Americans age 20 and older have had a stroke and that 795,000 people have a stroke each year (American Heart Association, 2012). Each year, 610,000 new and 185,000 reoccurring incidents of stroke occur (American Heart Association, 2012). It is also estimated that there are three million stroke survivors living in the United States today (Gillen, 2011).

According to Denti, Agosti, & Franceschini (2008), “stroke represents the most prevalent disabling disorder requiring rehabilitation service” (p. 4). There is a discrepancy in the percentage of stroke survivors that still have functional limitations. Legg et al. (2007) state that about half of stroke survivors are dependent on others. Not only does a stroke have a major impact medically on one person, there is also a large financial burden to society as well. Gillen (2011) states that the “economic impact of stroke in 2007 was estimated at $62.7 billion, markedly increased from the estimate in 2001 of $30 billion” (p. 1).

Wolf, Baum, and Connor (2009) state “stroke is one of the most expensive and life-altering syndromes affecting the ability of people to participate fully in their lives” (p. 621). Functional limitations associated with stroke include difficulties with dressing, eating, walking, and communication. Cramer et al. (2011) estimate that “55-75% of stroke survivors still have functional limitations and reduced quality of life months after the infarct” (p. 1592). With a greater number of aging individuals in the United States it is imperative that occupational therapists understand how and what approaches to use when working within this population.

<u>Definitions of Common Problems Caused by Stroke</u>

Common problems caused by stroke and the definitions of those problems include the following:

- Hemiplegia- “paralysis of one side of the body” (Hemiplegia, 2012).

- Neglect of one side of the body (Cognitive hemi-inattention)- "Failure to report, respond, or orient to a unilateral stimulus presented to body side contralateral to a cerebral lesion" (Gillen, 2011, p. 475).
- Motor apraxia- "Loss of access to kinesthetic memory patterns so that purposeful movement cannot be achieved because of defective planning and sequencing of movements, even though idea and the purpose of task are understood" (Gillen, 2011, p. 473).
- Aphasia- "acquired communication disorder caused by brain damage, characterized by an impairment of language modalities: speaking, listening, reading, and writing; it is not the result of a sensory or motor deficit, a general intellectual deficit, confusion, or a psychiatric disorder" (Gillen, 2011, p. 536).
- Increased tone (Spasticity)- "a motor disorder characterized by a velocity-dependent increase in tonic stretch reflexes with exaggerated tendon jerks" (Gillen, 2011, p. 21).
- Decreased tone (Flaccidity)- "quality of lack of tone of muscular or vascular organ or tissue" (Flaccidity, 2012).
- Contractures- "periarticular motion impairments that result from loss of elasticity in the periarticular tissues, which include muscles, tendons, and ligaments" (Gillen, 2011, p. 19).
- Deconditioning- "decreased strength of tendons, ligaments, bones, and muscles" (Gillen, 2011, p. 23).

- Aspiration- “penetration of food or liquid into the airway, below the level of the vocal folds, before, during, or after the swallow” (Gillen, 2011, p. 634).
- Dysphagia- “difficulty swallowing” (Gillen, 2011, p. 629).

Functional Independence Measure

There are many measurement tools that can be used to assess functional independence within the stroke population. The Functional Independence Measure (FIM) is one of the common and most trusted measurement tools used in rehabilitation to assess functional independence within the stroke population (Granger, Hamilton, Linacre, Heinemann, & Wright, 1993). The FIM is an instrument made up of both motor and cognitive subscales. The scores on the FIM items range from 1, which equates to total assistance, to a 7, which equates to complete independence. The total score on the FIM can range from 18 to 126. Therefore, it is important that occupational therapists have knowledge of the psychometric properties of the FIM and how accurate it is in measuring functional independence within this particular subpopulation.

There are eighteen subscales on the FIM, which include eating, grooming, bathing, dressing-upper body, dressing-lower body, toileting, bladder management, bowel management, transfer to and from bed, chair, wheelchair, transfer to and from toilet, transfer to and from tub, shower, walk/wheelchair locomotion, stairs, comprehension, expression, social interaction, problem solving, and memory. Eight subscales that are customarily measured by occupational therapists are included in this study. These subscales include: eating, grooming, bathing, dressing-upper body, dressing-lower body, toileting, transfers to and from bed, chair, wheelchair, and walk/wheelchair locomotion. Patient skill improvement on these subscales from baseline to discharge is studied.

Intervention for Stroke

After using a measurement tool for evaluation the occupational therapist's next task is to decide on an intervention approach. The task-oriented approach within occupational therapy is an effective approach to use when working with stroke survivors. The aim of this approach is to "improve occupational performance by optimizing motor behavior" and it is based on "a systems model of motor behavior and emphasizes the interrelatedness of client, task, and environment factors on motor performance" (Pressner, 2010, p. 727). It is a "top-down, client-centered, and occupation-focused approach to evaluation and treatment" (Pressner, 2010, p. 728). The biggest differences between this approach and other approaches used in occupational therapy or rehabilitation is that in the task-oriented approach the client gets to choose the tasks that they want to work on throughout therapy. This focus may encourage clients to work harder and to give a better effort during therapy.

To supplement the task-oriented approach, ability and skill retraining enhances therapeutic gains (Woodson, 2008). Task-oriented options directed toward improvement in occupational performance in self-care form the basis of therapy. Additionally, ability and skill retraining include postural adaptation, upper extremity capacity and motor re-learning. The Occupational Functioning Model (OFM) illustrates the needed progression and interrelationship of areas of therapeutic emphasis (Latham, 2008). Within the model, abilities and skills contribute to activities and habits (see Figure 1). Practice in these two areas contributes to competence in tasks of life roles.

Evidence-Based Practice

One of the challenges for occupational therapists working in the field is using evidence-based practice. Evidence-based practice is used increasingly in health care as a whole. It is defined by Sackett, Rosenberg, Gray, Haynes, and Richardson (1996) as "integrating individual clinical expertise with the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients" (as cited in Holm, 2000, p. 576). It can also be considered "a combination of information from what we know from research, what we have learned from clinical wisdom, and what we learned from information from the client and their family" (Law, Pollock, & Stewart, 2004, p. 15). Evidence-based practice impacted occupational therapy because there was a shift to judging occupational therapists by the functional outcomes achieved by patients (Holm, 2000). The change was from "providing services as efficiently and cheaply as possible," to "doing things better," then to "doing things right,"

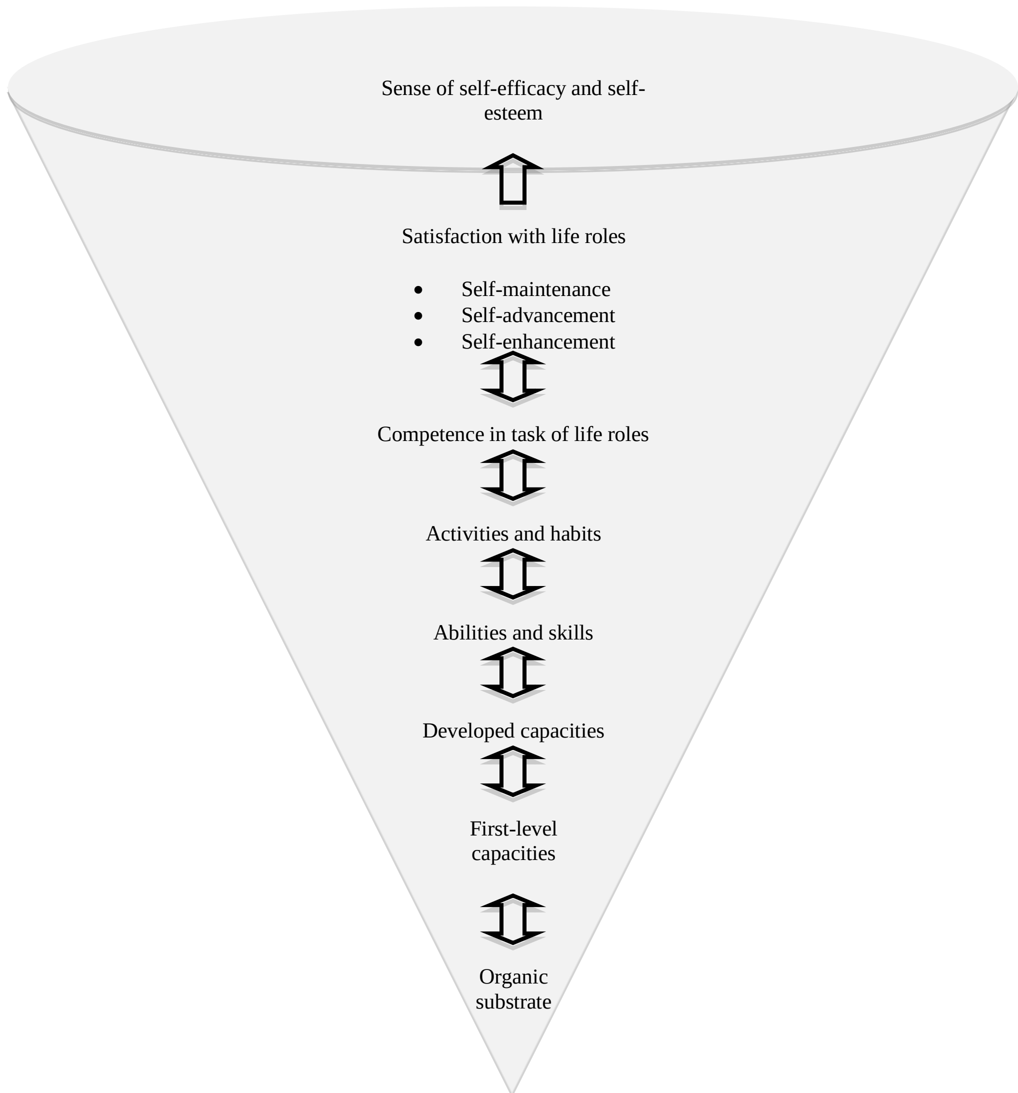

Figure 1. Occupational Functioning Model

Source(s): Latham, C. A. T. (2008). Conceptual foundations for practice. In Radomski, M. V. & Latham, C. A. T. (Eds.) *Occupational therapy for physical dysfunction* (p. 4). Baltimore, MD: Lippincott Williams & Wilkins. Used with permission.

and finally to “doing the right things” as described by Gary (1997) (as cited in Holm, 2000, p. 576). The ethical issue for occupational therapy is that “to be able to participate in evidence-based practice, we must have adequate evidence on which to base our treatment decisions” (Dirette, Rozich, & Viau, 2009, p. 782).

There are many myths that surround evidence-based practice. These myths include:

- evidence-based practice is ‘one size fits all’ care, with no need for individual clinical judgment;
- evidence-based practice is impossible;
- evidence-based practice is a tool of health policy makers, introduce only to cut costs;
- evidence-based practice rejects any research information that does not come from a randomized clinical trial;
- evidence-based practice conflicts with client-centered service; and
- there is little evidence available in occupational therapy that can be used to guide practice (Law, Pollock, & Stewart, 2004, p. 15-16).

Although the shift to evidence-based practice has led to more evidence available for occupational therapists to use, it has also caused significant issues. Two common issues are that “there is too much evidence to sift through” and “the quantity of evidence does not equal quality of evidence” (Holm, 2000, p. 576). The shift to evidence-based practice also led to the development of levels of evidence in occupational therapy. These levels allow for a person to read an article and determine its effectiveness in creating cause-and-effect results. It is important in occupational therapy to be able to show that the intervention that you are using has been proven to work with a particular population. Occupational therapy practitioners proclaim "practicing from an evidence-based perspective will increase effectiveness of occupational therapy and improve clients' outcomes" (Bailey, Bornstein, & Ryan, 2007, p. 86).

CHAPTER 2

REVIEW OF RELATED LITERATURE

Systematic literature reviews provide a way for occupational therapy researchers to look at many research articles on similar topics at one time. This helps to reduce the number of articles that a professional has to read in order to know if a specific treatment has been shown to work within a specific population of individuals or if there are other treatment options that need to be looked at more closely. Systematic reviews are able to "establish whether scientific findings are consistent and can be generalized across populations, settings, and treatment variations, or whether findings vary significantly by particular subsets" (Mulrow, 1994, p. 1).

A vast amount of research has been devoted to the stroke diagnosis and the Functional Independence Measure (FIM). In addition, there are different occupational therapy treatment options commonly used with clients that have had a stroke. Thus, it was determined that a systematic literature review would serve this topic. Search terms used included FIM, Functional Independence Measure, FIM and stroke, Functional Independence Measure and stroke, task-oriented approach, task-oriented approach and stroke, constraint-induced therapy, cerebral vascular accident, CVA, and stroke. The search consisted of peer-reviewed literature published between 2001 and 2011, and the databases searched included Academic Search Premier, CINAHL, MEDLINE, Psychology and Behavioral Sciences Collection, the American Journal of Occupational Therapy (AJOT), and

Google Scholar. Of the articles included in the Psychometrics of FIM (Table 1), one article was a Level I study and the remaining eight were Level III studies. Of the articles included in Table 2, one article was a Level I study, five were Level II studies, five were Level III studies, and one was a Level V study.

Table 1 includes nine references pertaining to the psychometric properties of FIM. The table is organized into six columns as follows: Author/Year, Study Objectives, Level/Design/Participants, Intervention and Outcome Measures, Results, and Limitations. Three of the references pertain to validity. Three of the references pertain to the discriminative ability of the FIM. Three of the references pertain to the reliability of the FIM.

Table 1

Psychometrics of FIM

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
Beninato et al. (2006)	Define the minimal clinically important difference for the FIM instrument in patients post-stroke	III-Cohort design, prospective study N= 113 Patients discharged from stroke unit between January and October 2003 Average age: 63.9 years Length of stay: 29.8 days Days since stroke to discharge: 41.1 days	No intervention FIM admission, discharge, and change scores for patients discharged from a stroke unit between January and October 2003 were collected and analyzed. Outcomes: • Admission FIM scores • Discharge FIM scores • Change in FIM scores • Minimal clinically important difference (MCID)	The MCID for total FIM score was 22, 17 for motor FIM scores, and 3 for cognitive FIM scores. Patients achieving MCID were younger, had higher admission FIM scores, and less time between their stroke and discharge from the stroke unit. They also had higher changes in total FIM score and motor FIM score. There were no significant differences between cognitive FIM scores in patients who achieved MCID and those who did not.	Finding cannot be generalized because patients were discharged from one acute care hospital. MCID may differ between settings. Small number of physicians participated.

Source(s): Beninato, M. B., Gill-Body, K. M., Salles, S., Stark, P. C., Black-Schaffer, R. M., & Stein, J. (2006). Determination of the minimal clinically important difference in the FIM instrument in patients with stroke. *Archives of Physical Medicine and Rehabilitation, 87*, 32-39.

Table 1 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
Bottemiller et al. (2006)	Evaluate the rate of FIM change with time "efficiency", admission and discharge FIM score, and discharge disposition of patients who underwent stroke inpatient rehabilitation	III- Case controlled designs, Retrospective study N=748 A clinical and demographic database from an acute rehabilitation unit was searched for patients admitted and discharged between January 1, 1997 and December 31, 2001 955 stroke patients were found through the database 187 were excluded because they did not give consent for their records to be reviewed, were under 18 years old, died during rehabilitation, or did	No intervention Instrument was administered within 24 hours of admission and at discharge by RNs that had been credentialed to administer the FIM. Outcomes: • FIM	FIM admission for patients discharged home: • 45 patients scored below a 40 • 245 patients scored between 40-79 • 199 patients scored an 80 or above FIM discharge for patients discharged home: • 9 patients scored below 40 • 64 patients scored between 40-79 • 416 patients scored an 80 or above FIM admission for patients discharged to a facility: • 78 patients scored below a 40 • 153 patients scored between 40-79 • 28 patients scored an 80 or above	FIM total scores were looked at without looking at separate cognitive and motor scores.

Table 1 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
		not complete rehabilitation at the hospital LOS ranged from 18 to 21 days		FIM discharge for patients discharged to a facility: • 32 patients scored below a 40 • 129 patients scored between 40-79 • 98 patients scored an 80 or above Differences in FIM efficiency by discharge disposition: • Discharged home: 1.92 ±1.47, range -2.0 to 13.5 • Discharged to facility: 0.96±1.07, range -3.6 to 5.5	
Source(s): Bottemiller, K. L., Bieber, P. L., Basford, J. R., & Harris M. (2006). FIM score, FIM efficiency, and discharge disposition following inpatient stroke rehabilitation. *Rehabilitation Nursing, 31*(1), 22-25.					
Brock, Goldie & Greenwood (2002)	Evaluate the discriminative ability of several measures used to determine outcome quality for post-stroke rehabilitation	III- Comparative study using Rasch analysis N= 106 Consecutive sample of patients with	No intervention Staff of the rehabilitation unit administered the measures at both admission and at discharge.	Each measure was measured for ceiling effects. Ceiling effect: FAC 46%, endurance test 39%, FIM motor section 16%, MAS 25%, and gait velocity no ceiling effect.	Patients were from the same rehabilitation hospital.

Table 1 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
		acute stroke admitted for rehabilitation between 1993 and 1995 Average age: 68.7 years 63% of the patients were men 46% had right-hemisphere lesions 45% had left-hemisphere lesions 9% had bilateral lesions 17% had hemorrhagic strokes 82% had infarcts	When administering the FIM the staff member considered the patient's performance over a 24-hour period. The use of aids and splints were allowed during assessment. Outcomes: • FIM motor section • MAS • FAC • Gait velocity • Walking endurance • Principal components analysis • Rasch analysis • Intraclass correlation	All the measures met the criteria of unidimensionality and were further examined with Rasch analysis. The mean case estimate for the FIM was 2.34 ± 1.56. The item separation reliability was .85. The ICC was .87. The correlation between change in raw scores and Rasch estimates was .71. The items that discriminated between ability the best were stairs, bathing, tub transfer, and walking. The mean case estimate for the MAS was 1.94 ± 1.60. The item separation reliability was .70. The ICC was .77. The correlation between raw MAS scores and Rasch estimates at discharge was .92. The	

Table 1 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
			coefficients (ICC)	items that were the best at discriminating between ability levels were walking and sitting. The mean case estimate for the gait measures was 1.43 ± 1.83. The item separation reliability was .83.	
Source(s): Brock, K. A., Goldie, P. A., & Greenwood, K. M. (2002). Evaluating the effectiveness of stroke rehabilitation: Choosing a discriminative measure. *Archives of Physical Medicine and Rehabilitation, 83,* 92-99.					
Chumney et al. (2010)	Evaluate the ability of the FIM to predict functional outcomes for stroke patients	I- Systematic review without meta-analysis N= 18 studies were reviewed	The method consisted of systematically selecting Level I or Level II studies using the predefined criteria and analyzing them. Outcomes: • FIM scores • Length of stay • Discharge destination • Discharge functional status	The systematic review provides limited evidence that the FIM can be used to predict outcomes in the stroke population.	Individual study limitations include no baseline data, possible significant error due to no staff training on scoring, use of several measures, and only using the motor portion of the FIM. The results of the systematic review should be interpreted with caution due to the limited number of articles used because

Table 1 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
					of exclusion criteria.
Source(s): Chumney, D., Nollinger, K., Shesko, K., Skop, K., Spencer, M., & Newton, R. (2010). Ability of functional independence measure to accurately predict functional outcome of stroke-specific population: Systematic review. *Journal of Rehabilitation Research & Development*, *47*(1), 17-30.					
Desrosiers et al. (2003)	Compare the association and responsiveness of the functional autonomy measurement system (SMAF) and functional independence measure (FIM) as outcome measures addressing functional independence in stroke patients involved in an intensive rehabilitation program and to compare their relationships with a social participation measure after rehabilitation period	III- Quasi-experimental design N= 132, average age 69.9±13.5 At the first and second measurements N=132 At the third measurement N=118 At the fourth measurement N=102 Time between stroke and admission 31.3 days±13.1 days	Participants were involved in an intensive rehabilitation program. Functional Autonomy Measurement System (SMAF) and Functional Independence Measure (FIM) were compared to LIFE-H. Outcomes: • SMAF • FIM • LIFE-H • SRMs • Correlation coefficients	Measurements for the SMAF and FIM were taken at 4 times during the study, twice while the participants were still involved in the rehabilitation program and twice after discharge. The LIFE-H was completed in addition to the SMAF and FIM the 2 times after discharge. Time 1: • Average SMAF score 44.1±12.2 Average FIM score 80.7±23.5 Time 2: • Average SMAF score 33.4±15.3 • Average FIM score	The study only looked at people with severe disability following a stroke so results cannot be generalized to people who have a mild stroke. There was no random selection of participants. Participants were expected to make large gains in function so it is not possible to know if the scales used would be able to detect small improvements in function. There was a decrease

Table 1 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
		LOS 79.0 days±45.5 days 47.7% were women 52.3% were men 54.3% had right hemisphere stroke 43.4% had left hemisphere stroke 2.3% had a bilateral stroke		94.7±23.9 Time 3: • Average SMAF score 31.4±14.8 • Average FIM score 94.7±22.5 • Average LIFE-H score 5.1±1.5 Time 4: • Average SMAF score 29.2±15.2 • Average FIM score 97.8±21.4 • Average LIFE-H score 5.5±1.6 Correlations between corresponding categories of the FIM and SMAF were calculated. Time 1: • Correlation between self-care & sphincter control on FIM and ADL on SMAF .93 • Correlation between	in sample size after discharge from the rehabilitation program.

Table 1 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
				mobility & locomotion on FIM and mobility on SMAF .87 • Correlation between communication on FIM and communication on SMAF .71 • Correlation between social cognition on FIM and mental functions on SMAF .83 • Correlation between total score on FIM and SMAF .94 Time 2: • Correlation between self-care & sphincter control on FIM and ADL on SMAF .93 Correlation between mobility & locomotion on FIM and mobility on SMAF .93 • Correlation between communication on FIM and communication on SMAF .65 • Correlation between	

Table 1 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
				social cognition on FIM and mental functions on SMAF .84 • Correlation between total score on FIM and SMAF .93 Time 3: • Correlation between self-care & sphincter control on FIM and ADL on SMAF .96 • Correlation between mobility & locomotion on FIM and mobility on SMAF .92 Correlation between communication on FIM and communication on SMAF .71 Correlation between social cognition on FIM and mental functions on SMAF .77 • Correlation between total score on FIM and SMAF .95	

Table 1 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
				Time 4: • Correlation between self-care & sphincter control on FIM and ADL on SMAF .96 • Correlation between mobility & locomotion on FIM and mobility on SMAF .94 • Correlation between communication on FIM and communication on SMAF .66 • Correlation between social cognition on FIM and mental functions on SMAF .81 • Correlation between total score on FIM and SMAF .95 Standardized response means (SRMs) were calculated for the FIM and SMAF. FIM: • SRMs for self-care & sphincter control .77 with	

Table 1 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
				a confidence interval (.57, .97) • SRMs for mobility & locomotion 1.54 with a confidence interval (1.28, 1.80 • SRMs for communication .06 with a confidence interval (-.11, .23 • SRMs for social cognition .05 with a confidence interval (-.12, .22) • SRMs for total FIM score .97 with a confidence interval (.76, 1.28) SMAF: • SRMs for ADL .88 with a confidence interval (.68, 1.08) • SRMs for mobility 1.28 with a confidence interval (1.03, 1.49) • SRMs for communication .09 with a confidence interval	

Table 1 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
				(1.03, 1.49) • SRMs for communication .09 with a confidence interval (-.08, .26) • SRMs for mental function .08 with a confidence interval (-.09, .25) • SRMs for IADL .97 with a confidence interval (.74, 1.20) • SRMs for total SMAF score 1.20 with a confidence interval (.98, 1.42) • SRMs for total score IADL 1.04 with a confidence interval (.82, 1.26) Time 3: • Correlation between SMAF total score and LIFE-H total score .85 • Correlation between FIM total score and LIFE-H total score .79	

Table 1 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
				Time 4: • Correlation between SMAF total score and LIFE-H total score .89 • Correlation between FIM total score and LIFE-H total score .85	
Source(s): Desrosiers, J., Rochette, A. Noreau, L., Bravo, G., Hebert, R., & Boutin, C. (2003). Comparison of two functional independence scales with a participation measure in post-stroke rehabilitation. *Archives of Gerontology and Geriatrics*, *37*, 157-172.					
Dromerick, Edwards & Diringer (2003)	Compare the sensitivity to change of three scales used in acute stroke trials	III- Cohort design, prospective study N=95 Consecutive admissions to stroke rehabilitation unit with primary diagnosis of stroke	No intervention Modified Rankin Scale and International Stroke Trial Measure were compared to Barthel Index and FIM. Outcomes: • Modified Rankin Scale (MRS) • International Stroke Trial Measure (ISTM) • Barthel Index (BI)	The MRS detected significant change in 55 participants, the ISTM detected change in 23 participants, the BI detected change in 71 participants but had a ceiling effect if subjects scored over 95, and the FIM detected change in 91 subjects. The FIM was the most sensitive of the four measures in detecting changes in participants.	Not a random sample. Participants were only moderately disabled from their stroke.

Table 1 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
			• FIM		
Source(s): Dromerick, A. W., Edwards, D. F., & Diringer, M. N. (2003). Sensitivity to changes in disability after stroke: A comparison of four scales useful in clinical trials. *Journal of Rehabilitation Research and Development, 40*(1), 1-8.					
Hsueh et al. (2002)	Compare the reliability, validity, and responsiveness of the motor subscale of the functional independence measure (FIM), the original 10 item Barthel index (BI), and the 5 item short form (BI-5) in inpatients with stroke receiving rehabilitation	III-Cohort design, prospective study N=125, 7 suffered another stroke and were there for not included for further testing, 118 participants remained 50 participants were women 68 participants were men Average age was 67.5±10.9	No intervention Outcomes: • FIM motor subscale • BI motor subscale • BI-5 • Cronbach α • Spearman correlation coefficient • ICC • Wilcoxon Z	Floor/ceiling effect: • Admission FIM 5.8/0 • Discharge FIM 3.5/0 • Admission BI 18.2 • Discharge BI 4.7 • Admission BI-5 46.6 • Discharge BI-5 13.6 Reliability measured by Cronbach α: • Admission FIM .88 • Discharge FIM .91 • Admission BI .84 • Discharge BI .85 • Admission BI-5 .71 • Discharge BI-5 .73 Concurrent validity measured by Spearman correlation coefficient and ICC: • Admission FIM correlation coefficient .74, ICC .55	

Table 1 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
				• Discharge FIM correlation coefficient .92, ICC .86 • Admission BI correlation coefficient .92, ICC .83 • Discharge BI correlation coefficient .94, ICC .87 • Admission BI-5 correlation coefficient .74, ICC .36 • Discharge BI-5 correlation coefficient .94, ICC .74 Responsiveness measured by Wilcoxon Z: • Admission FIM 7.5 • Admission BI 7.4 • Admission BI-5.7	
Source(s): Hsueh, I. P., Lin, J. H., Jeng, J. S., & Hsieh, C. L. (2002). Comparison of the psychometric characteristics of the functional independence measure, 5 item barthel index, and 10 item barthel index in patients with stroke. *Journal of Neurology Neurosurgery and Psychiatry*, *73*, 188-190.					
Kohler et al. (2009)	Analyze paired measurements of FIM item scores carried out in routine clinical practice for patients transferred	III- Case controlled design, Retrospective study N= 143	No intervention Outcomes: • Admission FIM • Discharge FIM • Cohen's κ	Average admission FIM: • Eating- 5.90 • Grooming- 5.16 • Bathing- 3.96 • Dressing Upper body- 4.74	There is no recorded data that says how many of the raters were trained which could severely impact the interrater

Table 1 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
	from one rehabilitation unit to another and determine the interrater reliability using standard measures of agreement and bias	63% of patients had an orthopedic condition 13% of patients had a stroke Two rehabilitation units adjacent to each other were used for the study. One unit was the "Subacute Unit" which had 20 beds The other unit was the "Rehabilitation Unit" which had 36 beds All patients transferred between these two units between August 2006 and October 2007 were included in the study	coefficients • ICC • McNemar's test of overall bias • Bhapkar's test for marginal homogeneity	• Dressing lower body- 3.52 • Toileting- 4.30 • Bladder management- 4.34 • Bowel management- 4.64 • Transfer bed/ chair/ wheelchair- 4.20 • Transfer toilet- 4.41 • Transfer bath/shower- 4.39 • Walking- 3.04 • Stairs- 1.62 • Comprehension- 5.75 • Expression- 5.84 • Social Interaction- 5.72 • Problem solving- 5.42 • Memory- 5.36 Average discharge FIM: • Eating- 6.13 • Grooming- 5.19 • Bathing- 4.20 • Dressing Upper body- 2.67 • Dressing lower body- 2.28 • Toileting- 4.69	reliability.

Table 1 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
		Patients had admission and discharge FIM scores from both units as they were admitted and discharged from them		• Bladder management- 4.92 • Bowel management- 5.34 • Transfer bed/ chair/ wheelchair- 4.36 • Transfer toilet- 4.39 • Transfer bath/shower- 4.34 • Walking- 3.64 • Stairs- 1.38 • Comprehension- 6.20 • Expression- 6.22 • Social Interaction- 6.09 • Problem solving- 5.34 • Memory- 5.43 κ Value: • Eating- .219 • Grooming- .129 • Bathing- .185 • Dressing Upper body- .063 • Dressing lower body- .083 • Toileting- .141 • Bladder management- .130 • Bowel management- .096	

Table 1 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
				• Transfer bed/ chair/ wheelchair- .186 • Transfer toilet- .186 • Transfer bath/shower- .199 • Walking- .132 • Stairs- .121 • Comprehension- .203 • Expression- .235 • Social Interaction- .161 • Problem solving- .192 • Memory- .182 Floor and ceiling effects are believed to be the cause of low κ values. Weighted κ values: • Eating- .398 • Grooming- .257 • Bathing- .392 • Dressing Upper body- .105 • Dressing lower body- .138 • Toileting- .405 • Bladder management- .348	

Table 1 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
				• Bowel management- .259 • Transfer bed/ chair/ wheelchair- .427 • Transfer toilet- .430 • Transfer bath/shower- .438 • Walking- .256 • Stairs- .211 • Comprehension- .346 • Expression- .462 • Social Interaction- .357 • Problem solving- .432 • Memory- .425 Weighted κ values take relative agreement as well as absolute agreement into account. ICC: • Eating- .599 • Grooming- .445 • Bathing- .578 • Dressing upper body- .124 • Dressing lower body- .176 • Toileting- .604	

Table 1 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
				• Bladder management- .526 • Bowel management- .391 • Transfer bed/ chair/ wheelchair- .635 • Transfer toilet- .623 • Transfer bath/shower- .625 • Walking- .359 • Stairs- .297 • Comprehension- .509 • Expression- .661 • Social Interaction- .567 • Problem solving- .612 • Memory- .630 ICC showed moderate levels of correlation besides for walking, stairs, dressing, and bowel management. McNemar's test of overall bias: • Eating- .024 • Grooming- .750 • Bathing- .044 • Dressing Upper body-	

Table 1 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
				.000 • Dressing lower body- .000 • Toileting- .072 • Bladder management- .000 • Bowel management- .000 • Transfer bed/ chair/ wheelchair- .144 • Transfer toilet- .677 • Transfer bath/shower- .168 • Walking- .001 • Stairs- .031 • Comprehension- .007 • Expression- .000 • Social Interaction- .002 • Problem solving- .670 • Memory- .552 The test of overall bias shows that some patients' scores differed significantly between the two occasions except grooming, toileting, transfers, transfer toilet, problem solving and memory.	

Table 1 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
				P-value on Bhapkar test of marginal homogeneity: • Eating- .017 • Grooming- .056 • Bathing- .002 Dressing Upper body- .000 • Dressing lower body- .000 • Toileting- .067 • Bladder management- .000 • Bowel management- .000 • Transfer bed/ chair/ wheelchair- .402 • Transfer toilet- .188 • Transfer bath/shower- .012 • Walking- .000 • Stairs- .151 • Comprehension- .010 • Expression- .012 • Social Interaction- .026 • Problem solving- .028 • Memory- .094	

Source(s): Kohler, F., Dickson, H., Redmond, H., Estell, J., & Connolly, C. (2009). Agreement of functional independence measure item scores in patients transferred from one rehabilitation setting to another. *European Journal of Physical and Rehabilitation Medicine*, *45*(4), 479-485.

Table 1 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
Reistetter et al. (2010)	Evaluate the ability of patient functional status to differentiate between community and institutional discharges after rehabilitation for stroke	III-Retrospective cross-sectional design N= 157,066 Data was obtained through the UDSMR 172,840 patients fit the criteria, 9923 were excluded because it was not their initial evaluation and 5851 were excluded because they had atypical LOS 51.8% of the patients were women 45,626 were discharged to institutional settings 111,440 were	No intervention Outcomes: • Discharge FIM total • LOS	Total sample: • Average discharge FIM motor 56.3±18.6 • Average discharge FIM cognition 24.2±7.3 • Average discharge FIM total 80.5±23.6 • Average LOS for the total sample 17.1±9.5 days Institutional setting: • Average discharge FIM motor 39.6±16.7 • Average discharge FIM cognition 20.0±7.7 • Average discharge FIM total 59.7±21.5 Average LOS 18.8±10.3 days Community setting: • Average discharge FIM motor 63.1±14.5 • Average discharge FIM cognition 26.0±6.5Average discharge FIM total 89.1±18.5 • Average LOS for the	Sensitivity and specificity provided only population-level information about the diagnostic ability of a measurement instrument. Discharge settings were narrowed down to two groups. Other influences of discharge setting were not accounted for.

Table 1 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
		discharged into the community Average age 70.5±13.8 Average age of patients discharged to institutional settings 73.9±12.6 Average age of patients discharged into the community 69.1±14.0		16.5±9.1 FIM total scores and motor scores showed moderately high discriminative abilities.	

Source(s): Reistetter, T. A., Graham, J. E., Deutsch, A., Granger, C. V., Markello, S., & Ottenbacher, K. J. (2010). Utility of functional status for classifying community versus institutional discharges after inpatient rehabilitation for stroke. *Archives of Physical Medicine and Rehabilitation*, *91*, 345-350.

To summarize the content of Table 1, Beninato et al. (2006) concluded that younger patients with higher FIM scores at admission and less time from onset to discharge were more likely to achieve the minimal clinically important difference, indicating higher performance. There were differences in total FIM score and motor FIM score but not in cognitive FIM scores. Bottemiller, Bieber, Basford, and Harris (2006) concluded that there were significant differences between the FIM scores at admission and at discharge between the individuals discharged home and the individuals discharged to a facility. There was also a large difference in discharge disposition between the two groups. Reistetter et al. (2010) concluded that the total FIM scores and motor FIM scores were able to discriminate between discharge settings at a moderately high level.

Brock, Goldie, and Greenwood (2002) concluded that there were four items on the FIM that were the best at discriminating between ability. Those items were stairs, bathing, tub transfer, and walking. Chumney et al. (2010) concluded that the FIM can predict outcomes across several populations post-stroke through a systematic review of the literature. Desrosiers et al. (2003) concluded that there is a strong correlation between the Functional Autonomy Measurement System (SMAF) and the FIM through correlation coefficients and standardized response means.

Dromerick, Edwards, and Diringer (2003) concluded that the FIM was the most sensitive to change between the Modified Rankin Scale (MRS), International Stroke Trial Measure (ISTM), Barthel Index (BI), and FIM. Hsueh, Lin, Jeng, and Hsieh (2002) concluded that both the FIM and BI have "acceptable and similar psychometric characteristics in inpatients with stroke" (p. 189) through the use of Cronbach α, correlation coefficient, and Wilcoxon Z. Kohler, Dickson, Redmond, Estell, and Connolly (2009) concluded that there is only fair inter-rater reliability of FIM scores within clinical practice through the use of Cohen's κ coefficients, Linear weighted Cohen's κ coefficients, intraclass correlation coefficients (ICC), McNemar's test of overall bias, and Bhapkar's test for marginal homogeneity.

Motor Performance Intervention as Measured with FIM (Table 2) includes twelve references pertaining to motor performance interventions as measured with FIM. The table is organized into six columns as follows: Author/Year, Study Objectives, Level/Design/Participants, Intervention and Outcome Measures, Results, and Limitations. Two of the references pertain to the effect of intervention after a stroke. Two of the references pertain to the impact that a stroke can have on functional outcomes. Two of the references pertain to explaining how task-oriented treatment works. Two of the references pertain to explaining the affect of a stroke on activities. Four of the references pertain to the use of constraint-induced therapy.

Table 2

Motor Performance Intervention as Measured with FIM

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
Chan, Chan & Au (2006)	Investigate the effect of using a sequential function-based task strategy in a six-week motor relearning programme for improving the balance function and functional performance of a group of poststroke patients	II- Matched-pair randomized controlled trial N=52 95 participants were recruited 29 were excluded 66 were randomized into either the motor relearning group (experimental group) or the conventional therapy group (control group) 7 participants from each group discontinued intervention during the treatment phase Data from the	Both groups received intervention for 6 weeks, 3 2-hour sessions for a total of 18 sessions. The researcher conducted the motor relearning intervention while other occupational therapists provided the conventional intervention. Both groups also received physical therapy and their attendance for physical therapy was documented. Both groups participated in feeding, grooming,	Baseline outcome measures for motor relearning group: • BBS- 28.2±8.0 • TUGT- 60.5±22.3 • FIM-MM- 61.2±12.7 • IADL- 54.2±13.1 • CIQ- 26.9±17.7 2nd week outcome measures for motor relearning group: • BBS- 35.3±7.7 • TUGT- 53.8±19.9 • FIM-MM- 67.5±10.7 • IADL- 62.6±17.8 • CIQ- 43.9±18.7 4th week outcome measures for motor relearning group: • BBS- 41.1±6.0 • TUGT- 47.1±18.0 • FIM-MM- 73.6±7.6 • IADL- 73.3±13.7 • CIQ- 59.5±18.7 6th week outcome measures for motor relearning group:	The randomization process of matching participants together may have introduced biases. Participants dropping out of the study. Other treatments received may have contaminated the treatment effects. Other activities that the participants completed outside of therapy may have also contaminated the effects. The participants were less than 65 and may have been able to do more than older adults.

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
		remaining 26 participants from each group was analyzed 28 participants were female (14 in each group) 24 participants were male (12 in each group) Motor relearning group average poststroke duration 117.7 days Conventional therapy group average poststroke duration 88.8 days Average age of participants in motor relearning group 53.8±15.4 years Average age of	buttoning, moving bowels, bed mobility, dressing upper garment, dressing lower garment, cleaning buttocks, and bathing in sitting. They also participated in grooming, toileting (male), standing to fasten pant zipper, transfer, toilet transfer, bathtub transfer, bathing, and IADL and community activities in standing. The motor relearning programme consisted of four steps: • Identification of the missing	• BBS- 45.8±3.7 • TUGT- 36.4±15.5 • FIM-MM- 80.0±5.3 • IADL- 82.2±12.1 • CIQ- 73.0±19.9 Baseline outcome measures for control group: • BBS- 27.9±7.8 • TUGT- 62.8±22.2 • FIM-MM- 60.7±13.2 • IADL- 47.4±14.7 • CIQ- 21.5±16.1 2nd week outcome measures for control group: • BBS- 30.0±10.4 • TUGT- 61.8±21.0 • FIM-MM- 62.4±12.2 • IADL- 45.9±16.6 • CIQ- 25.5±18.0 4th week outcome measures for control group: • BBS- 30.1±6.9 • TUGT- 58.2±21.3 • FIM-MM- 64.1±11.5 • IADL- 50.6±16.5	

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
		participants in control group 54.4±13.7 years	performance components • Training using remedial exercises (30 min) • Training using functional task components (30 min) • Transfer of skills to functional task performance (60 min) The conventional therapy programme consisted of: • Select 3 remedial tasks based on functional status and 2 functional tasks based on performance level • Task by task practice • Practice tasks	• CIQ- 31.4±16.8 6th week outcome measures for control group: • BBS- 37.4±17.5 • TUGT- 58.2±26.1 • FIM-MM- 66.3±10.5 • IADL- 54.4±19.7 • CIQ- 36.3±17.0 Two-way repeated-measure ANOVAs were conducted on each of the clinical outcome measures. Significant between-group differences were seen for FIM-MM, IADL, and CIQ ($F(1,150)=6.34$-41.86, $P \leq 0.015$). Difference in TUGT were statistically insignificant ($F(3,150)=2.70$, $P=0.107$). Significant differences with-in group differences were found on all five measures ($F(3,150)=28.92$-	

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
			without drawing the patient's attention to their deficits • Practice functional tasks without relating it to learned remedial tasks Outcomes: • Berg Balance Scale (BBS) • Timed Up and Go (TUGT) Functional Independence Measure motor scale (FIM-MM) • Assessment of Instrumental Activities of Daily Living (IADL) • Community Integration Questionnaire (CIQ)	170.70, $P < 0.001$). ANOVAs indicated that rates of change across time between the groups differed ($F(3,150)=3.60\text{-}33.58$, $P < 0.015$).	

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
Source(s): Chan, D. Y. L., Chan, C. C. H., & Au, D.K.S. (2006). Motor relearning programme for stroke patients: A randomized controlled trial. *Clinical Rehabilitation*, *20*, 191-200.					
Denti, Agosti & Franceschini (2008)	Identify outcome determinants of stroke rehabilitation specific for the elderly	III- Cohort design, prospective design N=359, average age 80.8 ± 4.7 All first time stroke patients age 75 or older Patients from 18 Italian rehabilitation centers between February 1, 1999 and November 30, 2000 37.9% (136) men and 62.1% (223) women Average days since onset 22.3 days ± 14.6 Average LOS 50.0	All patients received physical therapy. 40% also received occupational therapy. 35% also received speech therapy. Patients were treated for a mean time of 95 min. a day 5 days a week. Outcomes: • Rankin scale • Motricity Index (MI) • Trunk Control Test (TCT) • Mini Mental State Examination (MMSE)	The mean MI score was 42.3±31.7 at admission and indicated severe motor impairment. The mean was 56.5±32.8 at discharge. The mean MMSE score was 20.5±7.4 where a score less than 24 indicates cognitive impairment. The mean was 23.0±5.0 at discharge. Cognitive impairment as defined by the MMSE was found in 41% of the patients. The mean TCT score at admission was 44.06±34.6 and at discharge it was 67.5±32.0.	Comorbidities were not taken into account with the patients so it is not known if other factors other than those looked at specifically for the study affected the results. There had been no research that looks at the impact of medical complications on functional recovery following a stroke. Floor-ceiling effects were not determined for the outcome measures.

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
		days ± 27.7 26.2% had aphasia 19.8% had neglect 20.3% had dysphagia	• FIM • Montebello Rehabilitation Factor Score (MRFS) efficacy	The mean admission total FIM score was 55.8±24 and at discharge it was 75.3±30. The mean motor subscale was 33±18 at admission and 51±23 at discharge. The mean cognitive subscale was 22.8±9.6 at admission and 24.7±9.1 at discharge. FIM gains in total scores was 19.9±15.2. FIM gains in motor scores was 18.0±14.1. FIM gains in cognitive scores was 1.87±3.5. The mean relative efficacy or MRSF was 0.33±0.25 and efficiency was 0.012±0.03.	

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
				Admission FIM scores were independently related to any measures of functional outcome. Admission FIM scores were the most effective scores at predicting the outcome. Age accounted for 1.3% of score variation on the FIM.	
Source(s): Denti, L., Agosti, M., & Franceschini, M. (2008). Outcome predictors of rehabilitation for first stroke in the elderly. *European Journal of Physical and Rehabilitation Medicine, 44*(1), 3-11.					
Desrosiers et al. (2005)	Evaluate the effect of an arm training programme combining repetition of unilateral and symmetrical bilateral tasks for people in the subacute phase after stroke	II- Randomized controlled trial, Pretest-posttest design N= 41 176 patients were contacted or their records were consulted 123 were found to be ineligible	Participants received their usual occupational and physical therapy in addition to the study intervention. The experimental group received intervention based on motor learning principles and task variability.	Experimental group pretest: • Fugl-Meyer 42.9±20.0 • Martin vigorimeter 24.8±23.5 kPa • Box & Block 15.7±14.3 • Purdue Pegboard 2.2±2.6 • Finger-to-Nose Test 6.5±8.1 • TEMPA unilateral tasks with affected side 7.6±4.0 • TEMPA bilateral tasks 4.1±2.3 • TEMPA unilateral + bilateral tasks 11.8±5.4	Drop out between pretest and posttest.

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
		53 were found to be eligible but 12 refused The remaining 41 participants were randomly assigned to either the experimental or control group 20 in the experimental group and 21 in the control group 3 participants dropped out of the experimental group and 5 out of the control group Average age of participants 73.2±10.4 years 22 female and 19 male	They were given standardized activities that related to everyday tasks that involved use of the arms. There were symmetrical, asymmetrical, bilateral, and unilateral tasks. The physical and mental effort required of the participants was high for the tasks in the experimental group. The control group received functional activities and exercises to enhance strength, active, assisted and passive movements, and	• MIF 31.0±7.0 • AMPS 0.42±0.8 Experimental group posttest: • Fugl-Meyer 46.1±18.4 • Martin vigorimeter 26.4±25.4 kPa • Box & Block 23.5±14.3 • Purdue Pegboard 3.2±3.1 • Finger-to-Nose Test 8.1±5.8 • TEMPA unilateral tasks with affected side 4.8±4.4 • TEMPA bilateral tasks 2.9±2.1 • TEMPA unilateral + bilateral tasks 7.8±6.3 • MIF 35.6±4.7 • AMPS 1.3±0.9 Control group pretest: • Fugl-Meyer 47.0±16.1 • Martin vigorimeter 29.1±24.8 • Box & Block 20.4±16.5 • Purdue Pegboard 4.3±6.9 • Finger-to-Nose Test	

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
			sensorimotor skills of the arm. The control group intervention was based on a neurodevelopmental approach to inhibit abnormal patterns of movement and stimulating normal active reactions of the affected arm. Tasks done by the control group were putting blocks or cones in a pile, changing a light bulb, shuffling playing cards, putting a pillow in a pillowcase, and tearing up sheets of paper. Outcomes: • Fugl-Meyer Upper extremity	6.9±5.1 • TEMPA unilateral tasks with affected side 5.6±4.6 • TEMPA bilateral tasks 3.3±2.9 • TEMPA unilateral + bilateral tasks 8.8±7.0 • MIF 28.3±9.3 • AMPS 0.45±0.9 Control group posttest: • Fugl-Meyer 51.3±14.1 • Martin vigorimeter 31.1±28.8 • Box & Block 26.6±16.5 • Purdue Pegboard 4.3±3.2 • Finger-to-Nose Test 10.2±7.4 • TEMPA unilateral tasks with affected side 4.0±3.7 • TEMPA bilateral tasks 1.6±2.1 • TEMPA unilateral + bilateral tasks 5.6±5.4 • MIF 33.2±9.0 • AMPS 1.2±1.0	

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
			motor subtest • Martin vigorimeter • Box and Block Test • Purdue Pegboard Test • Finger-to-Nose Test • TEMPA • French translation of Functional Independence Measure (FIM), Mesure de I'independence (MIF) • AMPS		
Source(s): Desrosiers, J., Bourbonnais, D., Corriveau, H., Gosselin, S., & Bravo, G. (2005). Effectiveness of unilateral and symmetrical bilateral task training for arm during the subacute phase after stroke: A randomized controlled trial. *Clinical Rehabilitation*, *19*, 581-593.					
Gialanella & Ferlucci (2010)	Investigate the role that aphasia and neglect have on functional outcomes of patients with strokes using the FIM	III- Cohort study, prospective design N=301 There were three groups:	Participants followed a rehabilitation program. They all had an average of 330 minutes per week of motor	Neglect group: • Initial NIHSS score 10.7±2.3 • Initial TCT score 10.1±9.5 • Initial total FIM 44.4±11 • Initial motor FIM score	Not all stroke survivors were enrolled because it was not a population-based study. All possible

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
		1) Neglect, average age 72.7 years (2) Aphasia, average age 69.0 years (3) Without either aphasia or neglect (WAN), average age 70.7 years	rehabilitation. Participants with aphasia or neglect also had an average of 120 minutes per week of neuropsychological rehabilitation. Outcomes: • Final motor FIM • Efficiency in motor FIM • Final cognitive FIM • Efficiency in cognitive FIM • Discharge destination • Rehabilitation length of stay (LOS) • National Institutes of Health Stroke Scale	22.8±7.6 • Initial cognitive FIM score 21.5±7.2 • Final NIHSS score 7.55±2.3 • Final TCT score 31.7±13 • Final total FIM score 61.0±17 • Final motor FIM score 37.3±14 • Final cognitive FIM score 23.8±6.4 • Efficiency in motor FIM score 1.03±0.7 • Efficiency in cognitive FIM score 0.14±0.2 Aphasia group: • Initial NIHSS score 11.8±3.9 • Initial TCT score 21.4±19 • Initial total FIM score 43.0±19 • Initial motor FIM score 30.6±15 • Initial cognitive FIM score 12.5±6.1 • Final NIHSS score 8.96±4.1	predictors were included in the analysis. Examiners knew what the study was trying to prove so there may have been a bias to have the results come out the way they wanted them to.

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
			(NIHSS) • Trunk Control Test (TCT)	• Final TCT score 49.5±25 • Final total FIM score 71.8±25 • Final motor FIM score 55.2±20 • Final cognitive FIM score 16.9±7.2 • Efficiency in motor FIM score 1.75±1.0 • Efficiency in cognitive FIM score 0.27±0.2 WAN group: • Initial NIHSS score 6.64±2.9 • Initial TCT score 32.3±23 • Initial total FIM score 66.1±21 • Initial motor FIM score 38.2±16 • Initial cognitive FIM score 27.7±5.8 • Final NIHSS score 4.04±2.8 • Final TCT score 65.2±26 • Final total FIM score 95.9±21 • Final motor FIM score	

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
				66.6±18 • Final cognitive FIM score 29.3±4.9 • Efficiency in motor FIM score 2.03±0.9 • Efficiency in cognitive FIM score 0.09±0.1 Participants with neglect had lower final motor FIM scores than those with aphasia or WAN and the group with aphasia had lower final motor FIM scores than WAN. The aphasia group had lower final cognitive FIM scores than the neglect or WAN group and the neglect group had lower scores than the WAN group. Neglect and aphasia groups had lower final motor and cognitive FIM scores than did the WAN group. They are predictors of these	

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
				outcome measures. Individuals with neglect and aphasia had similar discharge destinations and had a similar LOS.	
Source(s): Gialanella, B. & Ferlucci, C. (2010). Functional outcome after stroke in patients with aphasia and neglect: Assessment by the motor and cognitive functional independence measure instrument. *Cerebrovascular Diseases, 30,* 440-447.					
Hartman-Maeir et al. (2007)	Evaluate the chronic affect of stroke in terms of activity limitations, restricted participation and dissatisfaction from life, and the relationship between these in stroke survivors in the community one-year post-stroke	III- Cohort design N=56, average age 57.7 years 60 participants started the study but four were excluded due to a recurring stroke	No intervention Outcomes: • FIM • IADLq • Interview about work situation • Activity Card Sort (ACS) • Life-Satisfaction questionnaire • Geriatric Depression Scale (GDS)	FIM Motor Scale: • Eating 6.89±0.49 • Grooming 5.71±1.58 • Bathing 4.41±1.95 • Dressing upper body 4.63±2.11 • Dressing lower body 4.52±2.13 • Toileting 6.64±0.84 • Bladder control 6.68±1.11 • Bowel management 6.82±0.77 • Bed, chair, wheelchair transfer 6.04±0.97 • Toilet transfer 5.98±1.0 • Tub, shower transfer 5.46±1.39 • Walk/wheelchair 5.88±0.76	Limited generalization because of small sample size selected from one rehabilitation center.

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
				• Stairs 5.23±1.28 • Total motor score 75.88±12.88 More than 90% of participants were completely independent in eating, toileting, and sphincter control. In all other areas measured by the FIM 25% of the participants scored below a 5 on each item. Highest percentages were seen in bathing, dressing, and use of stairs. In IADLs the mean score was 8.61 out of 23 indicating more dependence in IADLs. High percentages of full assistance were shopping, meal preparation, housekeeping, and laundry.	

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
				Only one subject out of 39 who were employed returned to work. According to the ACS, on average the participants gave up 57.2% of their activities after their stroke. 39% of participants rated themselves using the Life-Satisfaction questionnaire as satisfied with 'life as a whole'. The GDS revealed 24% of the sample was not depressed, 45% fell in the suspected depression range, and 31% fell in the probable depression range.	
Source(s): Hartman-Maeir, A., Soroker, N., Ring, H., Avni, N., & Katz, N. (2007). Activities, participation and satisfaction one-year post stroke. *Disability and Rehabilitation, 29*(7), 559-566.					
Huang et al. (2010)	Identify predictors of changes in QoL after distributed CIT with the CHAID method	III- Cohort design, Prospective study N= 58	Participants practiced functional tasks involving the affected upper extremity for 2	SIS domains: • Strength 40.73±20.05 • Memory 81.54±19.17 • Emotion 59.63±17.25 • Communication	Participants received routine interdisciplinary stroke rehabilitation which may have

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
		Average age 56.42±11.67 years 20 females and 38 males Average time since stroke 17.85 months	hours each weekday for 3 weeks. Shaping/adaptive and repetitive task practice techniques were used during training sessions. Outcomes: • SIS scale • MMSE • Fugl-Meyer Assessment (FMA) • Functional Independence Measure (FIM)	89.71±16.87 • ADL/IADL 67.41±20.10 • Mobility 79.25±18.08 • Hand function 29.63±25.39 • Participation 47.92±25.13 • Overall SIS 61.98±12.27 FIM was most strongly correlated with overall SIS score. Participants with FIM scores of 109 or less improved more in terms of their overall SIS score. The CHAID analysis found the room for improvement is 10 to 15%, which meets the minimal clinically important change.	impacted the improvement seen.
Source(s): Huang, Y., Wu, C., Hsieh, Y., & Lin K. (2010). Predictors of change in quality of life after distributed constraint-induced therapy in patients with chronic stroke. *Neurorehabilitation and Neural Repair*, *24*(6), 559-566.					
Iwai et al. (2011)	Clarify the structure of activities of daily living and their characteristics based	III- Case controlled design, Retrospective study	No intervention Outcomes: • FIM	Admission motor FIM capability ADL score: 43.0±24.9	Study excluded individuals with subarachoid hemorrhages.

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
	on the relationship with their difficulty levels and the gaps between the actual activity level achieved in daily living and the potential activity level that can be performed under supervision	N= 255 317 cases were reviewed but only 255 met inclusion criteria 117 males 138 females Average age 73.5±10.6 Length of time from onset to admission 45.9±16.4 days Length of stay 110.2±43.4 days		Admission motor FIM performance ADL score: 40.7±24.4 Discharge motor FIM capability ADL score: 53.0±27.3 Discharge motor FIM performance ADL score: 50.7±27.5 Average FIM scores at admission capability ADL: • Eating 4.9±2.2 • Grooming 4.0±2.3 • Bathing 2.5±2.2 • Dressing upper body 3.6±2.2 • Dressing lower body 3.2±2.3 • Toileting 3.3±2.3 • Bladder Management 3.5±2.6 • Bowel Management 3.7±2.7 • Transfer-Walking or Wheelchair 3.9±2.1 • Transfer- Toilet 3.5±2.2	

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
				• Tub/Shower Transfer 2.0±1.8 • Walking or Using Wheelchair 3.1±2.1 • Stairs 1.9±1.7 • Total 43.0±24.9 Average FIM scores at admission performance ADL: • Eating 4.7±2.3 • Grooming 3.7±2.3 • Bathing 2.3±2.1 • Dressing upper body 3.3±2.3 • Dressing lower body 3.0±2.3 • Toileting 3.2±2.3 • Bladder Management 3.5±2.6 • Bowel Management 3.7±2.7 • Transfer- Walking or Wheelchair 3.8±2.1 Transfer- Toilet 3.3±2.3 • Tub/Shower Transfer 1.9±1.7 • Walking or Using	

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
				• Wheelchair 3.0±2.1 • Stairs 1.5±1.4 • Total 40.7±24.4 Average FIM scores at discharge capability ADL: • Eating 5.3±2.1 • Grooming 4.5±2.3 • Bathing 3.3±2.2 • Dressing upper body 4.4±2.3 • Dressing lower body 3.9±2.4 • Toileting 4.1±2.4 • Bladder Management 4.3±2.6 • Bowel Management 4.3±2.7 • Transfer- Walking or Wheelchair 4.7±2.1 • Transfer- Toilet 4.4±2.3 • Tub/Shower Transfer 2.9±2.2 • Walking or Using Wheelchair 4.2±2.2 • Stairs 2.8±2.2 • Total 53.0±27.3	

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
				Average FIM scores at discharge performance ADL: • Eating 5.1±2.3 • Grooming 4.3±2.4 • Bathing 3.1±2.3 • Dressing upper body 4.1±2.4 • Dressing lower body 3.7±2.5 • Toileting 4.0±2.4 • Bladder Management 4.2±2.7 • Bowel Management 4.3±2.7 • Transfer- Walking or Wheelchair 4.6±2.2 • Transfer- Toilet 4.3±2.3 • Tub/Shower Transfer 2.9±2.2 • Walking or Using Wheelchair 4.0±2.3 • Stairs 2.2±2.0 • Total 50.7±27.5 Item difficulty on capability ADL at admission was high for stairs (1.62), tub/shower	

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
				transfer (1.52), and bathing (0.85), low for eating (-1.62), and in the range of -0.68 to 0.13 for the other 9 items. Item difficulty on performance ADL at admission was high for stairs (2.03), tub/shower transfer (1.37), and bathing (0.86), low for eating (-1.60), and in the range of -0.70 to 0.09 for the other items. The same trend was seen in the scores for performance and capability ADL at discharge.	
Source(s): Iwai, N., Aoyagi, Y., Tokuhisa, K., Yamamoto, J., & Shimada, T. (2011). The gaps between capability ADL and performance ADL of stroke patients in a convalescent rehabilitation ward-Based on the functional independence measure. *Journal of Physical Therapy Science, 23*(2), 333-338.					
Lin et al. (2009)	Compare a modified CIT intervention with a dose-matched control intervention that included restraint	II- Randomized controlled trial, pretreatment-posttreatment study	All participants received individualized 2-hour therapy sessions 5 times a	FMA pretreatment CIT: 46.56±7.47 FMA posttreatment CIT: 53.13±6.35	Time that constraint was worn by individual differed significantly.

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
	of the less affected hand and assessed for differences in motor and functional performance and health-related quality of life	N= 32 22 males, 10 women Average age 55.7 years The participants were randomized into a constraint-induced treatment group (CIT) and a control group Average age CIT group 54.14±11 years Average age control group 57.38 ±12.78 years Average time after onset 15.1 months	week for 3 weeks. All participants were asked to wear a mitt on their less affected hand while they were active during the day. CIT group focused on functional training by shaping, adaptive, and repetitive practice of functional tasks. Control group focused on neurodevelopmental techniques emphasizing functional task practice when possible by weight bearing and fine motor dexterity activities. Outcomes:	FMA pretreatment control: 49.13±13.02 FMA posttreatmen control: 51.88±13.90 FMA Effect Size: 0.57 FIM pretreatment CIT: 118.19±8.96 FIM posttreatment CIT: 122.13±5.90 FIM pretreatment control: 117.88±11.99 FIM posttreatment control: 118.19±9.93 FIM Effect Size: 0.67 NEADL pretreatment CIT: 28.31±11.82 NEADL posttreatment CIT: 30.88±12.42 NEADL pretreatment	

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
			• Functional Independence Measure (FIM) • Fugl-Meyer Assessment (FMA) • Nottingham Extended Activities of Daily Living (NEADL)	control: 26.69±16.29 NEADL posttreatment control: 25.94±15.10 NEADL Effect Size: 0.31	
Source(s): Lin, K., Wu, C., Liu, J., Chen, Y., & Hsu, C. (2009). Constraint-induced therapy versus dose-matched control intervention to improve motor ability, basic/extended daily functions, and quality of life in stroke. *Neurorehabilitation and Neural Repair*, *23*(2), 160-165.					
Lin et al. (2007)	Evaluate changes in motor control characteristics of the hemiparetic hand during the performance of a functional reach-to-grasp task and functional performance of daily activities in patients with stroke treated with modified constraint-induced movement therapy	II- Randomized controlled trial, Pretest-posttest study N=32 256 were assessed for eligibility 222 were excluded due to not meeting inclusion criteria 34 participants were randomized but 2	Modified constraint-induced movement therapy group had unaffected hand placed in a mitt for 6 hours a day and underwent intensive training of the affected arm for 2 hours per weekday. Activities that were participated in were activities that were similar to what the individual would	FIM pretreatment mCIMT: 104.00±13.60 FIM posttreatment mCIMT: 113.06±10.55 FIM pretreatment TR: 102.00±17.8 FIM posttreatment TR: 105.67±15.85 MANCOVA showed significant and moderate-to-large effect of mCIMT on functional ability	Some participants dropped out of the study.

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
		dropped out due to unstable medical condition 21 males 11 females Average age 57.89 years Average post-onset 16.27 months Participants were randomized into either traditional intervention group (TR) or modified constraint-induced movement therapy (mCIMT) Participants were attending outpatient rehabilitation programmes at three hospitals	usually do during their daily life. Traditional intervention group participated in therapy 2 hours a day, five days a week. Therapy involved strength, balance, and fine motor dexterity training, functional task practice and stretching/weight bearing on the affected arm. Outcomes: • Functional Independence Measure (FIM)	(F(1.21)=4.44, P=0.012)	

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
Source(s): Lin, K., Wu, C., Wei, T., Lee, C., & Liu J. (2007). Effects of modified constraint-induced movement therapy on reach-to-grasp movements and functional performance after chronic stroke: a randomized controlled study. *Clinical Rehabilitation, 21*, 1075-1086.					
Preissner (2010)	Explain how the task-oriented evaluation framework and treatment principles can be used to optimize motor behavior and improve occupational performance of clients with cognitive limitations	V- Single-subject design N=1 4 weeks of intervention Female, age 85 years-old Client was evaluated using task-oriented approach framework Client's daughter identified occupational therapy goals	Intervention: 90 minutes of occupational therapy 6 days a week Focused on ADLs because of daughter's identified goals. After further evaluation emphasized environmental modifications and caregiver training. Helped client adjust to role and task performance limitations, create environment that utilizes common challenges of everyday life, practice functional	Selected scores on FIM at admission: • Feeding- 4 • Grooming- 3 • Bathing- 1 • Upper-body dressing- 1 • Lower-body dressing- 1 • Toileting- 1 • Bed-to-wheelchair transfers- 1 • Toilet transfers- 1 Selected scores on FIM at discharge: • Feeding- 5 • Grooming- 5 • Bathing- 2 • Upper-body dressing- 3 • Lower-body dressing- 2 • Toileting- 2 • Bed-to-wheelchair transfers- 3 • Toilet transfers- 3 Long-term goals were met	Single-subject design does not allow for generalization. AMPS not repeated at discharge.

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
			tasks or close simulations to find effective and efficient strategies, minimize ineffective and inefficient movement patterns. Outcomes: • FIM • AMPS	with the exception of bathing and dressing but these were partially met. FIM scores increased on all self-care areas. Increase in these areas allowed for the client to return home with her daughter. Client was able to identify occupations that she could engage in after discharge from therapy. Caregiver training was successful in teaching about assisting during self-care and helping client to stay engaged in other occupations.	
Source(s): Preissner, K. (2010). Use of the occupational therapy task-oriented approach to optimize the motor performance of a client with cognitive limitations. *American Journal of Occupational Therapy*, *64*(5), 727-734.					
Timmermans et al. (2010)	Evaluates the underlying training components currently used in task-oriented training and assesses	I- Systematic literature review with meta-analysis N= 16 studies were	The method consisted of searching for articles that fit within	Significant evidence supports feedback, distributed practice, functional everyday activities (ADL), and	Not all studies could be compared using effect size due to different duration, dosage of task

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
	the effects of these components on skilled arm-hand performance in patients after a stroke	reviewed 528 patients were included within the 16 studies Average age of participants: 68.9 years Articles published until March 2009 written in Dutch, French, English or German were considered	predetermined inclusion criteria and analyzing them using meta-analysis Outcomes (Exercises presented in studies): • Functional everyday activities (ADL) • Client centered • Frequent repeating • Real-life object manipulation • In context-specific environments • Increasing difficulty • Feedback given • Different movement planes • Total skill performance • Customized for training load • Opportunities for random practice • Distributed	random practice. Large treatment effect size support the use of these intervention strategies. Not all components lead to higher treatment effect size. Distributed practice improves postintervention performance specifically better motor learning. Random practice is linked to better follow-up outcomes and leads to better retention of learned motor performance. Feedback has positive effects on motor learning.	practice, stroke severity, and time since stroke in different studies. Some training components within individual studies were not well defined and made it difficult to evaluate and analyze them. Studies using constraint induced therapy were not included but could have further explained task-oriented training.

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
			practice		
Source(s): Timmermans, A. A. A., Spooren, A. I. F., Kingma, H., & Seelen, H. A. M. (2010). Influence of task-oriented training content on skilled arm-hand performance in stroke: A systematic review. *Neurorehabilitation and Neural Repair*, *24*(9), 858-870.					
Wu et al. (2007)	Examine the benefits of modified constraint-induced movement therapy (mCIMT) on motor function, daily function, and health-related quality of life in elderly stroke survivors	Level II- Randomized controlled trial, pretest-posttest study N= 26 15 males, 11 females 298 assessed for eligibility 257 did not met inclusion criteria and 15 refused to participate Average age 71.69 years Randomized into modified constraint-induced therapy	Study treatment occurred during regularly scheduled occupational therapy sessions. Participants also received routine interdisciplinary stroke rehabilitation. mCIMT group received 2-hour treatment sessions 5 times a week for 3 weeks. mCIMT group used shaping and repetitive task techniques. They participated in activities chosen by the participants.	FMA pretreatment mCIMT 41.85±11.33 FMA pretreatment TR 47.08±10.94 FMA post-treatment mCIMT 49.54±12.84 FMA post-treatment TR 49.38±10.18 FIM pretreatment mCIMT 95.08±15.24 FIM pretreatment TR 98.31±21.48 FIM post-treatment mCIMT 104.85±12.13 FIM post-treatment TR 100.85±20.08 MAL amount of use	Outcome measures were taken immediately after treatment session so it is unknown if improvements remained over time. Randomization appeared to have resulted in nonequivalency in some of the outcome measures. mCIMT group received more treatment by wearing restraint outside of clinic.

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
		group (mCIMT) and traditional rehabilitation group (TR)	TR group received 2-hour treatment sessions 5 times a week for 3 weeks. 75% of session focused on NDT techniques such as weight bearing. 25% of session focused on compensatory techniques using the unaffected arm to complete functional tasks. Outcomes: • FMA • FIM • MAL • SIS	pretreatment mCIMT 0.80±1.38 MAL AOU pretreatment TR 1.37±1.71 MAL AOU post-treatment mCIMT 1.78±1.28 MAL AOU post-treatment TR 1.57±1.76 MAL quality of movement pretreatment mCIMT 0.79±1.29 MAL QOM pretreatment TR 1.35±1.64 MAL QOM post-treatment mCIMT 1.99±1.31 MAL QOM post-treatment TR 1.49±1.58 Effect Size FMA .48 Effect Size FIM .42	

Table 2 (continued)

Author/Year	Study Objectives	Level/Design/ Participants	Intervention and Outcome Measures	Results	Limitations
				Effect Size MAL AOU .55 Effect Size MAL QOM .63	

Source(s): Wu, C., Chen, C., Tsai, W., Lin, K., & Chou, S. (2007). A randomized controlled trial of modified constraint-induced movement therapy for elderly stroke survivors: Changes in motor impairment, daily functioning, and quality of life. *Archives of Physical Medicine and Rehabilitation, 88*, 273-278.

To summarize the content of Table 2, Chan, Chan, and Au (2006) concluded that “patients in the motor relearning group showed better functional recovery than those who were in the conventional therapy group” (p. 196) through use of the Berg Balance Scale, Timed Up and Go Test, FIM motor subscale, assessment of instrumental activities of daily living, and the Community Integration Questionnaire. Desrosiers, Bourbonnais, Corriveau, Gosselin, and Bravo (2005) concluded that an “arm training programme based on repetition of unilateral and symmetrical bilateral practice did not reduce impairment and disabilities nor improve functional outcomes in the subacute phase after stroke more than the usual therapy” (p. 581) through a test-retest design.

Denti, Agosti, and Franceschini (2008) found that FIM scores at admission were related to functional outcome and that these scores were the most effective at predicting outcomes. Gialanella and Ferlucci (2010) concluded that both unilateral neglect and aphasia can impact functional outcomes and that individuals with neglect or aphasia were discharged to similar settings and had a similar length of stay in the hospital after their stroke. Preissner (2010) concluded that a task-oriented approach allowed the client in the case study to become more independent in self-care areas and identify occupations that she could do after therapy. Timmermans, Spooren, Kingma, and Seelen (2010) found that “substantial evidence exists for the positive effects of distributed practice, random practice, feedback, and clear functional goals for motor learning after stroke" (p. 862) through a systematic review of the literature.

Hartman-Maeir, Soroker, Ring, Avni, and Katz (2007) concluded that "stroke survivors dwelling in the community demonstrate long-standing dissatisfaction one-year post onset, correlating with activity limitation and restricted participation" (p. 559). These limitations are primarily in the areas of IADL and leisure activities. Iwai, Aoyagi, Tokuhisa, Yamamoto, and Shimada (2011) found that there is a gap between the improvement of performance ADL and capability ADL and state that this is because "improvement or capability ADL precedes that of performance ADL in the process of ADL improvement" (p. 333).

Huang, Wu, Hsieh, and Lin (2011) concluded that "after a form of CIT for patients with chronic stroke, daily functional performance, measured by the FIM, predicted overall QoL and the ADL/IADL domains of QoL" (p. 564). Lin, Wu, Liu, Chen, and Hsu (2009) found that "the robust effects of intensive training of an affected limb on various daily functions important for home and community living are significant" (p. 164). Lin, Wu, Wei, Lee, and Liu (2007) concluded that "in addition to improving functional use of the affected arm and daily functioning, modified constraint-induced movement therapy improved motor control strategy during goal-directed reaching" (p. 1075) based on pretreatment and posttreatment measures. Wu, Chen, Tsai, Lin, and Chou (2007) concluded that "mCIMT improves movement performance and ADL abilities as measured by clinical tests, whether subjective or objective" and that "mCIMT improved physical aspects of QOL and was well tolerated by the elderly patients" (p. 277).

Summary

This chapter provides a review of related literature. This includes two systematic literature review tables to concisely summarize the references. First, Table 1, addresses the psychometrics of the Functional Independence Measure (FIM). Second, Table 2, addresses motor performance intervention as measured with FIM. This literature is foundational for the use of FIM as an outcome measure in this study.

CHAPTER 3

METHODS

Overview of Research Methods

A large data set of a retrospective study of medical records for persons in long term care (LTC) with the primary diagnosis of stroke was used in this study. Patients admitted to the setting over a two-year period were included. The current study included a review of part of this large data set. The larger data set was derived from three approved Institutional Review Board (IRB) studies that permitted data use in thesis, presentation, and publication. Data examined in this study included no identifiable indicators of patients, providers, or settings.

The research study was exempt from additional IRB reporting because of the way in which the data was collected and recorded. It does not allow for the subjects to be identified either directly or through identifiers linked to the subjects. According to the Office for Human Research Protection (OHRP), "to qualify for this exemption the data, documents, records, or specimens must be in existence before the project begins." There was only review of past documentation from older persons, both male and female, in long term care. All therapy records were reviewed and there was no direct contact with any patients at the facility. The data was analyzed in group, aggregate format only.

Students enrolled in graduate occupational therapy courses at Eastern Kentucky University collected the data. They received human subjects' tutorial training and a human subjects/IRB certificate completed within the year prior to data collection. All students were trained on data transcription, the data collection form, and duplication/black-out method of eliminating identifying information. For the original data collection, the Principal Investigator and others completed the Human Participants Protection Education for Research Teams sponsored by National Institute of Health (NIH).

For this study, the investigator completed the Collaborative Institutional Training Initiative (CITI) Biomedical Research- Basic/Refresher Curriculum Ref #6774920 and CITI Social and Behavioral Responsible Conduct of Research Curriculum Ref #6774921. The Principal Investigator is certified via the CITI program. The data collection included initial evaluation and periodic re-certification data. Only facility and IRB-authorized data was collected.

The Faculty Sponsor, Dr. Lynnda Emery, completed the Collaborative Institutional Training Initiative (CITI) Biomedical Research- Basic/Refresher Curriculum Ref #4100832 and CITI Social and Behavioral Responsible Conduct of Research Curriculum Ref #4100833.

There were no potential risks, known or anticipated, for the original study. This study involved extraction of data and analysis as previously approved by the IRB. There was no recruitment of subjects or interaction with the clients. After the data was collected, each client's data was given a code number, which was used in the statistical analysis process. The data collection sheets from the original study will be returned to the Faculty Sponsor. Electronic storage will be in group, aggregate format and retained for publication and presentation purposes, as approved by the IRB.

Purpose of This Study

The purpose of the original study was to investigate the therapy outcomes in occupational therapy in long term care. It included goal attainment, functional improvement, and improvement in client factors and performance skills. The purpose of the current study was to examine the difference that ability and skill retraining with task-oriented intervention made on functional independence in persons with stroke.

Dependent Variable as Measured with FIM

The dependent variable is functional independence and was measured by the Functional Independence Measure (FIM). The FIM subscales that were analyzed during this study were eating, grooming, bathing, dressing-upper, dressing-lower, toileting, transfers, and wheelchair mobility. These subscales were included because these are the areas that are generally impacted by stroke in the vast majority of clients. Also, these areas are the most common for occupational therapists to assess and help a person improve.

The Functional Independence Measure (FIM) is one of the common and most trusted measurement tools used to assess functional independence within the stroke population (Granger et al., 1993). It is also a tool that can be used to show change in a client's ability, even if the change is small. This is important because it can help to show the client or the client's family that they are indeed making progress even though it may not seem as if much of a change has occurred. The FIM is also an assessment tool that can be easily understood by people in different disciplines. It makes it easy to communicate changes that a client has made to each health professional involved in the client's care.

Independent Variable- Ability and Skill Retraining with Task-Oriented Intervention

Clients within the original study received several different types of treatment at the long term care facility. Categories mentioned within the treatment plan can be categorized as task-oriented/functional emphasis or ability and skill retraining. In this study, task-oriented/functional oriented intervention is defined as: ADL compensatory training, transfer training, upper extremity (UE) functional exercise, restorative training, functional task/activity tolerance, therapeutic activities, ADL training, home management, wheelchair (w/c) training, and safety. Ability and skill retraining intervention is defined as: neuromuscular retraining, balance, UE coordination, therapeutic exercise, cognitive training, cognitive/perceptual retraining, orthotic checkout, splinting/positioning, staff/family education, and positioning/muscle re-education.

Procedures for Use of the Data Set

Baseline and discharge FIM subscale scores were examined. Means and standard deviations were examined. Significant difference between baseline and discharge means were examined using paired t-tests with post hoc testing. Differences in client performance based on gender were explored. Additionally, patient age and amount of skilled service received were explored.

Data collected from the original data sheets included eating, grooming, bathing, upper body dressing, lower body dressing, toileting, transfers, and wheelchair mobility baseline and discharge FIM scores, age, gender, length of stay (LOS) in occupational therapy, the number of minutes billed for therapeutic exercise, therapeutic activities, ADL training, cognitive training, orthotic check out, wheelchair training, and positioning/muscle re-education, and what was included within each patient's treatment plan. The treatment plan could include one or more of the following: evaluation only, cognitive/perceptual retraining, ADL compensatory training, neuromuscular retraining, splinting/positioning, home management, balance, transfer training, upper extremity functional exercise, upper extremity coordination, staff/family education, restorative training, safety, functional task/activity tolerance, and other.

In order to extract the desired data from the original data collection sheets, the Principal Investigator first numbered the collection sheets from 1-50. A data form was then created for data extraction that was filled out for each of the collection sheets. For data collection sheets that contained more than one admission and discharge date for the patient the date for which the most improvement was seen within occupational therapy was used. This data was then entered into the statistical program (IBM SPSS Statistics Version 21) for analysis.

Chapter three describes the methods in five sections. These sections are: overview of research methods, purpose of this study, dependent variable as measured with FIM, independent variable- ability and skill retraining with task-oriented intervention, and procedures for use of the data set. Next, chapter four presents the results of the study.

CHAPTER 4

RESULTS

Participants

The average age of the study participants was 69.94 years (see Table 3). The participants were 48% (n = 24) male and 52% (n = 26) female. Their average length of stay (LOS) is occupational therapy was 13.27 days.

Table 3

Demographics of Participants

Descriptor	N	Percentage (%)
Gender		
Male	24	48%
Female	26	52%
Age		
90-94	3	6%
85-89	1	2%
80-84	6	12%
75-79	8	16%
70-74	8	16%
65-69	8	16%
60-64	9	18%
55-59	3	6%
50-54	1	2%
45-49	3	6%

Functional Improvement

The baseline status of the participants is shown by the mean of the initial FIM score on each of the selected eight subscales (see Table 4). The highest performance was seen in eating (6.30), which was expected due to the impairment of movement that is usually seen within the stroke population. Grooming (3.27), upper body dressing (3.18), and wheelchair mobility (3.28) were completed, on average, with moderate assistance. The lowest performance was seen in bathing (1.89), lower body dressing (2.22), toileting (2.82), and transfers (2.82) indicating patients required maximal assistance or were dependent in these areas. This corresponds with the findings that balance (39), ADL compensatory training (43), transfer training (43), upper extremity exercise (40), and functional task/activity tolerance (37) were the most used in the treatment plan.

Table 4

Functional Improvement After Stroke

FIM Subscale	Baseline		Discharge		Paired t	p-value for t-test
	Mean	Standard Deviation	Mean	Standard Deviation		
Self Care						
Eating	6.30	1.611	6.33	1.584	-1.000	.323
Grooming	3.27	1.698	4.69	1.970	-7.356	.000
Bathing	1.89	1.202	3.53	2.084	-7.301	.000
UB Dressing	3.18	1.679	4.29	2.092	-6.033	.000
LB Dressing	2.22	1.327	3.43	2.170	-5.727	.000
Toileting	2.82	1.867	3.65	2.278	-4.574	.000
Mobility						
Bed, Chair, W/C transfer	2.90	1.686	4.37	2.079	-7.265	.000
Locomotion						
Walk/W/C	3.28	2.534	4.03	2.500	-3.746	.001

Note. Scale: 1= dependent, 2= maximal assist, 3= moderate assist, 4= minimal assist, 5= supervision, 6= modified independence (device), 7= independent.

The level of improvement was discovered by using paired t-tests with post hoc analysis (see Table 4). The FIM scores for each of the eight selected subscales improved 1.06 points, on average, from admission to discharge. The largest improvement was seen in bathing with an increase of 1.64, then transfers with an increase of 1.47 and then grooming with an increase of 1.42. At discharge the eight FIM subscale scores, on average, had improved to moderate assistance or better performance. Statistically significant improvement was found in all of the measured FIM subscales, with the exception of eating.

The ability and skill retraining interventions that were billed most often were therapeutic exercise and positioning/muscle re-education and the task-oriented/functional oriented interventions that were used most often were therapeutic activities and ADL training (see Table 5).

Table 5

Billed Intervention for Stroke

Ability and Skill Retraining	Total Min.	Mean	SD
Therapeutic Exercise	8865	180.92	176.620
Positioning/Muscle Re-education	870	16.84	90.552
Cognitive Training	15	.31	2.143
Orthotic Check Out	435	8.88	46.225
Task-Oriented/Functional Oriented	Total Min.	Mean	SD
Therapeutic Activities	13810	281.84	256.137
ADL Training	5525	112.76	86.422
W/C Training	60	1.22	6.734

The ability and skill retraining intervention that was listed within the treatment plan the most was balance and the task-oriented/functional oriented interventions listed within the treatment plan were ADL compensatory training, transfer training, upper extremity functional exercise, and functional task/activity tolerance (see Table 6).

Table 6

Intervention for Stroke from Treatment Plan

Ability and Skill Retraining	Yes	Percentage (%)	No	Percentage (%)
Neuromuscular Retraining	2	4%	48	96%
Balance	39	78%	11	22%
UE Coordination	1	2%	49	98%
Cognitive/Perceptual Retraining	1	2%	49	98%
Splinting/Positioning	9	18%	41	82%
Staff/Family Education	11	22%	39	78%
Task-Oriented/Functional Oriented	Yes	Percentage (%)	No	Percentage (%)
ADL Compensatory Training	43	86%	7	14%
Transfer Training	43	86%	7	14%
UE Functional Exercise	40	80%	10	20%
Restorative Training	0	0%	50	100%
Functional Task/ Activity Tolerance	37	74%	13	26%
Home Management	17	34%	33	66%
Safety	10	20%	40	80%

Overall, about two-thirds of the billed intervention addressed task-oriented/functional oriented and about one-third addressed ability and skill retraining (see Table 7).

Table 7

Summary of Intervention: Ability and Skill Retraining as Foundational to Task-Oriented/Functional Oriented

Ability and Skill Retraining	Minutes Billed	Treatment Plan
Therapeutic Exercise	8865	Included balance, staff/family education, and splinting
Positioning/Muscle Re-education	870	
Cognitive Training	15	
Orthotic Check Out	435	
Total	10185 (34.4%)	
Task-Oriented/Functional Oriented	**Minutes Billed**	**Treatment Plan**
Therapeutic Activities	13810	Included ADL compensatory training, transfer training, UE functional exercise, restorative training, functional task/activity tolerance, home management, and safety
ADL Training	5525	
W/C Training	60	
Total	19395 (65.6%)	
Total Intervention Provided	29580 (100.0%)	

Chapter four includes the results of the study. This includes the following sections: participants and functional improvement. Next, in chapter five, the results are discussed and clinical implications are presented.

CHAPTER 5

DISCUSSION AND CLINICAL IMPLICATIONS

Overview of Study Methods

This study consisted of the review of a large data set of a previous retrospective study. Fifty cases were analyzed looking at the baseline and discharge scores on eight FIM subscales. These subscales included eating, grooming, bathing, dressing-upper, dressing-lower, toileting, transfers, and wheelchair mobility. These areas are generally impacted by stroke and are the most often areas assessed by occupational therapists. Also, analyzed were the interventions that were used in the long term care facility. These interventions were classified as either ability and skill retraining or task-oriented/functional oriented.

In order to analyze the data, it was entered in to IBM SPSS Statistics Version 21. Means and standard deviations for the FIM subscales were examined. Also, differences between the means at baseline and discharge were examined using paired t-tests with post hoc testing. After analysis the findings were summarized in tables 4, 5, 6, and 7.

Summary of Major Findings

Improvement was seen on all of the FIM subscales measured with the exception of eating. This was expected because eating was the highest scoring area at baseline and therefore had the least amount of room for change. The subscale in which there was the most improvement was bathing with a 1.64 point improvement.

Both ability and skill retraining and task-oriented/functional oriented interventions were used with the participants but the vast majority of the billing was the task-oriented/functional oriented intervention of therapeutic activities at 13,810 total minutes for the fifty cases reviewed. The ability and skill retraining intervention of therapeutic exercise at 8,865 total minutes for the fifty cases was the second highest. Overall, according to the treatment plans of the cases reviewed, task-oriented/functional oriented interventions were used more often than ability and skill retraining interventions.

Limitations of Study

One limitation of the current study was that there were several patients who had multiple admissions. This was dealt with by taking the admission and discharge data from the time that the patients made the most therapeutic improvement. There were six patients for which this was an issue. Another limitation was that the patients had many different diagnoses, making it difficult to know if it was their stroke or another condition that impacted their performance on FIM subscales. There were also thirty patients that had missing data, either FIM scores or billing information, which impacted the statistical analysis. These are all typical occurrences with this age group.

Conclusions and Clinical Implications

The results of this study show the ability of the FIM to measure the change in performance from baseline to discharge in the stroke population. This is also supported within the literature. Chumney et al. (2010) found that "evidence exists that FIM scores can be used to accurately predict outcomes in patients post-stroke" (p. 26). Also, Dromerick, Edwards, and Diringer (2003) stated "the FIM detected change in more patients than the BI and did not exhibit the ceiling and floor effects seen in BI" (p. 6). This shows that the FIM is a measure that can be trusted to measure the change between admission and discharge performance, especially in the stroke population.

The results show that about one-third of billed service was ability and skill retraining. Chan, Chan, and Au (2006) state the importance of working on the underlying skills such as, balance, in addition to occupations. Desrosiers et al. (2005) found that working on the underlying skills can lead to functional improvement as well as improvement on the individual skills (p. 588).

The results show that about two-thirds of billed service was task-oriented/functional oriented interventions. Wu et al. (2007) found that by practicing the tasks and functional activities "patients improved in different aspects of motor function, daily function, and participation" (p. 276).

The Occupational Functioning Model (OFM) is used within this study to divide the billable services into ability and skills retraining and task-oriented/functional oriented. Within the model this study particularly looks at competence in tasks of life roles, mastery of activities and habits, and having abilities and skills that underlie mastery and competence (Latham, 2008, p. 9). These match up with the World Health Organization's (WHO) International Classification of Functioning (ICF) concept of activity (p. 9). The results of this study support the use of this model.

Suggestions for Future Research

Future research is still needed within the area of using the FIM as a measure of improvement within the stroke population. Future studies may include a larger number of patients or examination of differences between patients in long term care compared with those who are able to return home after a stroke.

Additional research may include differences based on demographics or gender and age as well as, studies of stroke outcomes in different settings such as long term care versus home and with other treatment approaches. Another suggestion for future research would be a systematic literature review with a meta-analysis that calculated the effect size of the differences between groups of patients as well as differences between treatment approaches.

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APPENDIX A:

SPSS Outputs

Table 8

Age Statistics

Statistics

Age

N	Valid	50
	Missing	0
Mean		69.94
Median		70.50
Std. Deviation		10.858
Range		48
Minimum		45
Maximum		93

Table 9

Gender Statistics

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	F	26	52.0	52.0	52.0
	M	24	48.0	48.0	100.0
	Total	50	100.0	100.0	

Table 10

Length of Stay Statistics

Statistics

LOS

N	Valid	49
	Missing	1
Mean		13.27
Median		9.00
Std. Deviation		11.273
Range		45
Minimum		1
Maximum		46

Table 11

FIM Baseline and Discharge Statistics

Subscale	N	Mean	Standard Deviation
Eating Baseline	43	6.30	1.611
Eating Discharge	43	6.33	1.584
Grooming Baseline	48	3.27	1.698
Grooming Discharge	48	4.69	1.970
Bathing Baseline	47	1.89	1.202
Bathing Discharge	47	3.53	2.084
UB Baseline	49	3.18	1.679
UB Discharge	49	4.29	2.092
LB Baseline	49	2.22	1.327
LB Discharge	49	3.43	2.170
Toileting Baseline	49	2.82	1.867
Toileting Discharge	49	3.65	2.278
Transfers Baseline	49	2.90	1.686
Transfers Discharge	49	4.37	2.079
W/C Mobility Base	29	3.28	2.534
W/C Mobility Dis	29	4.03	2.500

Table 12

Statistics for Billed Interventions

Intervention	N	Mean	Standard Deviation
Therapeutic Exercise	49	180.92	176.620
Therapeutic Activities	49	281.84	256.137
ADL Training	49	112.76	86.422
Cognitive Training	49	.31	2.143
Orthotic Checkout	49	8.88	46.225
W/C Training	49	1.22	6.734
Positioning/Muscle Re-Ed	49	16.84	90.552

Table 13

Paired t-Test for FIM Subscales

Subscale	Paired t	p-value for t-test
Eating	-1.000	.323
Grooming	-7.356	.000
Bathing	-7.301	.000
UB Dressing	-6.033	.000
LB Dressing	-5.727	.000
Toileting	-4.574	.000
Transfers	-7.265	.000
W/C Mobility	-3.746	.001

Table 14

Treatment Plan Statistics

Intervention	Yes	Percentage (%)	No	Percentage (%)
Cognitive/Perceptual Retraining	1	2%	49	98%
ADL Compensatory Training	43	86%	7	14%
Neuromuscular Retraining	2	4%	48	96%
Splinting/Positioning	9	18%	41	82%
Home Management	17	34%	33	66%
Balance	39	78%	11	22%
Transfer Training	43	86%	7	14%
UE Functional Exercise	40	80%	10	20%
UE Coordination	1	2%	49	98%
Staff/Family Education	11	22%	39	78%
Safety	10	20%	40	80%
Activity Tolerance	37	74%	13	26%