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Functional Independence Measurement Scale: Analysis of Variables to Determine Predictability to Stroke Patient's Discharge Site

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THESIS

Submitted to the Department of Physical Therapy
of Grand Valley State University
Allendale, Michigan
in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE IN PHYSICAL THERAPY

1995

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ABSTRACT

The purpose was to define subsets of variables that are found within the Functional Independence Measurement (FIM) scale that demonstrate a high predictability to right cerebral vascular accident (CVA) patient's discharge site, including home, foster home, and skilled nursing facility. The researchers wanted to find if gait, along with other subsets, has a high prediction to discharge site than overall FIM admission and discharge scores together and separately.

Gait did not show a higher prediction to discharge site compared with subsets of FIM variables and overall FIM admission and discharge scores, together and separately. However, other subsets were found to demonstrate a high prediction to discharge site. Subset one, which includes ADL's, and subset five, which includes mobility and cognitive items, demonstrated a high prediction to discharge site. Therefore it is possible to develop a shortened screening tool to decrease the time it takes to determine the most appropriate discharge site.

DEDICATION

We would like to dedicate this work to our parents and loved ones for their love and support throughout our education.

ACKNOWLEDGMENTS

We would like to extend our appreciation to the following individuals who contributed their time, knowledge, and advice in support of our research: Barb Baker, Dr. William Bell, Cathy Harro, Dr. Timothy Lesnick, and Nancy Myers Database Supervisor at Mary Free Bed Hospital.

TABLE OF CONTENTS

Dedication ii
Acknowledgements iii
List of Tables vi
List of Figures vii

Chapter
1. Introduction 1
Problem 1
Purpose of Study 1
Backkground on the FIM 2
Hypothesis 1 2
Hypothesis 2 2

2. Literature Review 4
Background on FIM and Hypothesis 4
Support for Hypothesis 5
Significance of Study 9
FIM as a Discrimitive and Predictive Tool 10
General Scoring and Gait Scoring 11
Procedures under FIM 11
Reliability and Validity of FIM 11
Factors not Assessed by FIM which effect Gait 13
Conclusion 14

3. Methodology 15
Study Design 15
Inclusion Criteria 15
Exclusion Criteria 15
Study Site 16
Procedure 16
Data Analysis 16

4. Results/Data Analysis 18
Purpose 18
FIM Items Analyzed 18
Results 18

5. Discussion 64
Limitations of Study 67
Dependence of Variables 67
Nonparametric Nature of Variables 67
Variables Possibly Affecting Discharge Site not Assessed under the FIM 67

Sample Size 68
Suggestions for Further Research 68
Conclusion 69

References 70

Appendix A- Description of the Levels of Function and their Scores 74

Appendix B- Description of Locomotion and Procedures for Scoring 75

Appendix C- General Procedures for Scoring the FIM 77

Appendix D- Description of Subsets and Additional Variables 78

Appendix E- Additional Results 79

LIST OF TABLES

Table Page

1. Total FIM Admission and Discharge Scores 20
2. Total FIM Admission Scores 22
3. Total FIM Discharge Scores 24
4. All 18 Weighted FIM Admission and Discharge Scores 26
5. All 18 Weighted FIM Admission Scores 28
6. All 18 Weighted FIM Discharge Scores 30
7. FIM Self-Care Admission and Discharge Scores 32
8. FIM Self-Care Admission Scores 34
9. FIM Bowel and Bladder Admission and Discharge Scores 36
10. FIM Bowel and Bladder Admission Scores 38
11. FIM Mobility Admission and Discharge Scores 40
12. FIM Mobility Admission Scores 42
13. FIM Cognitive Admission and Discharge Scores 44
14. FIM Cognitive Admission Scores 46
15. FIM Mobility and Cognitive Admission and Discharge Scores 48
16. FIM Mobility and Cognitive Admission Scores 50
17. FIM Locomotion Admission and Discharge Scores 52
18. FIM Locomotion Admission Scores 54
19. FIM Transfer Admission and Discharge Scores 56
20. FIM Transfer Admission Scores 58
21. FIM Transfer and Problem Solving Admission and Discharge Scores 60
22. FIM Transfer and Problem Solving Admission Scores 62

LIST OF FIGURES

Figure Page

1. Total FIM Admission and Discharge Scores 21
2. Total FIM Admission Scores 23
3. Total FIM Discharge Scores 25
4. All 18 Weighted FIM Admission and Discharge Scores 27
5. All 18 Weighted FIM Admission Scores 29
6. All 18 Weighted FIM Discharge Scores 31
7. FIM Self-Care Admission and Discharge Scores 33
8. FIM Self-Care Admission Scores 35
9. FIM Bowel and Bladder Admission and Discharge Scores 37
10. FIM Bowel and Bladder Admission Scores 39
11. FIM Mobility Admission and Discharge Scores 41
12. FIM Mobility Admission Scores 43
13. FIM Cognitive Admission and Discharge Scores 45
14. FIM Cognitive Admission Scores 47
15. FIM Mobility and Cognitive Admission and Discharge Scores 49
16. FIM Mobility and Cognitive Admission Scores 51
17. FIM Locomotion Admission and Discharge Scores 53
18. FIM Locomotion Admission Scores 55
19. FIM Transfer Admission and Discharge Scores 57
20. FIM Transfer Admission Scores 59
21. FIM Transfer and Problem Solving Admission and Discharge Scores 61
22. FIM Transfer and Problem Solving Admission Scores 63

CHAPTER 1

INTRODUCTION

Problem

The Functional Independent Measurement (FIM) is an aggregate scale consisting of 18 separate items which are added to produce a total score which may be used for discharge planning. The summation of FIM activities implies that all items have an equal weighting to the total functional independence which is highly unlikely (Cook, Smith, & Truman, 1994).

Purpose of Study

The purpose of this study was to analyze the scores of total FIM admission and discharge, weighted 18 FIM admission and discharge items, and specific subsets, which we designed, consisting of FIM items (appendix D) for their predicting the stroke patient's discharge site of home, foster home, or skilled nursing facility. This analysis was essential for many reasons. The first reason was to compare and identify FIM items, grouped as subsets, which demonstrate a high predictability in determining the stroke patient's discharge site. Once these subsets are identified, a shortened screening tool, composed of these subsets, may be developed to predetermine discharge sites. This screen could be utilized by health care professionals after total admission FIM scores have been obtained. This early utilization could allow clinicians to place patients on facility waiting lists and to possibly identify patient needs at the discharge site such as ramps or railings for possible mobility limitations secondary to their stroke. The second reason was to determine if total FIM admission and discharge scores together or separately demonstrated higher predictability than subset scores both upon admission or admission and discharge. This predictability could illustrate whether total FIM scores should be utilized in predicting patient discharge site.

Background on the FIM

The FIM is a measurement tool used to assess the patient's level of disability. This measurement is made up of 18 items; 13 motor items which include eating, grooming, bathing, dressing, tub/shower transfers, walking/wheelchair propulsion and stair climbing. The FIM also assesses five areas of speech and cognition which include comprehension, expression, social interaction, problem solving and memory. This measurement tool is used nationwide by rehabilitation facilities to evaluate patients at admission and discharge and rehabilitation outcome. Therefore, determination of which FIM items are predictive of the patient's discharge site is necessary for discharge planning and rehabilitation outcome (Uniform Data System, 1993).

Hypothesis 1

Gait appears to demonstrate a high predictability in determining the CVA survivor's discharge site due to following factors:

1. The physical constraints of most individuals homes may not be compatible with wheelchair bound individuals (Department of Labor, 1987; Feirer & Hutchings, 1986).
2. The number one patient goal is to achieve independent ambulatory status. This may be one reason why there is such a high percentage of CVA survivors who are discharged home with independent ambulatory status (D. Thomas & J. Ross, personal communication, July 6, 1994; Wall & Ashburn, 1979; Olney, Colborne, & Martin, 1989).

Hypothesis 2

FIM items grouped together under specific subsets may demonstrate a high predictability when determining the CVA patient's discharge site as compared with the total FIM admission and discharge scores.

1. Common variables such as bowel and bladder incontinence (Oczhowski & Barreca, 1993; Wade et al, 1985), patient's age (Oczhowski & Barreca, 1993)

family and social support (Andrews, Brocklehurst, Morris, Richards, & Laycock, 1981; Glass, Matchar, Belyea, & Feussner, 1993; Lincoln, Jackson, Edmans, & Walker, 1990), and depression (Kotila, Waltimo, Niemi, Laaksonem, & Lempinenn, 1984; Sinyor, Amato, Kalvupek, Becker, Goldenberg, & Coopersmith, 1986) have already demonstrated a high correlation in predicting CVA survivor's discharge site.

2. The admission scores of four specific Barthel Index items together under one subset have demonstrated a high prediction to the stroke patient's functional outcome at the time of patient discharge from a rehabilitation program. Furthermore, this subset demonstrated a higher predictability to the patient's discharge site of home compared with the total Barthel Index score at six months post-CVA (Granger, Hamilton, Gresham, & Kramer, 1989).

3. Individual FIM items provide more relevant information on outcome measures and as predictors of discharge status than total FIM scores (Cook, Smith, & Truman, 1994).

CHAPTER 2

LITERATURE REVIEW

Background on FIM and Hypotheses

The functional independent measurement (FIM) is a scale which assesses patients level of disability at admission, during rehabilitation, and upon discharge. Each of the 18 items are scored on a seven point scale, ranging from 1=dependent to 7=independent. Some of the items scored include self-care, sphincter control, mobility, locomotion, communication, and social cognition (Hamilton, Granger, Sherwin, Zeilezny, & Tashman, 1987).

At the present time, only two items under the FIM has been assessed for it's prediction in cerebral vascular accident (CVA) survivor's discharge site. Those items include bowel and bladder function which demonstrated a high correlation to the CVA survivor's discharge site (Oczhowski & Barreca, 1993). In addition to this variable, the level of independence in ambulation may also demonstrate a high correlation due to patient goals (Wall & Ashburn, 1979; Olney, Colborne, & Martin, 1989) and accessibility issues in the home (Feirer & Hutchings, 1986; McClain & Todd, 1990; McClain, Beringer, Kuhnert, Priest, Wilkes, Wilkinson, & Wyrick, 1993; Wilson, 1992). In addition to bowel and bladder function, other authors have identified specific variables to be highly predictive. For example, the authors Wade, Wood & Hewer (1985) stated that urinary incontinence, ease of transferring, and the ability to feed were all important factors in determining the stroke patient's discharge site of home. Furthermore, two studies have demonstrated that individual items may be more critical than total scores as outcome measures and predictors of discharge status (Granger, Hamilton, Gresham, & Kramer, 1989; Cook, Smith, & Truman, 1994). Granger et al. (1989) demonstrated that four specific Barthel Index (BI) variables (bladder and bowel control, eating and grooming) grouped as one subset demonstrated a high prediction to the stroke patient's functional outcome at the time of discharge. Furthermore, this subset demonstrated a higher prediction than the total BI score in determining the stroke patient's discharge site of community living at six months post-CVA. Furthermore, the authors Cook, Smith, & Truman, (1994) stated that individual FIM items demonstrate more relevant information on the patient's status than total FIM scores (Cook, Smith, & Truman, 1994). Therefore, it is possible that specific variables including gait under the FIM may demonstrate a higher prediction than total FIM admission and discharge scores.

Support for Hypotheses

A common goal that patients share is the ability to ambulate and be discharged home (D. Thomas & J. Ross, personal communication, July 6, 1994). According to a physical therapist, who is a CVA specialist and supervisor for the CVA team at Mary Free-Bed Hospital, the majority of CVA patient's primary goal is to ambulate (J. Ross, personal communication, July 6, 1994). Therefore, physical therapists often focus their rehabilitation efforts on independent functional ambulation (Wall & Ashburn, 1979; Olney, Colborne, & Martin, 1989). This strong emphasis on walking may be one of the reasons why there is a high percentage of CVA patients who regain the capacity to functionally ambulate. A range of fifty to eighty percent of stroke survivors will eventually walk independently after six months or more post-CVA (Wade, Wood, Heller, Maggs, & Hewer, 1987). The Framingham study, which assessed 148 stroke survivors, also found a high percentage of CVA patients who achieved functional gait recovery (Gresham, Phillips, Wolf, Kannel, & Dawber, 1979). Specifically, these investigators found that 78% of stroke survivors were independent in walking six months or more after their cerebral vascular accident. In addition, they found that 85% of these ambulatory individuals were living at home versus living in another facility such as a nursing home. This large percentage of CVA survivors who regained independent walking may contribute to this high percentage of CVA patients who were able to return to a home setting. Therefore, gait scores during the patient's rehabilitation should be collected to determine this prediction.

This ability to walk independently, allows the CVA survivor to return to home without being limited by the environmental barriers that a wheelchair bound individual may encounter. Physical therapists interviewed at Mary Free Bed stated that CVA patients, who use a wheelchair as their primary mode of mobility, have many difficulties participating in activities of daily living if discharged to an environment that contains architectural barriers (D. Thomas & J. Ross, personal communication, July 6, 1994). According to DeJong and Branch (1982) the CVA patient's residential status was highly affected by the degree to which the discharge environment was barrier-free. They found that a barrier-free living arrangement facilitated a more independent functional environment and that home barriers was negatively correlated to patient discharge site. Their study reviewed the discharge sites of 84 CVA patients and found that these CVA survivors chose to live in a more barrier-free living environment. Specifically, the authors stated, "stroke patients sometimes make a trade-off between a more barrier-free setting compared to a more independent living arrangement". In addition, they also stated that the higher the number of environmental barriers present in the home, the less chance of patients being discharged to this setting (DeJong & Branch, 1982).

Environmental barriers are often found in public buildings as in the home. The design and construction of homes naturally tend to accommodate walking individuals. The CVA patient returning home with independent ambulatory status, therefore, may not encounter as many environmental barriers and be more successful at maneuvering within the home compared to wheelchair bound individuals. These home barriers may include inaccessible bathrooms, narrow hallways and corners and insufficient floor space for maneuvering a wheelchair in rooms (McClain & Todd, 1990; McClain, Beringer, Kuhnert, Priest, Wilkes, Wilkinson, & Wyrick, 1993; Wilson, 1992).

Specific problems with construction dimensions are the standard door widths of the bedrooms, bathrooms, and closets; these areas are 2'6", 2'4, and 2', respectively. Bedrooms, closets, and bathrooms have industry standard sink dimensions of 30" in height and 21" of depth. The kitchen also has standard counter heights of 36" and cupboard heights that start at 50" and may reach the ceiling with a height of 83" (Feirer & Hutchings, 1986).

The required dimensions of wheelchair accessible buildings have been determined and outlined by the Michigan Department of Labor (1987). These measurements differ from the above conventions of the construction industry (Feirer & Hutchings, 1986). Wheelchair accessible doors must be a minimum of 32" wide for all rooms including the bathrooms, bedrooms, and closets. In the bathroom and kitchen there must be a minimum of a 5' diameter circle or 5' by 5' area of clear floor space to allow for wheelchair maneuvering. The sink dimensions required in these areas are for a minimum depth of 18" inches and a height minimum of 29" and maximum of 34". The height of the accessible kitchen counter tops and overhead cupboards shall be 34" and 48" maximum, respectively. As one can see from these measurements, conventional bathrooms and kitchens in the home are not designed to accommodate a wheelchair and therefore limit or pose a problem for discharging a wheelchair bound individual to the home.

Given the large disparity between construction industry standards and wheelchair accessible specifications, it would be very costly to change the home so that it is wheelchair accessible. Specifically, a Medicare representative for Michigan, stated that home accommodations for wheelchair bound individuals are not covered by Medicare insurance. Therefore, homes in which barriers cannot be modified or removed, will not impose a problem to a CVA patient who has been discharged with an independent walking status.

Since gait appears to have a high correlation to patient discharge site, it is possible that other specific variables including gait may demonstrate a higher predictability as compared to the total FIM admission and discharge FIM scores. Numerous studies have demonstrated that specific variables could be used in predicting the CVA patient's functional outcome and ultimately patient discharge site. The more common predictor variables that have been identified include patient's age, (Oczhowski & Barreca, 1993; Anderson, Bourestom, Greenberg, & Hildyard, 1974), level of bladder and bowel control (Oczhowski & Barreca, 1993; Wade et al, 1985; Lincoln, Jackson, Edmans, & Walker, 1990), family and social support (Andrews, Brockelhurst, Richards, & Laycock, 1981; Glass, Matchar, Belyea, & Feussner, 1993; Lincoln, Jackson, Edmans, & Walker, 1990), depression (Kotila, Waltimo, Niemi, Laaksonen, & Lempinenn, 1984; Sinyor, Amato, Kalvupek, Becker, Goldenberg, & Coopersmith, 1986), and transfers (J. Ross & D. Thomas, personal communication, July 6, 1994; D. Dewey, personal communication, May 31, 1994). Oczhowski & Barreca (1993) found that not only was the total FIM admission score to be a good predictor but that specific variables such as the degree of postural control on admission as measured by the Chedoke-McMaster Stroke Assessment, the FIM's bladder and bowel incontinence score on admission, and the patient's age were highly correlated to patient discharge outcome and ultimately, discharge site. In addition, Wade et al (1985) also found urinary incontinence to be highly correlated with patient functional outcome. These researchers looked at 99 CVA survivor's and compared 5 functions: urinary incontinence, mobility, the ability to transfer from bed to chair, ability to dress and the ability to feed. By comparing these functions, the authors found that urinary incontinence was the most important factor for predicting functional recovery (Wade et al, 1985). Besides urinary incontinence physical therapist's at Mary Free Bed and Hackley Hospital stated that the ability to transfer may also determine discharge site of the CVA survivor (J. Ross & D. Thomas, personal communication, July 6, 1994; D. Dewey, personal communication, May 31, 1994).

Not only have specific variables been demonstrated to be significant predictors, there is a possibility that specific variables assessed under scales may be higher when demonstrating patient functional outcomes and in predicting discharge status (Granger, Hamilton, Gresham, & Kramer, 1989). These authors found that admission scores together from a subset of four specific Barthel Index items (BI), bowel and bladder control, eating, and grooming, demonstrated a high correlation in determining patient functional outcome at the time of patient discharge from rehabilitation. Furthermore, the admission scores together of this subset also demonstrated a higher correlation in predicting the stroke patient's discharge site of community living at six months post-CVA compared to total BI score. The authors looked at 539 CVA patients, and found that 97% of the patients were independent in these four items upon admission, and at six month follow up, 93% were living at home, either alone or with someone, 8% transferred to an acute hospital, and 17% to a long-term care facility. Furthermore, by being independent in the four items chosen, there was a fourteen-fold increase chance of living at home at six months post-CVA (Granger et al, 1989). In addition, the authors Cook, Smith, & Truman (1994) believe that individual FIM items are more critical than total FIM scores as outcome measures and predictors of discharge status. These authors state that it is very unlikely that all 18 FIM items have equal weighting to total functional independence (Cook, Smith, & Truman, 1994). In addition, since the FIM is a 7-point ordinal scale, it would be improper to summate the scores of activities that produce the total score. Rather than overall scores, significance may be produced by summing interval or ratio scores (Merbitz, Morris, & Grip, 1989). Therefore, it may be more important to look at subsets containing FIM items than the overall FIM score.

Significance of Study

Since gait appears to have a high correlation with the CVA survivor's discharge site, this variable could be used as predictive tool. By analyzing specific admission FIM items grouped under subsets and gait, those subsets that show a high prediction to discharge site may be used as a shortened screening tool. This screen would be used after total admission FIM scores were obtained which may then aid the therapist with patient discharge preparation. Specifically, the results from the screen may identify what type of discharge location would be appropriate for the CVA patient and to identify accommodations needed at the discharge site. Once the possible location is identified, the therapist can then place the patient on that particular site's waiting list which may be necessary (Heinemann et al, 1994; Oczhowkski & Barrecca, 1993). Some of these possible locations could include patient home, foster care or skilled nursing facility. Foster homes are residences where several non-related elderly people create a community under the care of the home owner (Abramovice, 1988). Skilled nursing homes are defined by the National Center for Health Statistics (1977) as a facility offering living accommodations, and 24 hour health and personal care to the elderly and disabled.

FIM as a Discrimitive and Predictive Tool

Since this initial screen will contain specific predictive variables of patient discharge site, it must also be discriminative between different categories of patient hemiparesis. The FIM reportedly discriminates between patients with different types of strokes (right, left, or bilateral). If an individual has a motor impairment on one side with no evidence of cognitive impairment of the other cerebral hemisphere, patients had better rehabilitation outcomes than patients with both motor and cognitive impairments (Novack, Haban, Graham, & Satterfield, 1987). Patients with advancing age and bilateral motor involvement had decreased function on admission and discharge; decrease rates of discharge into the community; and longer lengths of stay than patients who are both younger in age and with unilateral involvement. For left hemiparetics, their total functional scores were slightly higher at admission and discharge than for right hemiparetics, partly because communication and social cognition scores were lower. Patients with either right or left cerebral involvement had similar outcomes for length of stay and discharge into the community. However, right hemiparetics had shorter total days from acute onset to rehabilitation discharge than a left or bilateral hemiparetic (Granger, Hamilton, & Fiedler, 1992).

The FIM may be predictive of the economic costs incurred by a patient after rehabilitation. Costs may include home health care, assistive devices, and/or home accommodations that may be required. Lastly, the FIM is reportedly a sensitive evaluative tool as therapists are able to detect changes in level of disability during rehabilitation, and evaluate program efficacy (Hamilton & Granger, 1994).

General Scoring and Gait Scoring

Specifically, the FIM items are scored on a seven point ordinal scale which measures the severity of disability (appendix A). This scale consists of gradations, according to the amount of assistance required. This scale is subdivided by whether a patient can carry out an activity independently or whether a helper is required; and how much assistance the helper provides (Uniform Data System, 1993). The scale score is summated from patient performance on eighteen items. The highest score that an individual can obtain is 126 points, 7 points per item, and the lowest total score would be 18, 1 point in each category (Granger & Hamilton, 1994). Locomotion is one item under the FIM which looks at one of two types of mobility, wheelchair propulsion and ambulation. This item also follows the same scoring guidelines as general scoring (appendix B).

Procedures under FIM

The FIM is a measurement of functional tasks that can be administered to patients with a variety of diagnoses (Hall, Hamilton, Gordon, & Zasler, 1993). In order for the patient to be categorized at a functional level, the patient must follow the correct format for that particular task. In addition, the FIM was designed so that a trained clinician can successfully assess and objectively measure performance based on FIM guidelines (appendix c) (Hamilton, Granger, Sherwin, Zeilezny, & Tashma, 1987).

Reliability and Validity of FIM

The FIM scale has been shown to be reliable and valid. Hamilton and associates found that during the trial phase of the development of FIM, intraclass correlation coefficients for reliability were 0.86 at admission and 0.88 at discharge for all patient populations (B. B. Hamilton, personal communication, May 31, 1994). Additionally, researchers have assessed the FIM's internal consistency, responsiveness over time, and construct validity. Internal consistency was found to be high as measured by Cronbach's alpha. Admission alpha was 0.93 and discharge alpha was 0.95, (standard 0.70). Therefore, all items were shown to be consistent at admission and at discharge, except for the locomotion scores which assessed two items, ambulation and stair walking (alpha 0.68). Therefore these two different FIM items may be measuring different functional abilities (Dodds, Martin, Stovlov, & Deyo, 1993). Responsiveness of FIM scale scores between admission and discharge showed improvements for all functional limitations ($p<.0005$). However, results may be effected by spontaneous recovery or biases by the clinician to demonstrate much improvement in rehabilitation by inflating discharge scores (Dodds, Martin, Stovlov, & Deyo, 1993). Researchers reported that the FIM has good interrater agreement as assessed by using intraclass correlation coefficients. Two or more pairs of clinicians measured each of the 263 patients undergoing inpatient rehabilitation. The correlation coefficients of the total FIM was 0.79, mobility transfers, 0.79, and locomotion 0.93 (Hamilton, Laughlin, Granger, & Kayton, 1991). Hamilton and associates also evaluated interrater reliability between two or more pairs of clinicians' FIM scores of patients undergoing inpatient rehabilitation (in press). The researchers studied 89 facilities and found that alpha intraclass correlation coefficients was 0.96. Of the 89 facilities that met the Uniform National Data System requirements, alpha was found to be 0.99. Increases in interrater reliability can be pointed towards the use of training videotapes, workshops, and a written clinical narrative "credentialing" test (B. B. Hamilton, personal communication, May 31, 1994).

Not only does the FIM demonstrate interrater reliability, it also is valid for distinguishing comorbidty. Many elderly individuals, including CVA survivors, may have other diseases present. Cerebral vascular accidents have profound effects on the individual's walking performance but this effect is magnified when a chronic disease and or normal age related changes are present (Burke & Walsh, 1993; Kart, Metress, & Metress, 1988). Chronic disease may cause pain-which can lead to chronic pain, limited range of motion and bony deformities which occur at the weight bearing joints such as the knee, hip and or spine (Burke & Walsh, 1993; Kart, Metress, & Metress, 1988). These musculoskeletal conditions may affect the CVA survivors ability to walk but the FIM has been shown to be capable of discriminating patients on basis of age and comorbid conditions. Specifically, the authors stated patients had lower FIM scale scores than those without comorbid conditions (Dodds, Martin, Stovlov, & Deyo, 1993).

Factors not Assessed by FIM which effect Gait

Even though the FIM has been proven to be reliable and valid, there are factors that may effect the CVA survivors ambulation that the FIM does not assess. Emotional factors can have a profound impact on a patients adaptation following a stroke. A number of studies have been performed on the effect of depression on rehabilitation process. Eisenberg & Grzesiak (1987) have determined that depression can influence the success of a patient's rehabilitation. Functional recovery and outcomes can be effected when depression is present several weeks to two years after stroke (Kotila, Waltimo, Niemi, Laaksonem, & Lempinenn, 1984; Sinyor, Amato, Kalvupek, Becker, Goldenberg, & Coopersmith, 1986). A lack of data exists for depression's effects on discharge placement of the stroke patient.

In addition to emotional factors, family support is also not measured by FIM. Since the FIM does not assess family support, the correlation between discharge sites and FIM scores can be affected. Brocklehurst et al (1981), stated that 97% of stroke survivors were able to return to their previous setting after discharge with the assistance of a care giver. Tamler & Perrin, (1992) stated that patients are an inseparable part of the family and therefore most families take care of the patient after hospitalization. Baker (1993) found that adaptation occurred to a higher degree when the patient was discharged home and was accompanied by his or her spouse versus being discharged home alone. The larger the social network that a patient was found to have the less limitations in physical function and chance of institutionalization was noted by Colantonio, Kasl, Osterfeld, & Berkman, (1993). Glass et al (1993), found a faster recovery rate in functional status in individuals who had adequate family and social support. The patient's social support following discharge from the hospital was found not to significantly affect patient's performance of activities of daily living (Norris, Stephens, & Kinney, 1990). Since some studies have demonstrated that social support can effect the discharge site, we collected this information for nonmathematical analysis.

Conclusion

The total FIM admission and total FIM discharge scores are useful when predicting discharge site, assessing recovery rate between admission and discharge, and determining efficacy of treatment. Numerous studies however, have shown that specific variables can predict discharge site. Two variables that were shown to be predictable, that are measured by the FIM, are bowel and bladder control. Therefore, other individual variables used as subsets , measured by the FIM, may be relevant when predicting discharge site. Specifically, gait may be an important variable because of accessibility issues (Department of Labor, 1987; Feirer & Hutchings, 1986), high rate of recovery and the high percentage of CVA survivors returning home (Wall & Ashburn, 1979; Olney, Colborne, & Martin, 1989; J. Ross, personal communication, July 6, 1994). By identifying specific subsets under the FIM that can predict discharge site, the physical therapist can design an initial screen which can be utilized after admission. This will allow discharge preparation such as the clinician placing the patient's name on a waiting list for entrance into a facility, and any modifications to the environment.

CHAPTER 3

METHODOLOGY

Study Design

We conducted a retrospective study of 1,596 medical records of right cerebral vascular accident patients discharged from a midwestern rehabilitation hospital. From this hospital, we reviewed records from January 19, 1992 through September 12 of 1994. Those records meeting the following inclusion and exclusion criteria were analyzed:

Inclusion criteria

1. Patients who had a right cerebral vascular accident with possible concurrent left hemiparesis to possibly preclude those patients who might possess problem solving or language difficulties.
2. Those patients admitted to Mary Free Bed immediately following their acute care hospitalization.
3. Those patients of either sex who were at least sixty five years of age.
4. Patients who had been discharged to their home, foster home, or skilled nursing facility.
5. Patients assessed by the FIM and scores recorded for total admission, discharge, and individual score items both upon admission and discharge.

Exclusion criteria

1. Patients who were nonambulatory prior and post to their CVA.
2. Patients who had a previous CVA if this diagnosis was listed under other diagnoses in the Mary Free Bed data system.

Records were stored and were accessed from a computerized database at the hospital. The following data was collected from these medical records: 1) total functional independence measure (FIM) admission and discharge scores, 2) 18 individual FIM category scores upon admission and discharge, 3) patient discharge site of home, foster care or skilled nursing facility, and 4) whether the patient was discharged home alone, or with family/relatives, friends, attendant or other.

Study Site

The study site was an 80 bed in-patient rehabilitation hospital, Mary Free Bed (MFB) Hospital, located in Grand Rapids, Michigan. This facility utilizes the FIM scale for assessing the CVA patient's functional level upon admission, during rehabilitation, and at discharge.

Procedure

Approval was sought from the Human Subject Review Boards of Grand Valley State University and Mary Free Bed Hospital. Records meeting our criteria between January 19, 1992 through September 12, 1994 were analyzed. Additionally, confidentiality has been preserved by the fact that the MFB database does not contain patient names or addresses.

Data Analysis

Data from 91 medical records were statistically analyzed using the SAS computer program. The statistical methods performed consisted of nonparametric canonical discriminant analysis of predetermined subsets consisting of individual FIM admission and admission and discharge scale items together and separately. Furthermore, total admission and total discharge scores together and separately, as well as all weighted 18 admission and discharge items together and separately were analyzed using nonparametric canonical discriminant analysis. An Epinechnikov kernel with a radius roughly optimized for a pooled normal distribution was used for the analysis.

In the above statistical analysis, subsets containing FIM items were predetermined based upon FIM categories and literature support. The subsets chosen were similar to FIM categories (Appendix D). The FIM categories included the following: self-care, sphincter control, mobility, locomotion, communication, and social cognition. Besides these categories, we designed subsets which included transfers with and without problem-solving, cognitive with social cognition, and mobility with cognitive items. Lastly, we analyzed ambulation on level surfaces.

Throughout the literature review, specific items assessed under the FIM have been proven to demonstrate a high correlation in predicting the stroke patient's discharge site These items include bowel and bladder control (Oczhowski & Barreca, 1993; Wade, et al. 1985). Furthermore, transfers may have a high correlation in predicting the stroke patient's discharge site according to physical therapists' opinion (J. Ross & D. Thomas, personal communication, July 6, 1994; D. Dewey, personal communication, May 31, 1994). In addition, gait may also demonstrate a high predictability in determining patient discharge site due to patient's goals (Wall & Ashburn, 1979; Olney, Colborne & Martin, 1989) and accessibility issues in the home (Feirer & Hutchings, 1986; McClain & Todd, 1990; McClain, et al. 1993; Wilson, 1992). Therefore, these items were analyzed separately. Lastly, cognitive and mobility items were analyzed both together and separately since mobility is dependent upon cognitive ability.

Individual FIM items were not analyzed primarily due to the numerous FIM item combinations that were possible. Analyzing these combinations would not only require more time then was given to complete this study, but that the statistical interpretation of these models would be extremely difficult. Specifically, interpreting these possible combinations of items may lead to false conclusions, inaccurate p-values, and many models with similar predictive ability (T. Lesnick, personal communication, January 30th, 1995).

CHAPTER 4
RESULTS/DATA ANALYSIS

Purpose

The purpose of this study was to analyze individual admission and discharge FIM scale items under subsets and total FIM scores to determine which item(s) demonstrated a high predictability in determining the stroke survivor's discharge site. With this analysis two hypotheses were tested. The first hypothesis was that gait may have a high predictive value for determining the discharge site for stroke survivors. The second hypothesis was that subsets of FIM items may be more predictive compared to the total of admission and discharge scores in determining the stroke patient's discharge site.

FIM Items Analyzed

From the records of Mary Free Bed Hospital, 91 records were found to meet our inclusion and exclusion criteria. Of the 91 records, 75 were discharged to home, 7 to a foster home and 9 to a skilled nursing facility. The FIM scores for these patients were assessed for their ability to predict the discharge site of the patient. Items assessed for their predictability were FIM total admission and discharge scores, eight subset scores (appendix D) and all 18 weighted admission and discharge scores.

Results

For results to be significant, we felt subsets had to correctly predict greater than 90% in all three discharge sites. Furthermore, any correct predictions below 90% for all three discharge sites, was grouped together as being non-significant.

At admission, all 18 weighted FIM items demonstrated a prediction of 90% or greater (92.00%; Table and Figure 5). No other admission subsets demonstrated a predictability of 90% or greater. Other subsets below 90% included: self-care (76.00%;

Subset 1, Table and Figure 8), mobility plus cognitive (66.67%; subset 5, Table and Figure 16), cognitive (52.00%; subset 4, Table and Figure 14), total FIM admission (12.00%; Table and Figure 2), bowel and bladder (24.00%; subset 2, Table and Figure 10), mobility (41.33%; subset 3, Table and Figure 12), locomotion (24.00%; subset 6, Table and Figure 18), transfer (22.67%; subset 7, Table and figure 20), and transfer plus problem-solving (26.67%; subset 8, Table and Figure 22).

For discharge, all 18 weighted discharge items was found to be 76.00% (Table and Figure 6). The only other item analyzed at discharge was total FIM scores, which was found to be 17.33% (Table and Figure 3).

The last set to be analyzed was admission plus discharge scores. Several subsets were found to be greater than 90%. These subsets included: all 18 weighted FIM items (100%; Table and Figure 4), self-care (90.87%; subset 1, Table and Figure 7), and mobility plus cognitive (92.00%; subset 5, Table and Figure 15). Other subsets below 90% include: mobility (73.33%; subset 3, Table and Figure 11), cognitive (72.00%; subset 4, Table and Figure 13), transfer plus problem-solving (53.33%; subset 8, Table and Figure 21), total FIM scores (24.00%; Table and Figure 1), bowel and bladder (29.33%; subset 2, Table and Figure 9), locomotion (32.00%; subset 6, Table and Figure 17), and transfer (49.33%; subset 7, Table and Figure 19).

Table 1

The Utilization of Total FIM Admission and Discharge Scores in Predicting Patient Discharge Site

Discharge site	Actual number of patients discharged to each setting	Correctly predicted number of patients discharged to each setting	Percentage of patients that were correctly predicted to be discharged to each setting
Home	75	18	24.00
Foster home	7	7	100.00
Skilled nursing facility	9	7	77.78

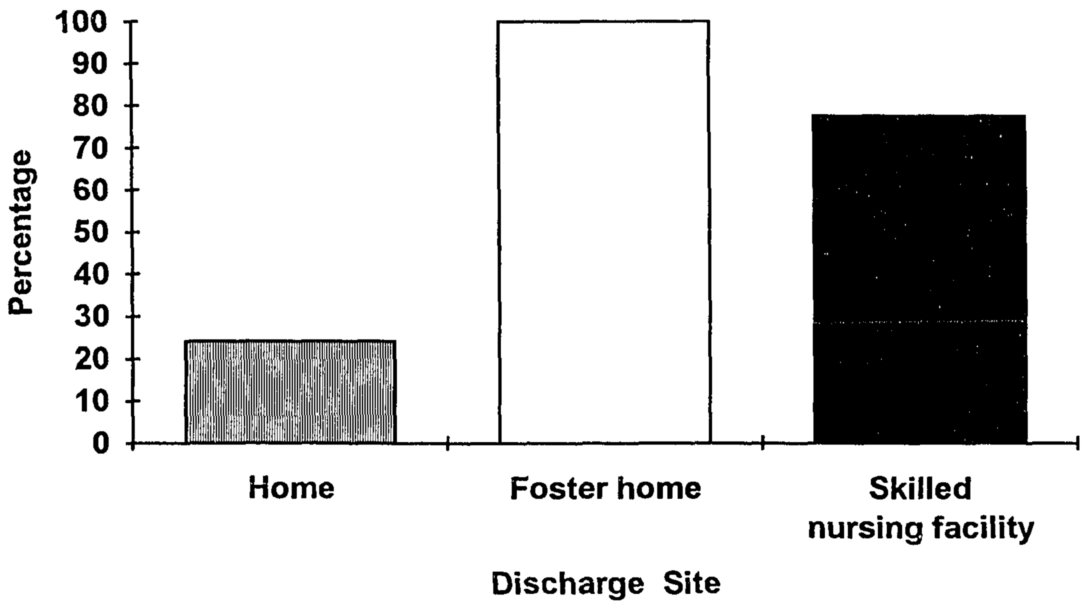


Figure 1. Percent of patients correctly predicted to be discharged at each setting by total FIM admission and discharge scores.

Table 2

The Utilization of Total FIM Admission Scores in Predicting Patient Discharge Site

Discharge site	Actual number of patients discharged to each setting	Correctly predicted number of patients discharged to each setting	Percentage of patients that were correctly predicted to be discharged to each setting
Home	75	9	12.00
Foster Home	7	5	71.43
Skilled nursing facility	9	8	88.89

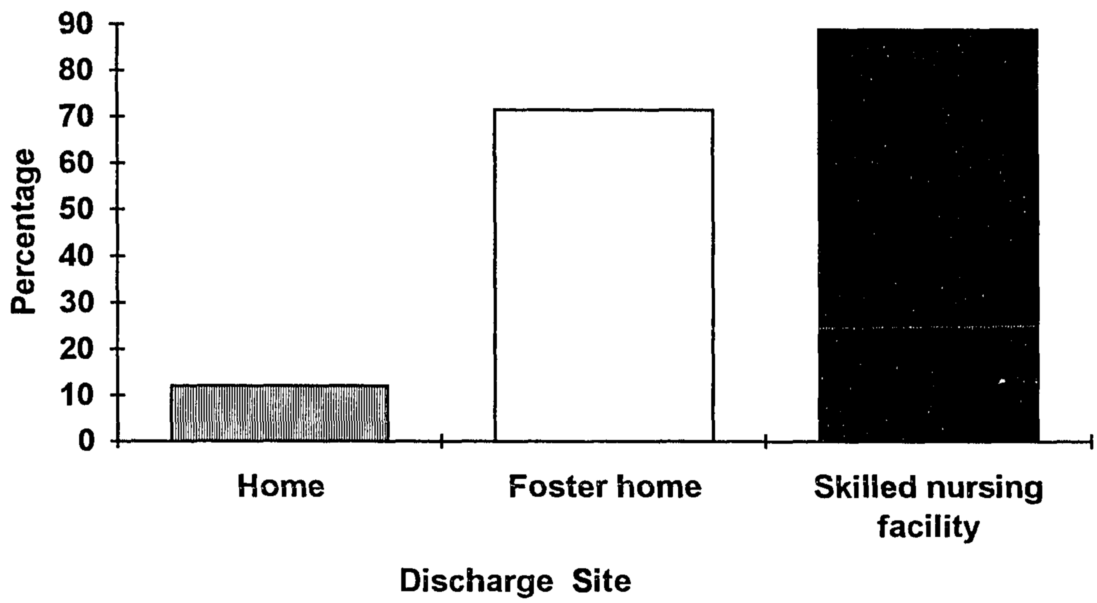


Figure 2. Percent of patients correctly predicted to be discharged at each setting by total FIM admission scores.

Table 3

The Utilization of Total FIM Discharge Scores in Predicting Patient Discharge Site

Discharge site	Actual number of patients discharged to each setting	Correctly predicted number of patients discharged to each setting	Percentage of patients that were correctly predicted to be discharged to each setting
Home	75	13	17.33
Foster home	7	6	85.71
Skilled nursing facility	9	7	77.78

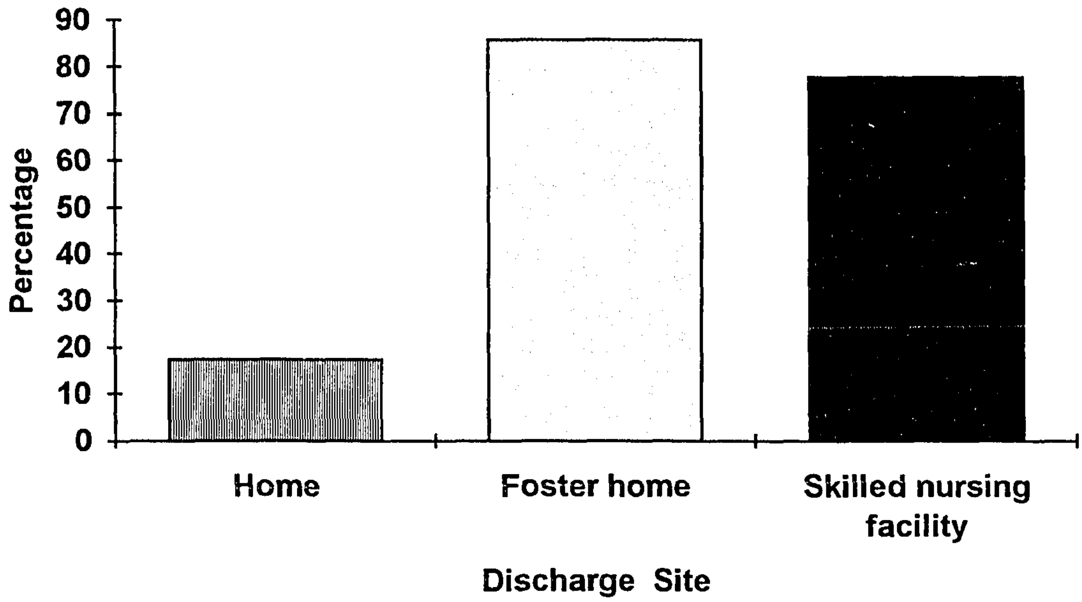


Figure 3. Percent of patients correctly predicted to be discharged at each setting with use of total FIM discharge scores.

Table 4

The Utilization of All 18 Weighted FIM Admission and Discharge Scores in Predicting Patient Discharge Site

Discharge site	Actual number of patients discharged to each setting	Correctly predicted number of patients discharged to each setting	Percentage of patients that were correctly predicted to be discharged to each setting
Home	75	75	100.00
Foster home	7	7	100.00
Skilled nursing facility	9	9	100.00

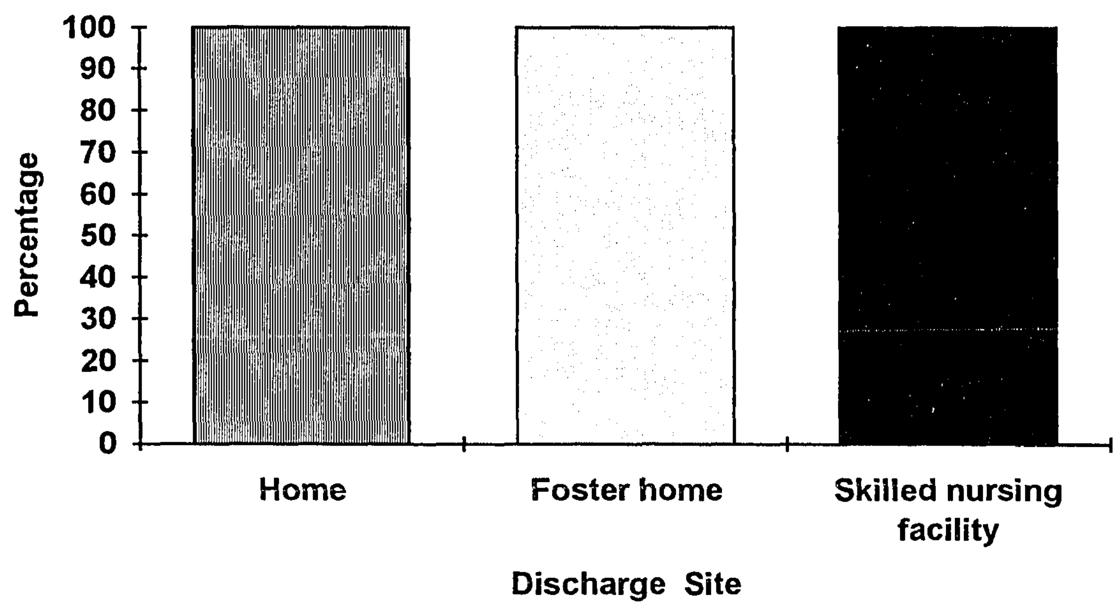


Figure 4. **Percent of patients correctly predicted to be discharged at each setting with use of all 18 weighted FIM admission and discharge scores.**

Table 5

The Utilization of All 18 Weighted FIM Admission Scores in Predicting Patient Discharge Site

Discharge site	Actual number of patients discharged to each setting	Correctly predicted number of patients discharged to each setting	Percentage of patients that were correctly predicted to be discharged to each setting
Home	75	69	92.00
Foster home	7	7	100.00
Skilled nursing facility	9	9	100.00

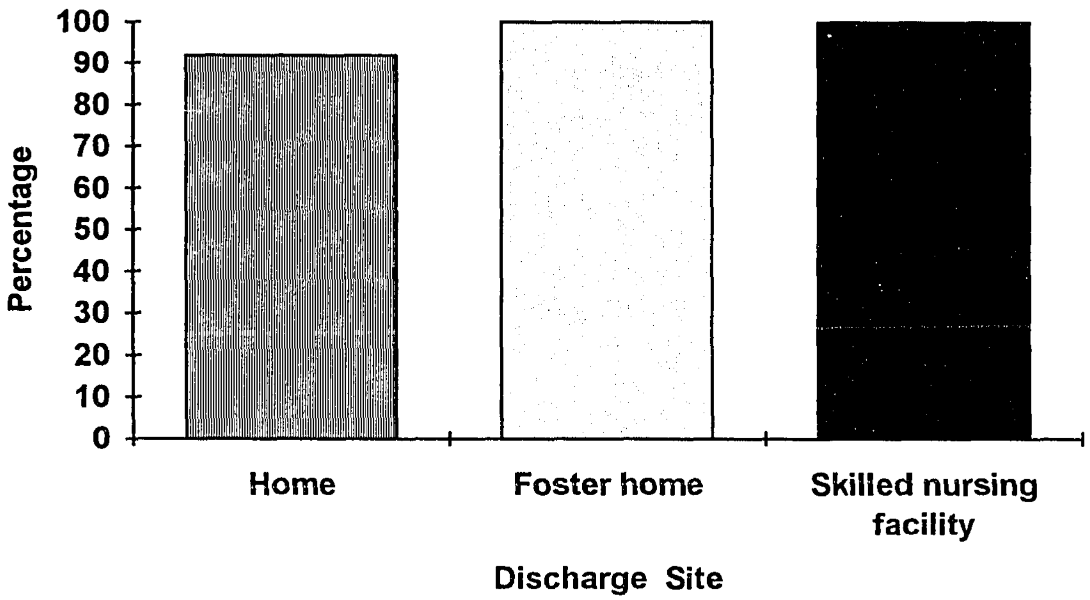


Figure 5. Percent of patients correctly predicted to be discharged at each setting with use of all 18 weighted FIM admission scores.

Table 6

The Utilization of All 18 Weighted FIM Discharge Scores in Predicting Patient Discharge Site

Discharge site	Actual number of patients discharged to each setting	Correctly predicted number of patients discharged to each setting	Percentage of patients that were correctly predicted to be discharged to each setting
Home	75	57	76.00
Foster home	7	7	100.00
Skilled nursing facility	9	9	100.00

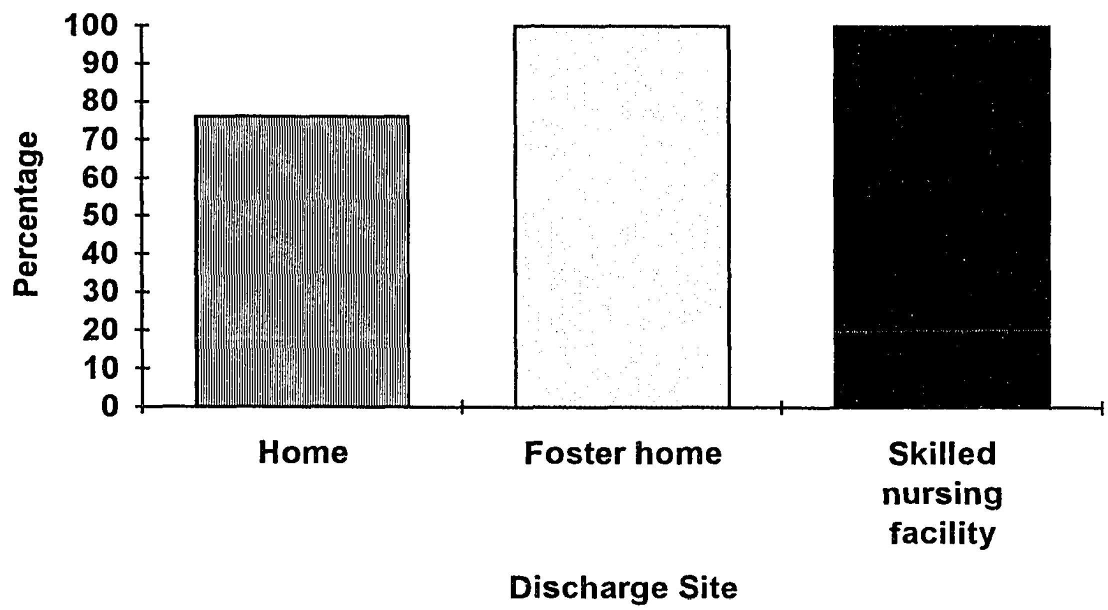


Figure 6. **Percent of patients correctly predicted to be discharged at each setting with use of all 18 weighted FIM discharge scores.**

Table 7

The Utilization of FIM Self-Care Admission and Discharge Scores in Predicting Patient Discharge Site

Discharge site	Actual number of patients discharged to each setting	Correctly predicted number of patients discharged to each setting	Percentage of patients that were correctly predicted to be discharged to each setting
Home	75	68	90.67
Foster home	7	7	100.00
Skilled nursing facility	9	9	100.00

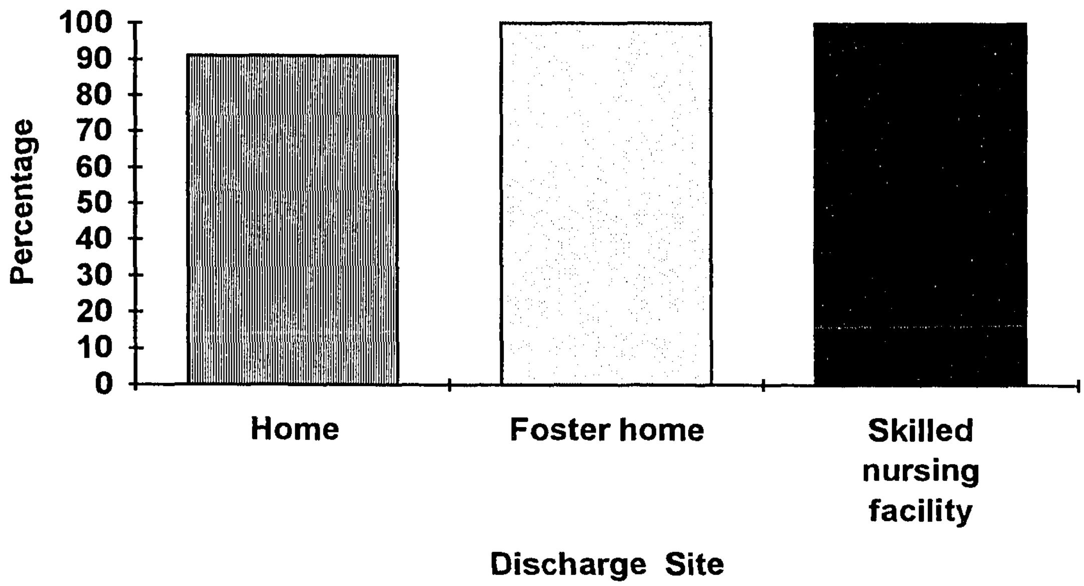


Figure 7. Percent of patients correctly predicted to be discharged at each setting by self-care admission and discharge scores.

Table 8

The Utilization of FIM Self-Care Admission Scores in Predicting Patient Discharge Site

Discharge site	Actual number of patients discharged to each setting	Correctly predicted number of patients discharged to each setting	Percentage of patients that were correctly predicted to be discharged to each setting
Home	75	57	76.00
Foster home	7	7	100.00
Skilled nursing facility	9	9	100.00

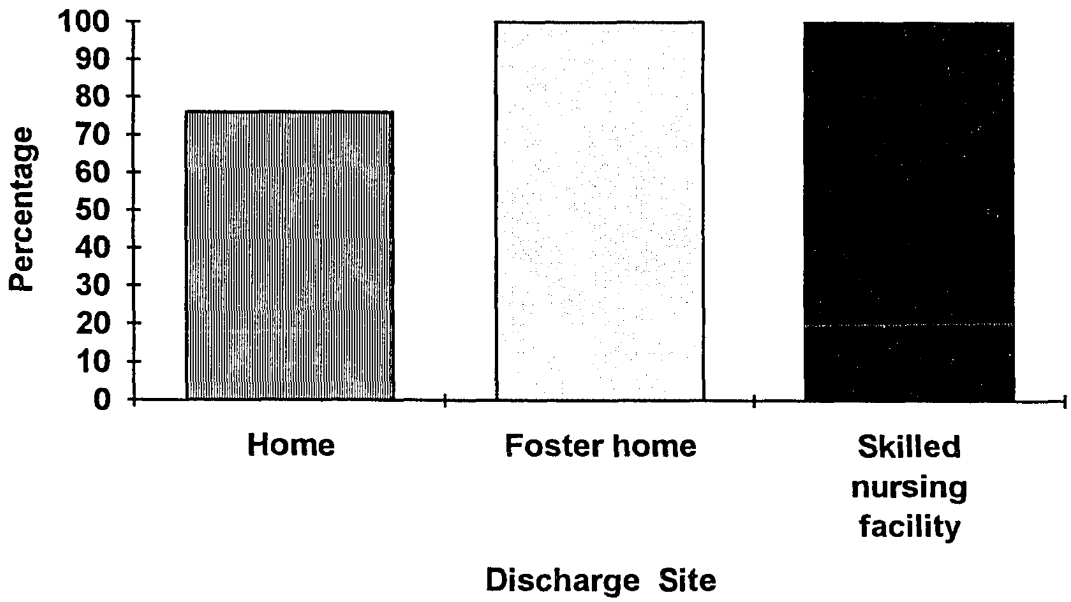


Figure 8. **Percent of patients correctly predicted to be discharged at each setting by self-care admission scores.**

Table 9

The Utilization of FIM Bowel and Bladder Admission and Discharge Scores in Predicting Patient Discharge Site

Discharge site	Actual number of patients discharged to each setting	Correctly predicted number of patients discharged to each setting	Percentage of patients that were correctly predicted to be discharged to each setting
Home	75	22	29.33
Foster home	7	7	100.00
Skilled nursing facility	9	4	44.44

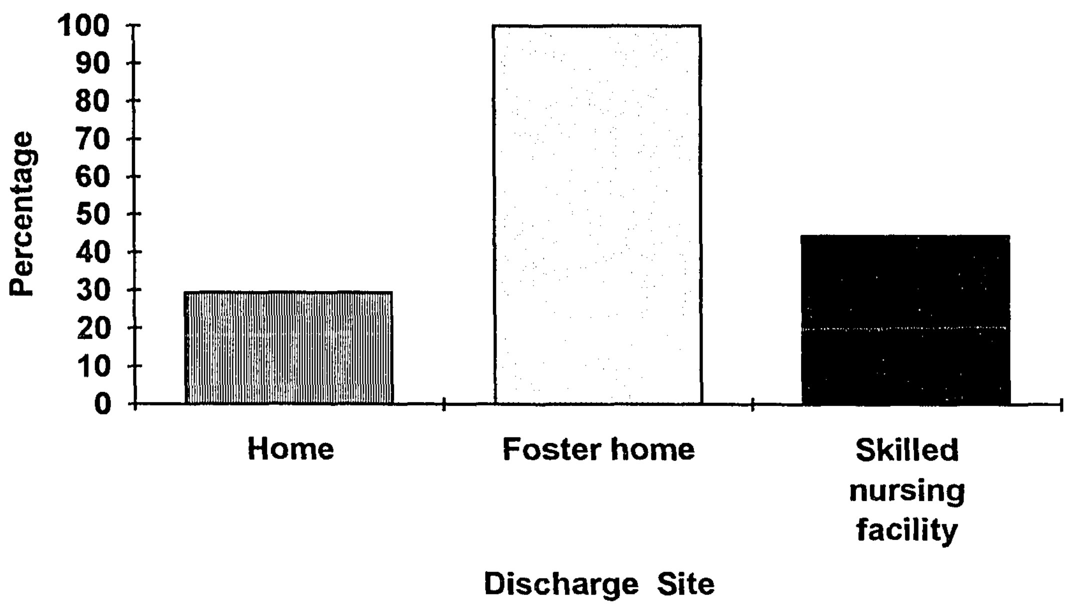


Figure 9. Percent of patients correctly predicted to be discharged at each setting by FIM bowel and bladder admission and discharge scores.

Table 10

The Utilization of FIM Bowel and Bladder Admission Scores in Predicting Patient Discharge Site

Discharge site	Actual number of patients discharged to each setting	Correctly predicted number of patients discharged to each setting	Percentage of patients that were correctly predicted to be discharged to each setting
Home	75	18	24.00
Foster home	7	7	100.00
Skilled nursing facility	9	4	44.44

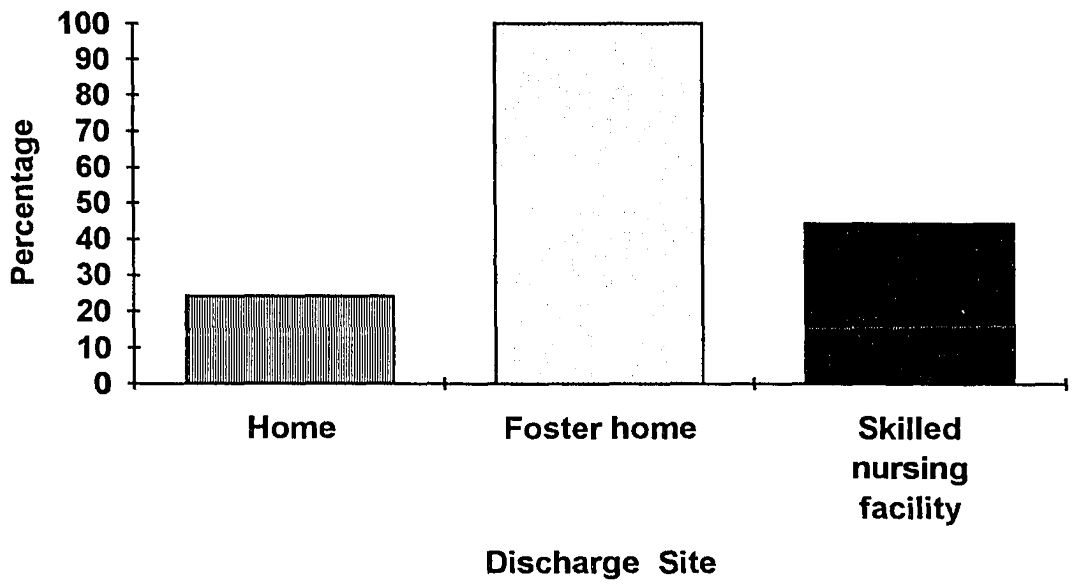


Figure 10. **Percent of patients correctly predicted to be discharged at each setting by FIM bowel and bladder admission scores.**

Table 11

The Utilization of FIM Mobility Admission and Discharge Scores in Predicting Patient Discharge Site

Discharge site	Actual number of patients discharged to each setting	Correctly predicted number of patients discharged to each setting	Percentage of patients that were correctly predicted to be discharged to each setting
Home	75	55	73.33
Foster home	7	7	100.00
Skilled nursing facility	9	9	100.00

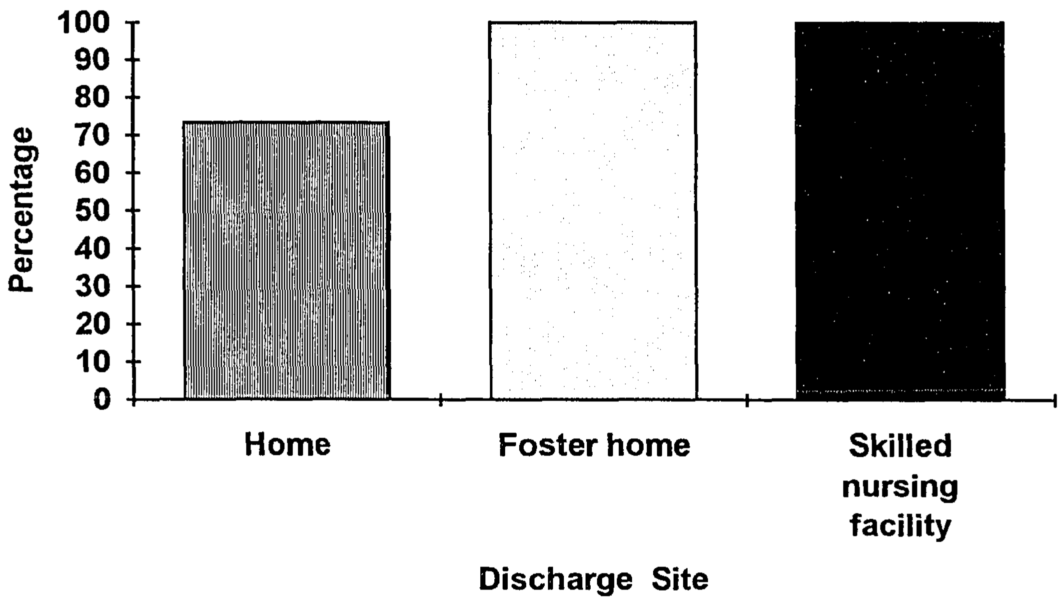


Figure 11. Percent of patients correctly predicted to be discharged at each setting by FIM mobility admission and discharge scores.

Table 12

The Utilization of FIM Mobility Admission Scores in Predicting Patient Discharge Site

Discharge site	Actual number of patients discharged to each setting	Correctly predicted number of patients discharged to each setting	Percentage of patients that were correctly predicted to be discharged to each setting
Home	75	31	41.33
Foster home	7	7	100.00
Skilled nursing facility	9	8	88.89

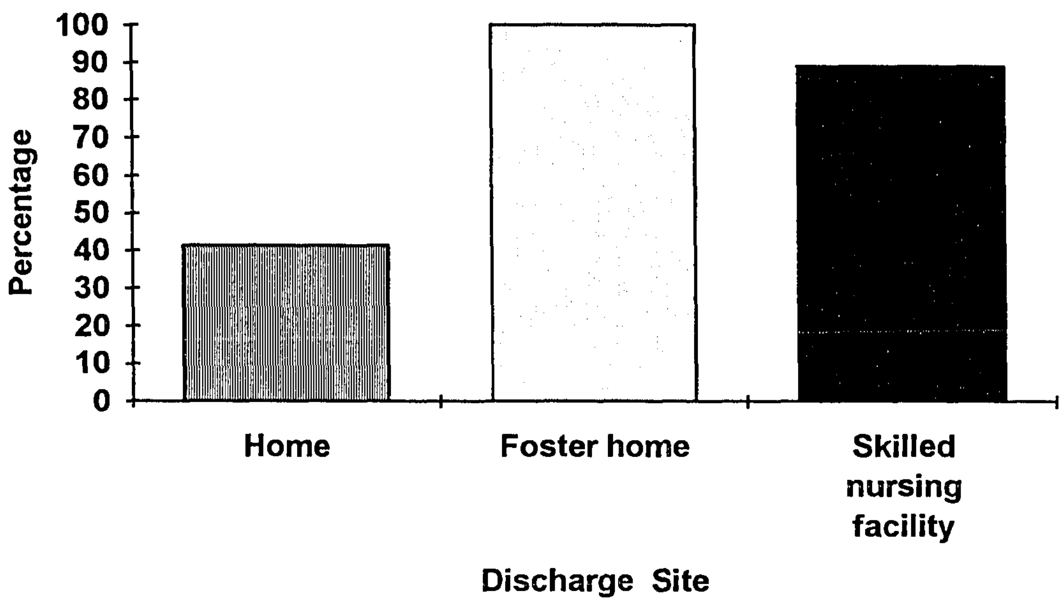


Figure 12. **Percent of patients correctly predicted to be discharged at each setting by FIM mobility admission scores.**

Table 13

The Utilization of FIM Cognitive Admission and Discharge Scores in Predicting Patient Discharge Site

Discharge site	Actual number of patients discharged to each setting	Correctly predicted number of patients discharged to each setting	Percentage of patients that were correctly predicted to be discharged to each setting
Home	75	54	72.00
Foster home	7	7	100.00
Skilled nursing facility	9	9	100.00

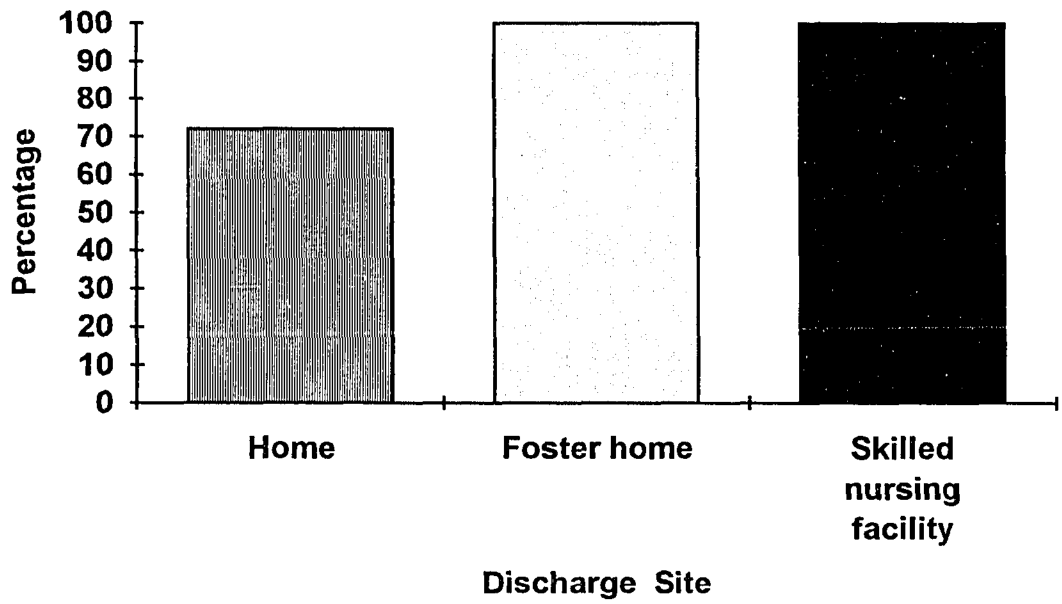


Figure 13. **Percent of patients correctly predicted to be discharged at each setting by FIM cognitive admission and discharge scores.**

Table 14

The Utilization of FIM Cognitive Admission Scores in Predicting Patient Discharge Site

Discharge site	Actual number of patients discharged to each setting	Correctly predicted number of patients discharged to each setting	Percentage of patients that were correctly predicted to be discharged to each setting
Home	75	39	52.00
Foster home	7	6	85.71
Skilled nursing facility	9	9	100.00

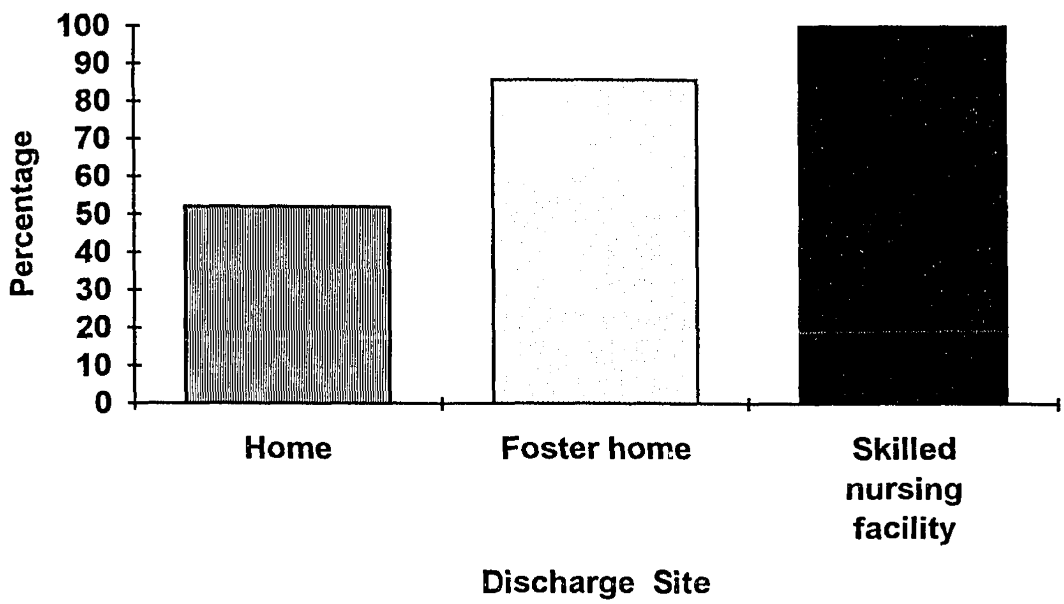


Figure 14. **Percent of patients correctly predicted to be discharged at each setting by FIM cognitive admission scores.**

Table 15

The Utilization of FIM Mobility and Cognitive Admission and Discharge Scores in Predicting Patient Discharge Site

Discharge site	Actual number of patients discharged to each setting	Correctly predicted number of patients discharged to each setting	Percentage of patients that were correctly predicted to be discharged to each setting
Home	75	69	92.00
Foster home	7	7	100.00
Skilled nursing facility	9	9	100.00

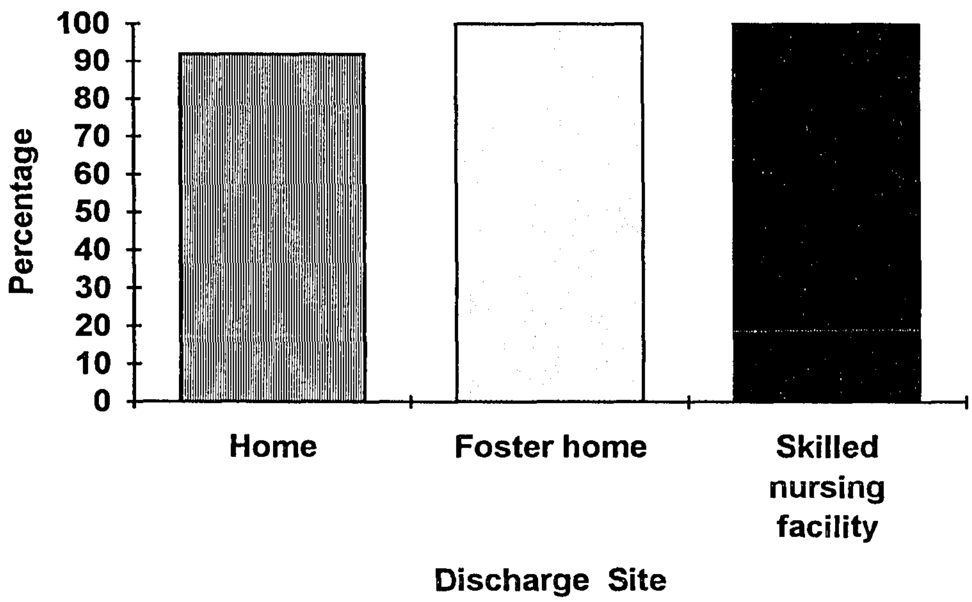


Figure 15. Percent of patients correctly predicted to be discharged at each setting by FIM mobility and cognitive admission and discharge scores.

Table 16

The Utilization of FIM Mobility and Cognitive Admission Scores in Predicting Patient Discharge Site

Discharge site	Actual number of patients discharged to each setting	Correctly predicted number of patients discharged to each setting	Percentage of patients that were correctly predicted to be discharged to each setting
Home	75	50	66.67
Foster home	7	7	100.00
Skilled nursing facility	9	8	88.89

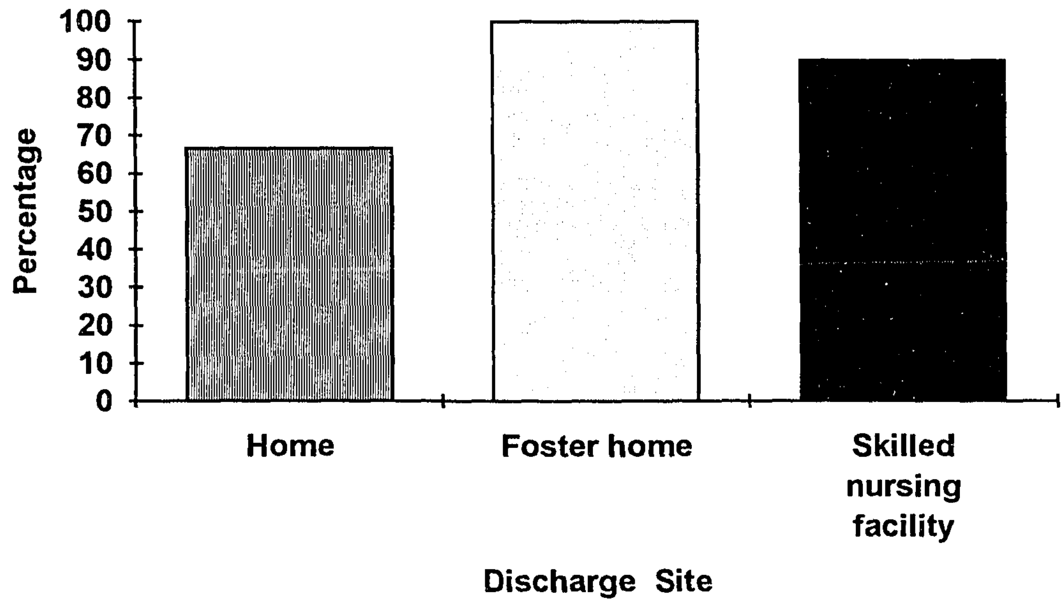


Figure 16. **Percent of patients correctly predicted to be discharged at each setting by FIM mobility and cognitive admission scores.**

Table 17

The Utilization of FIM Locomotion Admission and Discharge Scores in Predicting Patient Discharge Site

Discharge site	Actual number of patients discharged to each setting	Correctly predicted number of patients discharged to each setting	Percentage of patients that were correctly predicted to be discharged to each setting
Home	75	24	32.00
Foster home	7	5	71.43
Skilled nursing facility	9	9	100.00

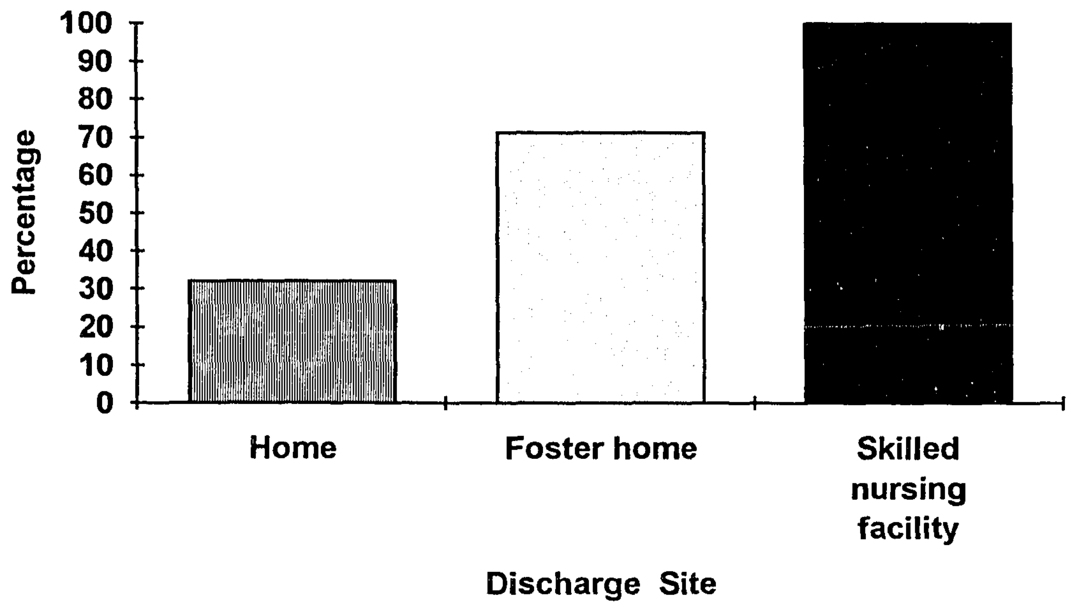


Figure 17. **Percent of patients correctly predicted to be discharged at each setting by FIM locomotion admission and discharge scores.**

Table 18

The Utilization of FIM Locomotion Admission Scores in Predicting Patient Discharge Site

Discharge site	Actual number of patients discharged to each setting	Correctly predicted number of patients discharged to each setting	Percentage of patients that were correctly predicted to be discharged to each setting
Home	75	18	24.00
Foster Home	7	2	28.57
Skilled Nursing Facility	9	8	88.89

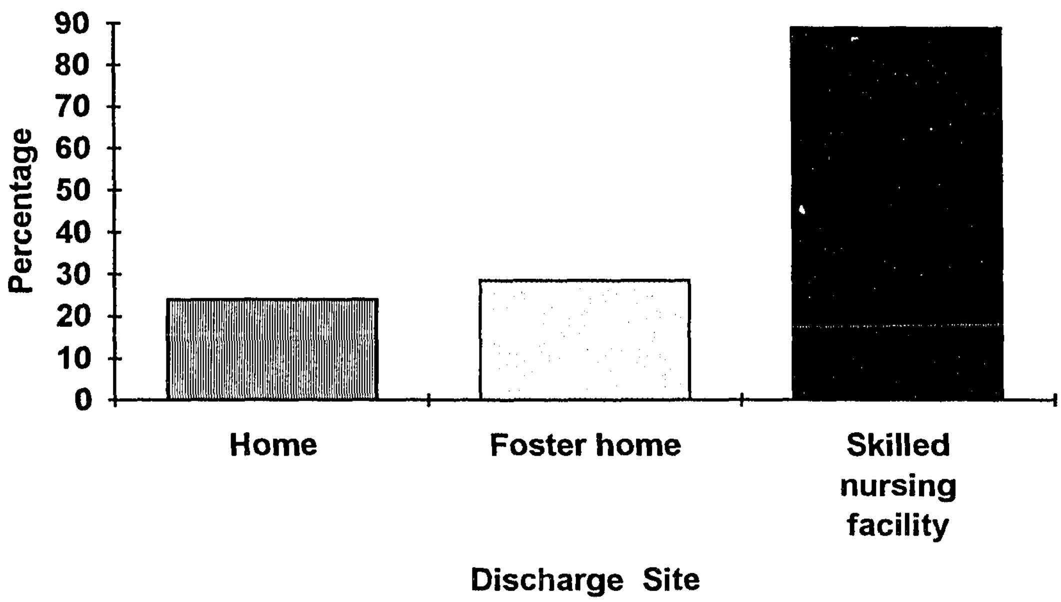


Figure 18. **Percent of patients correctly predicted to be discharged at each setting by FIM locomotion admission scores.**

Table 19

The Utilization of FIM Transfer Admission and Discharge Scores in Predicting Patient Discharge Site

Discharge site	Actual number of patients discharged to each setting	Correctly predicted number of patients discharged to each setting	Percentage of patients that were correctly predicted to be discharged to each setting
Home	75	37	49.33
Foster home	7	7	100.00
Skilled nursing facility	9	9	100.00

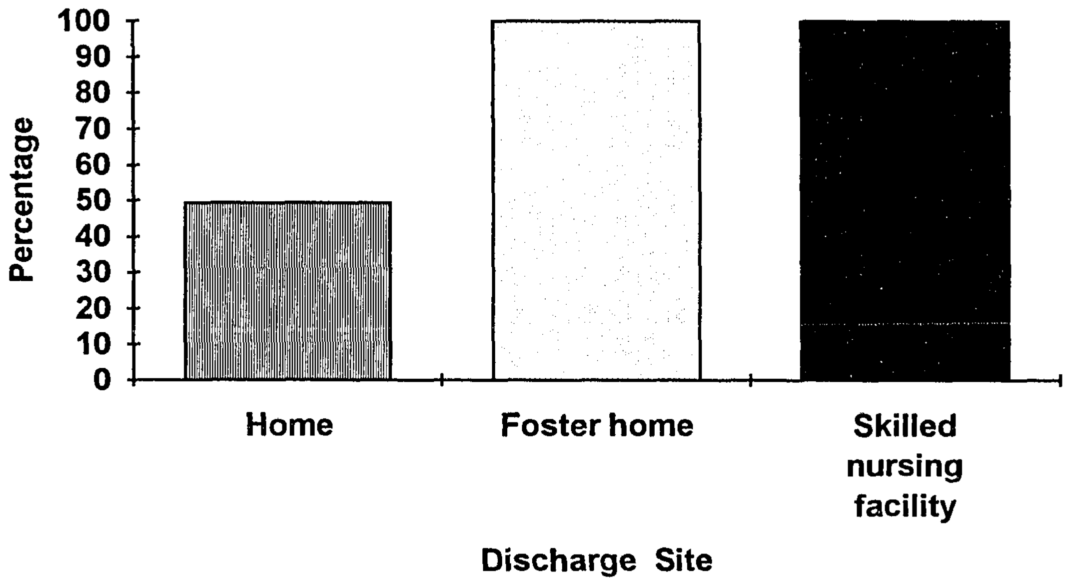


Figure 19. Percent of patients correctly predicted to be discharged at each setting by FIM transfer admission and discharge scores.

Table 20

The Utilization of FIM Transfer Admission Scores in Predicting Patient Discharge Site

Discharge site	Actual number of patients discharged to each setting	Correctly predicted number of patients discharged to each setting	Percentage of patients that were correctly predicted to be discharged to each setting
Home	75	17	22.67
Foster home	7	6	85.71
Skilled nursing facility	9	8	88.89

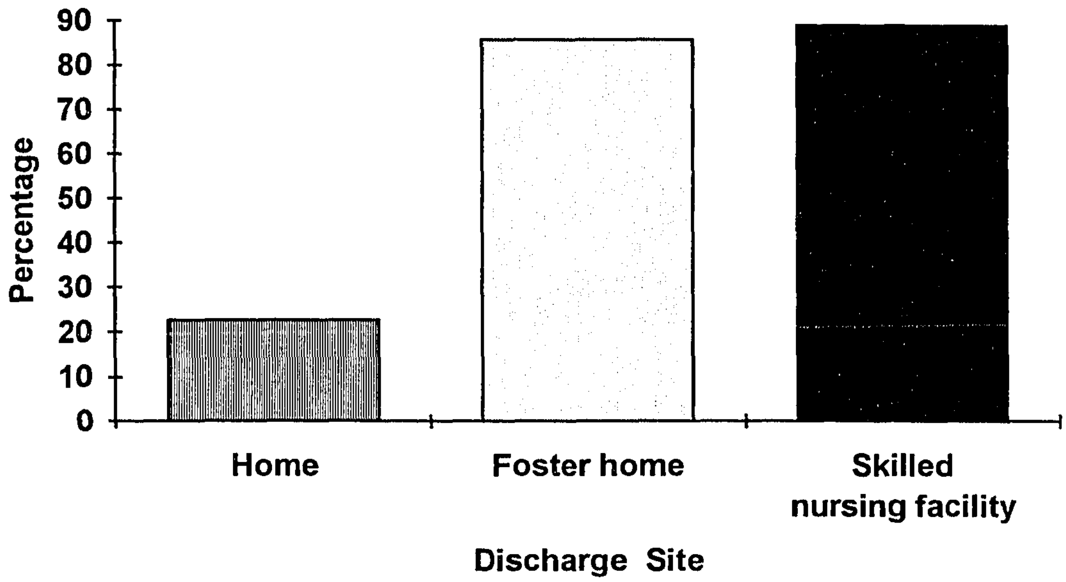
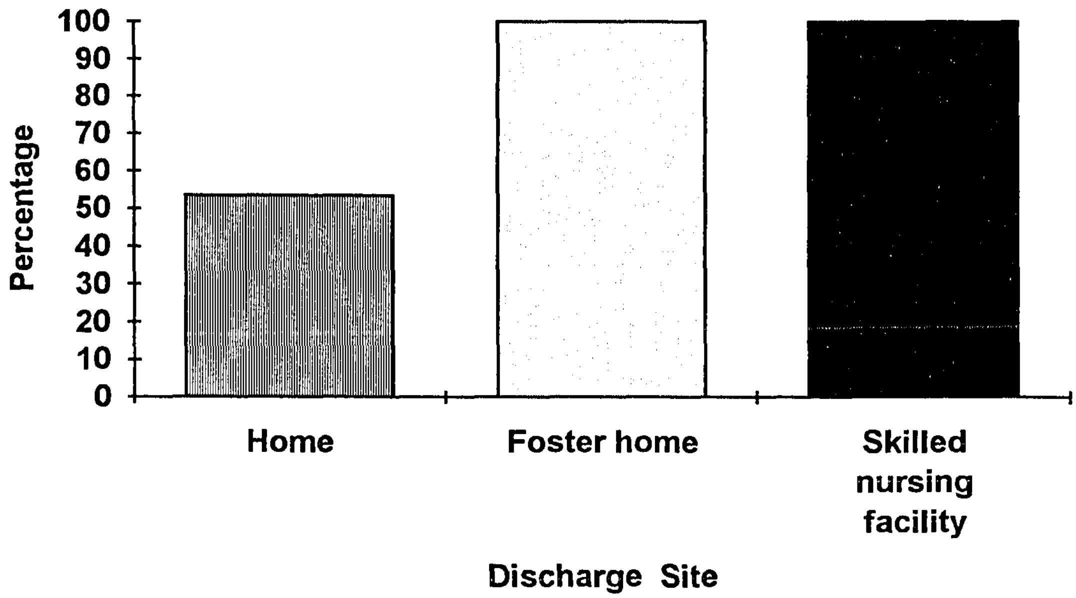


Figure 20. **Percent of patients correctly predicted to be discharged at each setting by FIM transfer admission scores.**

Table 21

The Utilization of FIM Transfer and Problem Solving Admission and Discharge Scores in Predicting Patient Discharge Site

Discharge site	Actual number of patients discharged to each setting	Correctly predicted number of patients discharged to each setting	Percentage of patients that were correctly predicted to be discharged to each setting
Home	75	40	53.33
Foster home	7	7	100.00
Skilled nursing facility	9	9	100.00



<u>Figure 21</u>. Percent of patients correctly predicted to be discharged at each setting by FIM transfer and problem solving admission and discharge scores.

Table 22

The Utilization of FIM Transfer and Problem Solving Admission Scores in Predicting Patient Discharge Site

Discharge site	Actual number of patients discharged to each setting	Correctly predicted number of patients discharged to each setting	Percentage of patients that were correctly predicted to be discharged to each setting
Home	75	20	26.67
Foster home	7	7	100.00
Skilled nursing facility	9	8	88.89

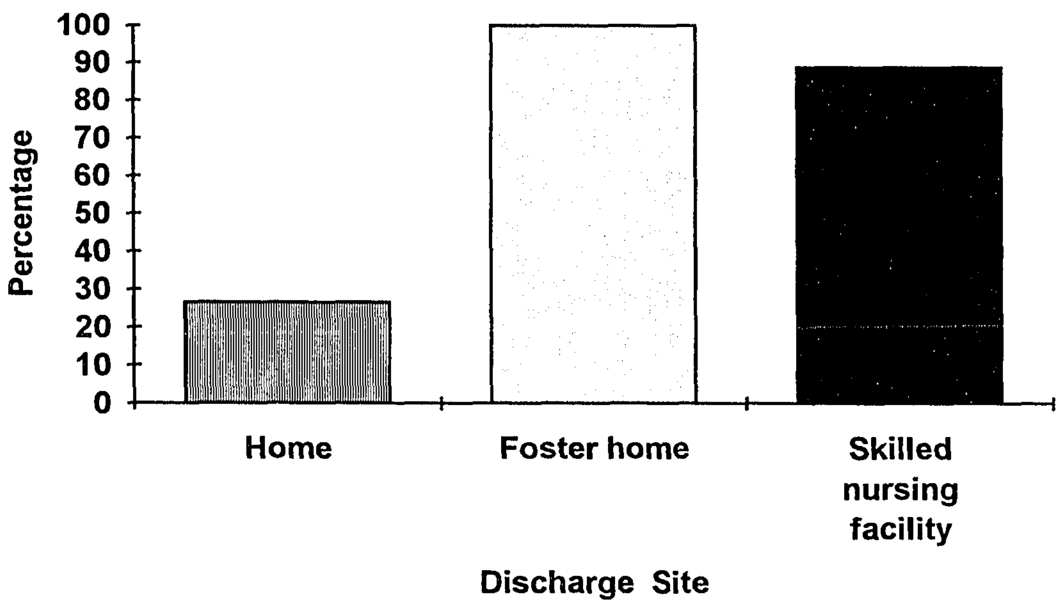


Figure 22. Percent of patients correctly predicted to be discharged at each setting by FIM transfer and problem solving admission scores.

CHAPTER 5

DISCUSSION

Individual subsets in this study were found to be highly predictive of discharge site. Upon analysis of what subsets are better predictors than other subsets and overall scores, an important factor must be considered first. There are variables that the FIM does not assess which have been proven in the literature to demonstrate a high predictability in determining the stroke patient's discharge site. These variables include the following: patient's age (Oczhowski & Barreca, 1993; Alexander, 1994), family and social support (Andrews, Brocklehurst, Richards, & Laycock, 1981; Glass, Matchar, Belyea, & Feussner, 1993; Lincoln, Jackson, Edmans, & Walker, 1990), and depression, (Kotila, Waltimo, Niemi, Laaksonem, & Lempinenn, 1984; Sinyor, Amato, Kalvapek, Becker, Goldenberg, & Coopersmith, 1986). The variables mentioned previously might be latent variables that can directly effect discharge site selection. Therefore, when predicting discharge sites, a higher dependence in each subset does not necessarily mean a more dependent discharge site. A patient might be discharged home, with higher dependence if adequate assistance is available. Therefore, these latent variables must be considered when determining patient discharge site.

Our study identified two subsets containing FIM items which demonstrated high predictability in determining the stroke patient's discharge site. These two subsets were one and five. Subset one which has been found to be highly predictive of all three discharge sites, includes variables which are important for activities of daily living, such as eating, grooming, bathing and dressing. These items are not only a necessary activity of daily living, but they require a great deal of time and effort from the patient, and or caregiver. Therefore, if a patient is not able to perform these activities themselves, or if a caregiver at home is not able to aid the patient in this activity due to the time and effort required, the patient probably would not be discharged home. Therefore, the appropriate discharge site may be a skilled nursing facility, or foster home.

Subset five, which includes cognitive and mobility items also demonstrated a high predictability for all three discharge sites. Even though these items are differing behaviors, they are interdependent on each other. Cognitive items such as comprehension and problem-solving , may be prerequisites in performing efficient mobility activities in a safe manner: a patient may need to problem-solve and comprehend differing heights and surfaces in his environment when transferring or ambulating.

Even though specific subsets demonstrated high ability to predict the stroke patients' discharge site, ambulation was not one of them. Locomotion admission and discharge scores together demonstrated only 32 % prediction in identifying home as the discharge site, 71% for foster care, and 100% for nursing home. Furthermore, locomotion admission scores demonstrated even less predictability in determining patient discharge site. Therefore, our first hypothesis, that gait might demonstrate a high predictability in determining the stroke patient's discharge site, was not supported by this study. This may be due to the latent variables effect on discharge site. Specifically, if the patient required assistance to ambulate within the home, and if this assistance was available, then the patient may have been discharged home. Whereby, if assistance was not available, then the patient may have been discharged to a more appropriate discharge site such as a nursing facility or foster home.

Besides these predictive subsets, the study identified three FIM items which were not highly predictive; in contrast to literature support and professional opinions. These three FIM items include bladder and bowel control, and transfers.

Many studies have been performed which demonstrated that bladder and bowel function was highly correlated in predicting the stroke patient's discharge site (Oczhowski & Barreca, 1993; Wade, 1985; Lincoln, Jackson, Edmans, & Walker, 1990). Specifically, Oczhowski and Barreca (1993) found that FIM admission bowel and bladder scores were very predictive for determining the discharge site of home, nursing home, and chronic care facility. In contrast, our study demonstrated that bowel and bladder scores both at admission, as well as admission and discharge scores considered together, were not highly predictive of all three discharge sites. This discrepancy may be due to the fact that our sample was small, due to the specific population studied, and to the various patient rate of recovery. Besides this function, the ability to perform bed/chair/wheelchair, toilet and tub/shower transfer was also not highly predictive for all three discharge sites when analyzing both admission as well as admission and discharge scores together. This finding is in contrast to physical therapists opinion both at Mary Free Bed and Hackley Hospital, and may be due to the small sample size analyzed in this study.

The study not only demonstrated specific subsets to be highly predictive of patient discharge site, but that these subsets were better predictors than total FIM admission and discharge scores together and separately. When analyzing admission and discharge scores together and separately, subset one and five, and the weighted 18 FIM items were found to be more predictive than total FIM scores. It is very unlikely that all 18 FIM items have equal weighting to total functional independence (Cook, Smith, & Trauma, 1994). Therefore, the second hypothesis, that FIM items under subsets might be more predictive of the stroke patient's discharge site as compared to total admission and discharge scores, was supported by this study. In addition, the total FIM admission and discharge scores were not as highly predictive as the weighted 18 FIM admission and discharge scores. With analysis of total FIM scores, the coefficient of one was assigned to the total score. Whereby, for the analysis of the 18 individual FIM items, each was assigned their own weighted coefficient. Then canonical discriminant analysis was performed to determine the predictability of total admission scores, total discharge scores, and the 18 weighted individual FIM item to patient discharge site. Since the 18 individual FIM items are assessed this gives a better measure of the patient's level of dependence as compared to the one variable of the total FIM score. This also indicates that the simple addition of individual FIM item scores is not optimum in prediction.

Limitations of Study

Dependence of variables

Even though the FIM scale identifies motor items separately from cognitive, these items are not completely independent of each other. These items have some degree of dependence since cognitive function in motor planning may be required for mobility. In discriminant analysis, we assume that FIM items are independent. However, this independence is unlikely. The results of this study should be interpreted cautiously. Furthermore, it may also be difficult to determine which FIM item under each subset demonstrates a higher predictability in determining discharge site as compared to other items within each subset.

Nonparametric nature of variables

The FIM scale is an ordinal scale with scores assigned in values from one to seven. Because of this, certain assumptions must be made for statistical analysis. These assumptions are that the distances between scores are equal and that they have an underlying continuous distribution. The assumption of equal distances between score values is not accurate; the levels of dependance between score values is varied. Also, the assumption of continuous distribution is reasonable but it may also be varied. A nonparametric analysis was performed to circumvent these problems.

Variables possibly affecting discharge site not assessed under the FIM

Variables not assessed under the FIM scale which may effect discharge site include, patient's age, family and social support, and depression. Since these variables are not assessed by the FIM scale, no direct cause and effect relationship can be determined, although, a relationship between the discharge sites and these variables can be inferred. The effect a patient's age can have upon his discharge site is obviously that as a patient ages the likelihood of a discharge to a nonhome setting is increased. If a patient has a large network of friends or family providing support this then makes it possible for a patient to live at home with a higher level of dependence. Lastly a patient's emotional state can affect the decision for a home discharge: a patient with depression is less likely to be able to function as independently as someone who has a similar level of disability.

Sample size

Our sample size included an unequal ratio of patients discharged to three different discharge sites. Specifically 75 patients were discharged home, 7 to a foster home, and 9 to a skilled nursing facility. It is suggested to use a larger sample size which demonstrates a greater amount of patients that have been discharged to foster and skilled nursing facilities.

Another limitation due to small sample size was that all 91 records used to create the canonical discriminant analysis equations were then run through these equations for predicting to validate the model. Performing an analysis in this manner will produce more correct predictions than would result from applying the equations to new data.

Suggestions for Further Research

It is the desire of the researchers that the results of this study will lead to further analysis on the topic of the predictability of FIM items. Specifically, researchers should continue analyzing a variety of subsets to predict the stroke patient's discharge site. It is imperative to attempt to reduce health care costs by efficiently implementing patient discharge planning. This pre-planning may result in the patient being accepted into the appropriate facility in a timely manner. A related study could be performed to compare health care costs both at rehabilitation facilities which utilize the FIM scale and those who do not. With the facilities who do utilize the FIM as outcome measures, it would be valuable to determine if total FIM scores or individual items/subsets were utilized for pre-discharge planning. Lastly, information on latent variables should be collected along with a study designed to address this studies limitations in size and design specifics.

Conclusion

In conclusion, it is still important to consider the total FIM admission and discharge scores. Each clinician may determine if his treatments were efficient or not by the patient's recovery rates between admission and discharge . Additionally, the scores may detect changes in level of disability, and be predictive of economic costs (Hamilton & Granger, 1994). However, it may be important to look at each variable secondary to the FIM scale being ordinal and that each variable does not have equal weighting when determining overall scores. Since there are numerous combinations of variables that may be grouped together and analyzed in determining their correlation in predicting patient discharge site, we had to predetermine subsets. Hopefully, the subsets that have been found to demonstrate a high predictability in determining the stroke patient's discharge site can be used as a shortened screening tool. Therefore, as clinicians, we may decrease the time it takes to determine a discharge site, and enhance the certainty of placing patients at an appropriate discharge site.

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APPENDIX A

Description of the Levels of Function and their Scores

Independence: Another person is not required for the activity (No Helper).

Score of 7 (Complete Independence): All of the tasks described as making up the activity are typically performed safely, without modification, assistive devices, or aids, and within a reasonable amount of time.

Score of 6 (Modified Independence): One or more of the following may occur: the activity requires an assistive device; activity takes more than reasonable time; or there are safety (risk) considerations.

Dependent: Subject requires another person for either supervision or physical assistance in order for the activity to be performed, or it is not performed (Requires Helper).

Modified Dependence: The subject expends half (50%) or more effort. The levels of assistance are:

Score of 5 (Supervision or Setup): Subject requires no more help than standby, cuing or coaxing, without physical contact, or, helper sets up needed items or applies orthoses.

Score of 4 (Minimal Contact Assistance): Subject requires no more help than touching, and expends 75% or more effort.

Score of 3 (Moderate Assistance): Subject requires more help than touching, or expends half (50%) or more (75%) of the effort.

Complete Dependence: The subject expends less than (less than 50%) of the effort. Maximal or total assistance is required, or the activity is not performed. The levels of assistance required are:

Score of 2 (Maximal Assistance): Subject expends less than 50%of the effort, but at least 25%.

Score of 1 (Total Assistance): Subject expends less than 25% of the effort.

(Uniform Data System for Medical Rehabilitation, 1993).

APPENDIX B

Locomotion Scoring

Locomotion

Walk/Wheelchair includes walking, once in a standing position, or if using a wheelchair, once in a seated position, on a level surface. Check the most frequent mode of locomotion (Walk or Wheelchair). If both are used equally, check both.

No Helper

Score of 7 (Complete Independence): Subject walks a minimum of 150 feet without assistive devices. Does not use a Wheelchair. Performs safely.

Score of 6 (Modified Independence): Subject walks a minimum of 150 feet but uses a brace (orthosis) or prosthesis on leg, special adaptive shoes, cane, crutches, or walker; takes more than reasonable time or there are safety considerations.

Score of 5, exception (Household Ambulation):[S1] Subject walks only short distances (a minimum of 50 feet) with or without a device. Takes more than reasonable time, or there are safety considerations, or operates a manual or motor wheelchair independently only short distances (a minimum of 50 feet).

Helper

Score of 5 (Supervision): If walking, subject requires standby supervision, cuing, or coaxing to go a minimum of 150 feet. If not walking, requires standby supervision, cuing, or coaxing to go a minimum of 150 feet in a wheelchair.

Score of 4 (Minimum Contact Assistance): Subject performs 75% or more of locomotion effort to go a minimum of 150 feet.

Score of 3 (Moderate Assistance): Subject performs 50-74% of locomotion effort to go a minimum of 150 feet.

Score of 2 (Maximal Assistance): Subject performs 25-49% of locomotion effort to go a minimum of 50 feet. Requires assistance of one person only.

Score of 1 (Total Assistance): Subject performs less than 25% of effort, requires assistance of two people, or does not walk or wheel a minimum of 50 feet. (Uniform Data System for Medical Rehabilitation, 1993).

APPENDIX C

General Procedures for Scoring the FIM

1. Admission data collected within 72 hours after admission.
2. Discharge data collected 72 hours before discharge.
3. Follow-up data collected 80 to 180 days after discharge.
4. Record the score which best describes the patient's level of function for every FIM item.
5. Actual performance and function is recorded by a clinician directly observing the patient.
6. Record the lowest score if differences in function are noticed in various environments.
7. Setup is uniformly rated at level 5 for all items.
8. If the subject would be put at risk for injury if tested, a score of 1 is entered.
9. If an activity is not performed, enter 1.
10. If two helpers are required to assist the subject, a score of 1 is entered.
11. Do not leave any FIM item blank.
12. Do not enter "N/A".
13. The mode of locomotion for item (Walk/Wheeelchair) must be the same on admission and discharge. If the subject changes the mode of locomotion from admission to discharge (usually wheelchair to walking), record the admission mode and score based on the most frequent mode of locomotion at discharge.

(Uniform Data System for Medical Rehabilitation, 1993).

APPENDIX D

Description of Subsets and Additional Variables

With each subset, total admission plus total discharge, and admission scores were used during statistical analysis.

Subset 1: Eating, grooming, bathing, dressing upper body, dressing lower body, toileting.

Subset 2: Bowel control and bladder control.

Subset 3: Transfer bed/chair/wheelchair, transfer toilet, transfer tub/shower, ambulation on level surfaces, and stairs.

Subset 4: Comprehension, expression, social interaction, problem-solving, and memory.

Subset 5: Subset three plus four.

Subset 6: ambulation on level surfaces.

Subset 7: Transfer bed/chair/wheelchair, transfer toilet, and transfer tub/shower.

Subset 8: Subset 7 and problem-solving.

Additional sets of variables used during analysis:

Set 1: Total admission plus total discharge scores.

Set 2: Total admission score.

Set 3: Total discharge score.

Set 4: All 18 weighted admission items.

Set 5: All 18 weighted discharge items.

APPENDIX E

Additional Results

The following are additional results from our study. They are included to give a clearer and more in depth look at the study we have performed. Listed in the tables are the predictions for the variables analyzed. Predictability is for the discharge site of patients as compared to their actual discharge site for the variable(s) listed. Horizontal rows are for the patients who were actually to the site listed at the left. The vertical columns that intersect these rows show what number and percentage of the total patients listed at the left were predicted to go to the site listed at the top of that column. Underlined items show the number and percentage of patients that were correctly predicted to go to the actual discharge site listed at the left. FH is foster home and SNF is skilled nursing facility.

Table E1

Number and percent of patients predicted at each setting by total FIM admission and discharge scores.

	Actual Total of Patients D/C Here	Percentage and number of patients predicted to go Home	Percentage and number of patients predicted to go to a FH	Percentage and number of patients predicted to go to a SNF
Actual Home Discharge	75	18	44	13
	100.00%	24.00%	58.67%	17.33%
Actual FH Discharge	7	0	7	0
	100.00%	0.00%	100.00%	0.00%
Actual SNF Discharge	9	0	2	7
	100.00%	0.00%	22.22%	77.78%
Total Patients	91	18	53	20
Percent Total	100.00%	19.78%	58.24%	21.98%

Table E2

Number and percent of patients predicted at each setting by total FIM admission scores.

	Actual Total of Patients D/C Here	Percentage and number of patients predicted to go Home	Percentage and number of patients predicted to go to a FH	Percentage and number of patients predicted to go to a SNF
Actual Home Discharge	75	9	31	35
	100.00%	12.00%	41.33%	46.67%
Actual FH Discharge	7	0	5	2
	100.00%	0.00%	71.43%	28.57%
Actual SNF Discharge	9	1	0	8
	100.00%	11.11%	0.00%	88.89%
Total Patients	91	10	36	45
Percent Total	100.00%	10.99%	39.56%	49.45%

Table E3

Number and percent of patients predicted at each setting by total FIM discharge scores.

	Actual Total of Patients D/C Here	Percentage and number of patients predicted to go Home	Percentage and number of patients predicted to go to a FH	Percentage and number of patients predicted to go to a SNF
Actual Home Discharge	75	13	47	15
	100.00%	17.33%	62.67%	20.00
Actual FH Discharge	7	1	6	0
	100.00%	14.29%	85.71%	0.00%
Actual SNF Discharge	9	0	2	7
	100.00%	0.00%	22.22%	77.78%
Total Patients	91	14	55	22
Percent Total	100.00%	15.38%	60.44%	24.18%

Table E4

Number and percent of patients predicted at each setting by all FIM admission and discharge scores.

	Actual Total of Patients D/C Here	Percentage and number of patients predicted to go Home	Percentage and number of patients predicted to go to a FH	Percentage and number of patients predicted to go to a SNF
Actual Home Discharge	75	75	0	0
	100.00%	100.00%	0.00%	0.00%
Actual FH Discharge	7	0	7	0
	100.00%	0.00%	100.00%	0.00%
Actual SNF Discharge	9	0	0	9
	100.00%	0.00%	0.00%	100.00%
Total Patients	91	75	7	9
Percent Total	100.00%	82.42%	7.69%	9.89%

Table E5

Number and percent of patients predicted at each setting by all FIM admission scores.

	Actual Total of Patients D/C Here	Percentage and number of patients predicted to go Home	Percentage and number of patients predicted to go to a FH	Percentage and number of patients predicted to go to a SNF
Actual Home Discharge	75	69	5	1
	100.00%	92.00%	6.67%	1.33%
Actual FH Discharge	7	0	7	0
	100.00%	0.00%	100.00%	0.00%
Actual SNF Discharge	9	0	0	9
	100.00%	0.00%	0.00%	100.00%
Total Patients	91	69	12	10
Percent Total	100.00%	75.82%	13.19%	10.99%

Table E6

Number and percent of patients predicted at each setting by all FIM discharge scores.

	Actual Total of Patients D/C Here	Percentage and number of patients predicted to go Home	Percentage and number of patients predicted to go to a FH	Percentage and number of patients predicted to go to a SNF
Actual Home Discharge	75 100.00%	57 76.00%	13 17.33%	5 6.67%
Actual FH Discharge	7 100.00%	0 0.00%	7 100.00%	0 0.00%
Actual SNF Discharge	9 100.00%	0 0.00%	0 0.00%	9 100.00%
Total Patients	91	57	20	14
Percent Total	100.00%	62.64%	21.98%	15.38%

Table E7

Number and percent of patients predicted at each setting by FIM self-care admission and discharge scores.

	Actual Total of Patients D/C Here	Percentage and number of patients predicted to go Home	Percentage and number of patients predicted to go to a FH	Percentage and number of patients predicted to go to a SNF
Actual Home Discharge	75	68	6	1
	100.00%	90.87%	8.00%	1.33%
Actual FH Discharge	7	0	7	0
	100.00%	0.00%	100.00%	0.00%
Actual SNF Discharge	9	0	0	9
	100.00%	0.00%	0.00%	100.00%
Total Patients	91	68	13	10
Percent Total	100.00%	74.73%	14.29%	10.99%

Table E8

Number and percent of patients predicted at each setting by FIM self-care admission scores.

	Actual Total of Patients D/C Here	Percentage and number of patients predicted to go Home	Percentage and number of patients predicted to go to a FH	Percentage and number of patients predicted to go to a SNF
Actual Home Discharge	75	57	11	7
	100.00%	76.00%	14.67%	9.33%
Actual FH Discharge	7	0	7	0
	100.00%	0.00%	100.00%	0.00%
Actual SNF Discharge	9	0	0	9
	100.00%	0.00%	0.00%	100.00%
Total Patients	91	57	18	16
Percent Total	100.00%	62.64%	19.78%	17.58%

Table E9

Number and percent of patients predicted at each setting by FIM bowel and bladder admission and discharge scores.

	Actual Total of Patients D/C Here	Percentage and number of patients predicted to go Home	Percentage and number of patients predicted to go to a FH	Percentage and number of patients predicted to go to a SNF
Actual Home Discharge	75	22	51	2
	100.00%	29.33%	68.00%	2.67%
Actual FH Discharge	7	0	7	0
	100.00%	0.00%	100.00%	0.00%
Actual SNF Discharge	9	0	5	4
	100.00%	0.00%	55.56%	44.44%
Total Patients	91	22	63	6
Percent Total	100.00%	24.18%	69.23%	6.59%

Table E10

Number and percent of patients predicted at each setting by FIM bowel and bladder admission scores.

	Actual Total of Patients D/C Here	Percentage and number of patients predicted to go Home	Percentage and number of patients predicted to go to a FH	Percentage and number of patients predicted to go to a SNF
Actual Home Discharge	75 100.00%	18 24.00%	52 69.33%	5 6.67%
Actual FH Discharge	7 100.00%	0 0.00%	7 100.00%	0 0.00%
Actual SNF Discharge	9 100.00%	0 0.00%	5 55.56%	4 44.44%
Total Patients	91	18	64	9
Percent Total	100.00%	19.78%	70.33%	9.89%

Table E11

Number and percent of patients predicted at each setting by FIM mobility admission and discharge scores.

	Actual Total of Patients D/C Here	Percentage and number of patients predicted to go Home	Percentage and number of patients predicted to go to a FH	Percentage and number of patients predicted to go to a SNF
Actual Home Discharge	75	55	13	7
	100.00%	73.33%	17.33%	9.33%
Actual FH Discharge	7	0	7	0
	100.00%	0.00%	100.00%	0.00%
Actual SNF Discharge	9	0	0	9
	100.00%	0.00%	0.00%	100.00%
Total Patients	91	55	20	16
Percent Total	100.00%	60.44%	21.98%	17.58%

Table E12

Number and percent of patients predicted at each setting by FIM mobility admission scores.

	Actual Total of Patients D/C Here	Percentage and number of patients predicted to go Home	Percentage and number of patients predicted to go to a FH	Percentage and number of patients predicted to go to a SNF
Actual Home Discharge	75	31	18	26
	100.00%	41.33%	24.00%	34.67%
Actual FH Discharge	7	0	7	0
	100.00%	0.00%	100.00%	0.00%
Actual SNF Discharge	9	0	1	8
	100.00%	0.00%	11.11%	88.89%
Total Patients	91	31	26	34
Percent Total	100.00%	34.07%	28.57%	37.36%

Table E13

Number and percent of patients predicted at each setting by FIM cognitive admission and discharge scores.

	Actual Total of Patients D/C Here	Percentage and number of patients predicted to go Home	Percentage and number of patients predicted to go to a FH	Percentage and number of patients predicted to go to a SNF
Actual Home Discharge	75	54	18	3
	100.00%	72.00%	24.00%	4.00%
Actual FH Discharge	7	0	7	0
	100.00%	0.00%	100.00%	0.00%
Actual SNF Discharge	9	0	0	9
	100.00%	0.00%	0.00%	100.00%
Total Patients	91	54	25	12
Percent Total	100.00%	59.34%	27.47%	13.19%

Table E14

Number and percent of patients predicted at each setting by FIM cognitive admission scores.

	Actual Total of Patients D/C Here	Percentage and number of patients predicted to go Home	Percentage and number of patients predicted to go to a FH	Percentage and number of patients predicted to go to a SNF
Actual Home Discharge	75	39	17	19
	100.00%	52.00%	22.67%	25.33%
Actual FH Discharge	7	0	6	1
	100.00%	0.00%	85.71%	14.29%
Actual SNF Discharge	9	0	0	9
	100.00%	0.00%	0.00%	100.00%
Total Patients	91	39	23	29
Percent Total	100.00%	42.86%	25.27%	31.87%

Table E15

Number and percent of patients predicted at each setting by FIM mobility and cognitive admission and discharge scores.

	Actual Total of Patients D/C Here	Percentage and number of patients predicted to go Home	Percentage and number of patients predicted to go to a FH	Percentage and number of patients predicted to go to a SNF
Actual Home Discharge	75	69	4	2
	100.00%	92.00%	5.33%	2.67%
Actual FH Discharge	7	0	7	0
	100.00%	0.00%	100.00%	0.00%
Actual SNF Discharge	9	0	0	9
	100.00%	0.00%	0.00%	100.00%
Total Patients	91	69	11	11
Percent Total	100.00%	75.82%	12.09%	12.09%

Table E16

Number and percent of patients predicted at each setting by FIM mobility and cognitive admission scores.

	Actual Total of Patients D/C Here	Percentage and number of patients predicted to go Home	Percentage and number of patients predicted to go to a FH	Percentage and number of patients predicted to go to a SNF
Actual Home Discharge	75	50	18	7
	100.00%	66.67%	24.00%	9.33%
Actual FH Discharge	7	0	7	0
	100.00%	0.00%	100.00%	0.00%
Actual SNF Discharge	9	0	1	8
	100.00%	0.00%	11.11%	88.89%
Total Patients	91	50	26	15
Percent Total	100.00%	54.95%	28.57%	16.48%

Table E17

Number and percent of patients predicted at each setting by FIM locomotion admission and discharge scores.

	Actual Total of Patients D/C Here	Percentage and number of patients predicted to go Home	Percentage and number of patients predicted to go to a FH	Percentage and number of patients predicted to go to a SNF
Actual Home Discharge	75	24	27	24
	100.00%	32.00%	36.00%	32.00%
Actual FH Discharge	7	0	5	2
	100.00%	0.00%	71.43%	28.57%
Actual SNF Discharge	9	0	0	9
	100.00%	0.00%	0.00%	100.00%
Total Patients	91	24	32	35
Percent Total	100.00%	26.37%	35.16%	38.46%

Table E18

Number and percent of patients predicted at each setting by FIM locomotion admission scores.

	Actual Total of Patients D/C Here	Percentage and number of patients predicted to go Home	Percentage and number of patients predicted to go to a FH	Percentage and number of patients predicted to go to a SNF
Actual Home Discharge	75	18	21	36
	100.00%	24.00%	28.00%	48.00%
Actual FH Discharge	7	1	2	4
	100.00%	14.29%	28.57%	57.14%
Actual SNF Discharge	9	0	1	8
	100.00%	0.00%	11.11%	88.89%
Total Patients	91	19	24	48
Percent Total	100.00%	20.88%	26.37%	52.75%

Table E19

Number and percent of patients predicted at each setting by FIM transfer admission and discharge scores.

	Actual Total of Patients D/C Here	Percentage and number of patients predicted to go Home	Percentage and number of patients predicted to go to a FH	Percentage and number of patients predicted to go to a SNF
Actual Home Discharge	75	37	31	7
	100.00%	49.33%	41.33%	9.33%
Actual FH Discharge	7	0	7	0
	100.00%	0.00%	100.00%	0.00%
Actual SNF Discharge	9	0	0	9
	100.00%	0.00%	0.00%	100.00%
Total Patients	91	37	38	16
Percent Total	100.00%	40.66%	41.76%	17.58%

Table E20

Number and percent of patients predicted at each setting by FIM transfer admission scores.

	Actual Total of Patients D/C Here	Percentage and number of patients predicted to go Home	Percentage and number of patients predicted to go to a FH	Percentage and number of patients predicted to go to a SNF
Actual Home Discharge	75	17	32	26
	100.00%	22.67%	42.67%	34.67%
Actual FH Discharge	7	1	6	0
	100.00%	14.29%	85.71%	0.00%
Actual SNF Discharge	9	0	1	8
	100.00%	0.00%	11.11%	88.89%
Total Patients	91	18	39	34
Percent Total	100.00%	19.78%	42.86%	37.36%

Table E21

Number and percent of patients predicted at each setting by FIM transfer and problem admission and discharge scores.

	Actual Total of Patients D/C Here	Percentage and number of patients predicted to go Home	Percentage and number of patients predicted to go to a FH	Percentage and number of patients predicted to go to a SNF
Actual Home Discharge	75	40	27	8
	100.00%	53.33%	36.00%	10.67%
Actual FH Discharge	7	0	7	0
	100.00%	0.00%	100.00%	0.00%
Actual SNF Discharge	9	0	0	9
	100.00%	0.00%	0.00%	100.00%
Total Patients	91	40	34	17
Percent Total	100.00%	43.96%	37.36%	18.68%

Table E22

Number and percent of patients predicted at each setting by FIM transfer admission and discharge scores.

	Actual Total of Patients D/C Here	Percentage and number of patients predicted to go Home	Percentage and number of patients predicted to go to a FH	Percentage and number of patients predicted to go to a SNF
Actual Home Discharge	75	20	30	25
	100.00%	26.67%	40.00%	33.33%
Actual FH Discharge	7	0	7	0
	100.00%	0.00%	100.00%	0.00%
Actual SNF Discharge	9	0	1	8
	100.00%	0.00%	11.11%	88.89%
Total Patients	91	20	38	33
Percent Total	100.00%	21.98%	41.76%	36.26%