

# A Rehabilitation Program for Patients Recovering from Severe Stroke

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**ABSTRACT: Objective:** The purpose of this study was to describe the outcomes of patients with a severe stroke admitted to a specialized “slow stream” rehabilitation program and to develop a model to predict discharge destination. **Methods:** Chart review of 196 consecutive non-ambulatory (“lower-band”) stroke patients admitted between 1996-2001, to a specialized in-patient rehabilitation unit designed to accommodate the needs of patients with profound disabilities, and who were considered inappropriate for conventional in-patient rehabilitation programs. Special features of this program included the availability of an independent living unit, therapies tailored to individual tolerance and the opportunity to remain on the unit for an extended period until such time that the patients’ rehabilitation potential had been maximized. **Results:** Patients were admitted to the unit after a median of 49 days following stroke onset. Their median admission and discharge functional independence measure (FIM™) scores were 46 and 70, respectively. The improvement in ability to perform self-care tasks was statistically significant ( $Z = -11.18$ ,  $p < 0.0001$ ). By discharge, 54 patients (28%) were able to ambulate independently (with or without an assistive device), while 142 patients (72%) remained wheelchair dependent. Eighty-five patients (43%) returned to their own home upon rehabilitation discharge, while the remainder were admitted to nursing homes or hospitals closer to the patients’ home. Admission FIM score, age, no previous history of stroke and male sex were the variables found to most strongly predict discharge home. **Conclusions:** Patients with severe strokes who received individualized care on a highly specialized stroke rehabilitation unit achieved impressive functional outcomes despite a lag of seven weeks post stroke before rehabilitation was initiated. Many patients were no longer wheelchair dependent and almost half returned home. Active rehabilitation should not be limited to “middle-band” stroke patients.

**RÉSUMÉ: Un programme de réadaptation pour les patients victimes d’un accident vasculaire cérébral sévère. Objectif:** Le but de cette étude était de décrire les résultats d’un programme de réadaptation spécialisé « allégé » chez des patients ayant subi un accident vasculaire cérébral (AVC) sévère et de développer un modèle pour prédire le type d’hébergement requis lorsqu’ils ont complété le programme. **Méthodes:** Il s’agit d’une revue du dossier de 196 patients consécutifs non ambulants ayant subi un AVC admis à une unité spécialisée de réadaptation entre 1996 et 2001. Cette unité est conçue pour répondre aux besoins de patients ayant des handicaps sévères pour lesquels les programmes de réadaptation conventionnels ne sont pas appropriés. Ce programme comporte une unité d’hébergement autonome, des traitements adaptés au niveau de tolérance individuelle et la possibilité d’y demeurer tant que le potentiel de réadaptation du patient n’a pas été maximisé. **Résultats:** Les patients étaient admis à l’unité après un temps médian de 49 jours post AVC. Le score médian à la mesure de l’indépendance fonctionnelle (MIF) au moment de l’admission et du départ était de 46 et 70 respectivement. L’amélioration de la capacité à pourvoir à leurs soins personnels était statistiquement significative ( $Z = -11,18$  ;  $p < 0,0001$ ). Au moment du congé, 54 patients (28%) pouvaient marcher seul (avec ou sans appareil) et 142 patients (72%) étaient en fauteuil roulant. Quarante-vingt-cinq patients (43%) sont retournés à leur domicile à leur sortie de l’unité alors que les autres ont été admis en centre de soins de longue durée ou à un hôpital plus près de leur domicile. Le score MIF à l’admission, l’âge, l’absence d’antécédents d’AVC et le genre masculin étaient les variables qui prédisaient le mieux le retour à domicile au moment du congé de l’unité. **Conclusions:** Les patients ayant subi un AVC sévère qui reçoivent des soins individualisés dans une unité de réadaptation spécialisée dans l’AVC réussissent à atteindre un niveau fonctionnel impressionnant en dépit d’un délai de sept semaines entre l’AVC et la réadaptation. Plusieurs patients ne sont plus dépendants du fauteuil roulant et presque la moitié retourne à la maison. La réadaptation active ne devrait pas être limitée aux patients ayant des déficits modérés.

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Following a stroke, many survivors will experience some form of functional impairment, which will require a period of rehabilitation. For those with mild disability this can be accomplished through a brief period of inpatient rehabilitation or through home-based or outpatient programs. Intensive inpatient rehabilitation programs are best suited to rehabilitating stroke patients with moderately severe disabilities, usually regarded to be “middle-band” patients,<sup>1</sup> who have sufficient physical endurance to tolerate a more intense rehabilitation environment (generally up to three hours of formal therapeutic activity per day), Carey et al<sup>2</sup>, Asberg and Nydevik<sup>3</sup> and Alexander<sup>4</sup> reported

those stroke patients in the middle band or middle severity range made the most functional gains while those at the extremes, the very disabled or the mildly disabled, made significantly lesser

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gains. These specialized hospital-based inpatient units located within conventional care institutions or stand-alone rehabilitation centres provide comprehensive rehabilitation programs delivered by a full range of healthcare professionals, as well as medical services for the prevention of complications and secondary prevention of stroke.

It has been estimated that 20% of stroke survivors have such severe functional deficits that they are expected to remain non-ambulatory and dependent, irrespective of rehabilitation efforts.<sup>5</sup> These patients are often referred to as the “lower band” group, as described by Garraway et al<sup>6</sup> and include patients with the most severe strokes, who are often unconscious at onset with severe unilateral or bilateral paresis.<sup>1</sup> Additionally, such patients may have serious medical co-morbidities that add to the stroke-related disability. These patients have also been characterised as having an early (within the first week of stroke onset) Functional Independence Measure (FIM<sup>TM</sup>) score <40 or early motor FIM<sup>TM</sup> scores <37<sup>7</sup> and are unlikely to achieve functional independence, regardless of treatment, unless they are younger, these patients have the longest rehabilitation stays as well as the lowest likelihood of community discharge.<sup>7</sup> Traditionally, these patients have not been considered appropriate candidates for conventional inpatient programs due to their “limited rehabilitation potential”. Consequently and paradoxically, it is our opinion that, patients with the most severe strokes often receive little or no rehabilitation, although some patients are treated with lower intensity rehabilitation programs that may be offered by some long-term care facilities. The goals of this form of rehabilitation, often referred to as “sub-acute” rehabilitation are modest in comparison to conventional rehabilitation, since functional ambulation and achievement of independence in activities of daily living (ADL) are often not realistic goals. However, these patients do have the potential to make significant gains which in turn can reduce their overall burden of disability, provided they are given sufficient time and opportunity within an appropriate rehabilitation program.<sup>8</sup>

Several authors have reported that among patients with severe strokes receiving rehabilitation, a greater proportion were discharged home and there were reductions in hospital lengths of stay and mortality rates, compared to patients rehabilitated in a non-stroke rehabilitation setting.<sup>7-12</sup> These studies emphasized the concept that even the most severely impaired stroke patients still benefit from rehabilitation. The rehabilitation outcomes of lower-band patients are of interest since this group is typically denied formal inpatient rehabilitation, yet it constitutes the most disabled group of stroke patients and represents the greatest cost to the system because of the frequent need for expensive institutionalization.

Many studies have also investigated a variety of factors, which can be assessed upon admission to rehabilitation and used to predict a variety of outcomes, including discharge disposition. While age and initial stroke severity or level of disability have been consistently found among the indicators that best predict an individual’s ability to return home following rehabilitation,<sup>13-16</sup> few models have been developed specifically for use in the subset of more severely impaired stroke patients. The purpose of this study was to describe the rehabilitation progress of a cohort of patients, who had sustained a severe stroke within the previous six months, following their admission to a specialized

slow stream (less intensive) program and to develop a logistic regression model to predict which patients were more likely to be discharged home.

## METHODS

### *i) Subjects and a Description of the Program*

The Stroke Rehabilitation Unit (SRU) was located at the Parkwood Hospital site of St. Joseph’s Health Care London, a publicly funded institution, which serves a population of approximately 600,000, including local inhabitants of the city and several municipalities within Southwestern Ontario. The ten-bed unit was established in January, 1996 at an existing rehabilitation facility to provide rehabilitation services to stroke patients with more profound disabilities, who typically had not been accepted into the conventional rehabilitation programs offered at two other tertiary care centres within the city. Given that the city lacked services to accommodate these more severely disabled stroke patients, they were often discharged directly to long-term care facilities, and received little or no formal rehabilitation. All patients were covered by the provincial health insurance plan. Approximately 5% of patients seen and admitted acutely with a confirmed diagnosis of stroke were eventually transferred to the SRU.

The SRU used a patient-centered, goal-oriented approach to rehabilitation, which strived to assist patients to reach their highest possible degree of physical and psychological performance. The unit was staffed similarly to a conventional rehabilitation unit, with an interdisciplinary staff, which included a full-time physical and occupational therapist, a speech-language pathologist and a social worker and a part-time dietitian. Staffing ratios were similar to those on the conventional rehabilitation unit in the city. However, there were two unique positions, a therapeutic recreation specialist and a rehabilitation therapist. The role of the former focused on the leisure activities while incorporating skills learned during other therapies. Patients were given the opportunity to practice skills outside of the hospital setting to assist with community reintegration. The rehabilitation therapist acted as a support person for the rest of the team members, by offering patients opportunities for repeated practice, especially for those with communication or behavioral problems. Another unique element of the SRU was the inclusion of a family support group, which met on a weekly basis.

To attain the patients’ goals, an integrated assessment and plan of care were developed using input from all members of an inter-disciplinary team. Consistency in communication and coordinated delivery of care were high priorities for the team. Scheduled therapies were tailored to the individual patient, and modified, based on tolerance, to a maximum of four hours per day. A normal movement (Bobath) treatment approach to rehabilitation was used, with reinforcement by the nursing staff 24 hours per day. A supported communication program for patients with aphasia was used, in addition to conventional therapy provided by a speech-language pathologist. The supported communication approach is based on the concept that the inherent competence of people with aphasia can be revealed through the skill of a conversation partner. The intervention approach has been used in a community-based aphasia center

using volunteers to interact with individuals with chronic aphasia and their families.<sup>17</sup>

Patients were evaluated for suitability for the program by a nurse clinician, in consultation with a program physician, based on the following eligibility criteria: 1) diagnosis of stroke, 2) needs cannot be met by community services or conventional inpatient rehabilitation, 3) potential for functional and/or neurological improvement, 4) patient must be medically stable and have sufficient endurance to participate in various therapies, 5) patient must require the services of a professional interdisciplinary team, 6) patient must have achievable rehabilitation goals, 7) a discharge plan following rehabilitation must be in place prior to admission. Patients were assessed for suitability on an individual basis; cut-off scores on standardized outcome measures were not used as part of the eligibility criteria and the final decision to accept a patient into the program was at the discretion of the admitting physician. The presence of a committed caregiver or family member(s), willing and able to provide support upon discharge was viewed as beneficial, but was not essential for acceptance into the program. An independent living unit was also available to patients and family members as a means to practice the skills and techniques required to function at home, prior to discharge. 'Graduated' weekend leaves of absences were also a feature of the program that helped patients and families to ease the transition between hospital and home. Community reintegration was an important component of the program and included education about accessibility and resources, as well as the opportunities for outings to practice necessary skills. Integrated discharge summaries were provided at the time of patients' discharge to promote continuity of care in the community. Patient / family education was an essential part of the program and included many one-to-one and group opportunities. In addition, a formal weekly Family Support Group was available to caregivers on an ongoing basis.

The charts of all non-ambulatory patients with a confirmed diagnosis of ischemic or hemorrhagic stroke, admitted to the rehabilitation unit within six months of onset of symptoms, were reviewed. The six-month cut-off for inclusion was chosen to capture those patients who were being rehabilitated as part of the initial management of their stroke and not as a later complication. From the inception of the program Jan 1, 1996 to Dec 31, 2001, 239 patients were admitted to the SRU. Twenty-four patients were excluded from the review because their admission to the rehabilitation units was greater than six months following stroke onset and a further 19 patients were excluded because they were ambulatory, with primarily cognitive/perceptual deficits. A total 196 patients remained for review.

The following information, recorded as part of usual clinical practice on standardized forms, was collected: age, gender, stroke type (ischemic, hemorrhagic) and location (right hemisphere, left hemisphere, bilateral hemisphere or brainstem), admission and discharge FIM™ scores, admission and discharge ambulation status and discharge destination. Stroke impairments, expressed as dichotomous variables (present/absent), were also recorded from the chart and included aphasia (global, expressive or conductive), apraxia, hemiparesis, dysphagia and neglect. These deficits were identified and recorded as part of usual clinical practice in the development of the patient's treatment

plan. This information was obtained from the reports of all members of the inter-disciplinary team involved in the patient's care including the physician, speech-language pathologist, dietitian, occupational and physical therapist.

## ii) Statistical Analysis

Wilcoxon signed-rank test for paired data was used to evaluate the differences in median FIM™ scores from admission to discharge for all patients. The analysis was also repeated for a subset of patients with an admission FIM™ score of less than 50. This cut-off point was chosen to represent a more conventional diagnostic indicator of severe stroke. A logistic regression model using a forward selection procedure, based on likelihood ratios was performed where discharge destination was the dependent variable (home vs. institution or other) and a variety of clinically important predictor variables were entered as possible candidates for inclusion including gender, age, stroke type (hemorrhage or ischemic), previous history of stroke, aphasia, dysphagia, urinary incontinence, neglect and admission FIM™ scores. (F to enter = 0.05, F to remove = 0.10). The differences in selected outcomes and characteristics between patients discharged home and to an institution were compared using either parametric or non-parametric methods, where appropriate. Two-tailed test of significance were performed. A p-value of <0.05 was considered to be statistically significant. Data was analyzed using Statistical Package for Social Sciences (SPSS) (version 10).

## RESULTS

Of 196 patients studied, there were 92 females and 104 males with an average ( $\pm$ SD) age of  $72 \pm 11$  years. Stroke location included: 105 right hemisphere (53.6%), 78 left hemisphere (39.8%) and 13 brainstem (6.6%). One hundred and sixty-six patients (85%) had suffered from ischemic and 30 (15%), from hemorrhagic strokes. The majority of the admissions came from hospitals in outlying areas or from other services within tertiary hospitals within the city ( $n=155$ , 79%). Twenty-two (11%) patients were admitted to the rehabilitation unit directly from the neurology service, while 16 (8%) were admitted from nursing homes. Three (1.4%) patients were referred from the acute rehabilitation units within the same city. Patients were admitted into the program a mean of  $56 \pm 33$  days following onset on symptoms (median 49, IQR 38.5, range 13-176).

The median admission and discharge FIM™ scores of patients were 46 (IQR 20, range: 19-96) and 70 (IQR 30, range: 18-121), respectively. (See Figures 1 and 2). The improvement over the course of hospitalization was statistically significant ( $Z = -11.18$ ,  $p < 0.0001$ ). The FIM™ scores were available for 181 patients, while 15 scores were missing. One hundred and seventy-one patients (94.5%) had higher discharge FIM™ scores compared to admission scores, while eight patients (4.4%) had lower FIM™ scores upon discharge and the FIM™ scores of two patients (1.1%) did not change. The median change in FIM™ score was +22 (IQR 19, range: -25 to 66). The mean ( $\pm$ SD) length of hospital stay was  $88 \pm 39$  days (median 84, IQR 54, range 11-232). By discharge 54 patients (27.6%) could ambulate, either independently or with the use of an assistive device, while 142 (72.4%) remained wheelchair dependent. Eighty-five patients (43.4%) returned to their own home upon discharge,

while the remainder were admitted to nursing homes or hospitals closer to the patients' home (n=104, 56.6%).

Complete FIM™ data was available for the sub-group of patients with admission FIM™ scores of < 50 (n=110). Their median admission and discharge FIM™ scores were 38.5 (IQR 13, range: 19-49) and 60 (IQR 21, range: 18-114), respectively. The change in FIM™ score (median = 21, IQR=21, range:-25-66) was also statistically significant (Z= -8.61, p<0.0001). Eight patients had lower FIM™ scores at discharge compared to

admission. One patient developed serious medical complications and deteriorated considerably (FIM™ change -25). The median length of hospital stay was similar for this sub group (80 days, IQR 57, range: 11-195 days.) Thirty-five (32%) of patients were able to return home upon discharge from the program, while 18 (16%) were able to ambulate with or without assistance at that point.

The results from multiple logistic regression showed that the most powerful predictors of successful discharge home in descending order of importance were admission FIM™ score, age, male sex, and no history of previous stroke (see Table). Possible predictor variables entered into the model included: gender, age, onset days, stroke type, stroke location, diabetes, hemiparesis, aphasia, dysphagia, urinary incontinence, neglect, admission FIM™, ambulation status on admission and previous stroke. The pseudo R-squared ranged from 0.253 (Cox & Snell R square) to 0.337 (Nagelkerke R square). The model was able to correctly predict the overall outcome 73.4% of the time. Of the patients, 65.4% were correctly predicted to return home, while 77% were predicted by the model to require institutionalization.

## DISCUSSION

This descriptive study examined the functional outcomes of a cohort of severely disabled stroke patients admitted to a unique and highly specialized rehabilitation unit. All patients were non-ambulatory on admission, while the majority entered the program with a FIM™ score generally regarded as incompatible with independence or likely discharge home without heroic efforts by the spouse or other family members. However, despite a lengthy average rehabilitation period of 88 days, almost half of the patients were able to return home after achieving significant gains in activities of daily living (ADL) performance by discharge. These patients, were considered to be "lower band", with an average admission FIM™ score of 47 at day 56 post

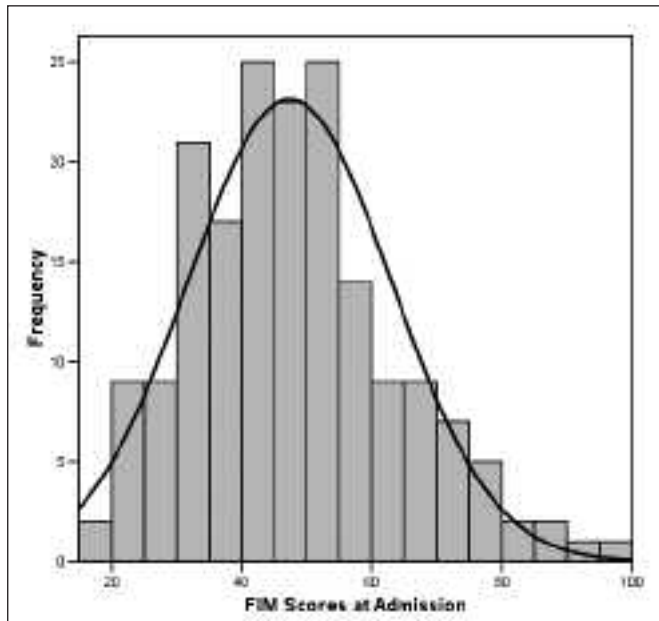


Figure 1: Admission FIM Scores

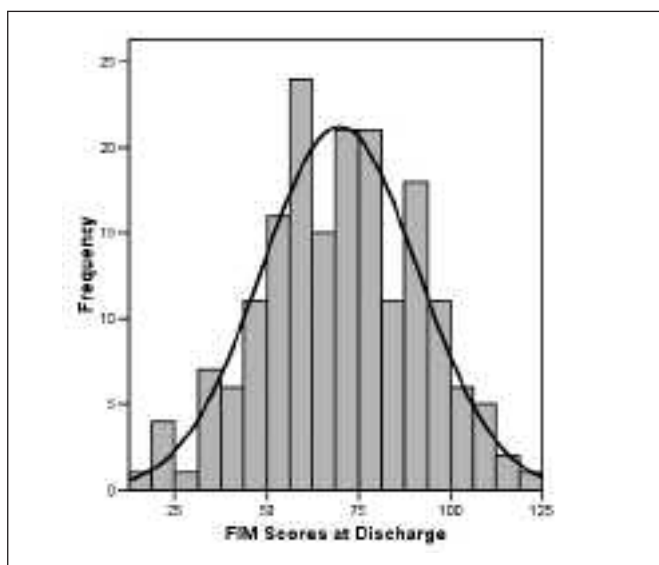


Figure 2: Discharge FIM Scores

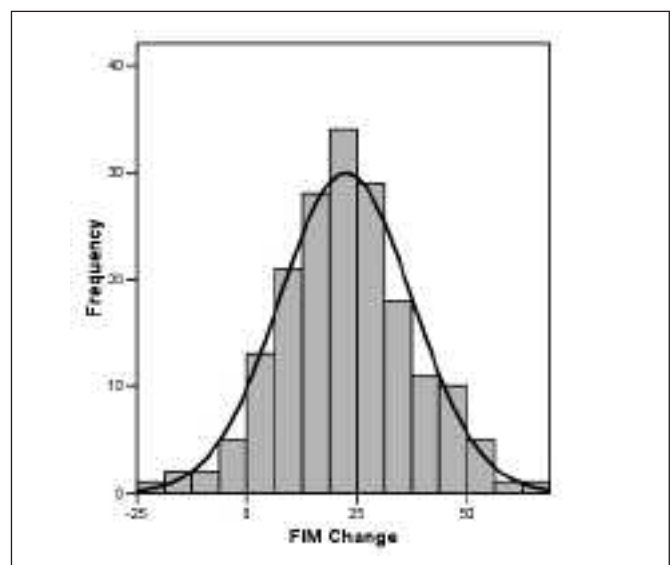


Figure 3: FIM Change Scores

**Table: Logistic Regression Model Predicting Home Discharge**

Variable	Co-efficient	SE	OR (95% CI)	p value
Constant	0.205	1.504		0.892
Admission FIM	-0.056	0.013	.95 (0.92, 0.96)	<0.0001
Age	0.052	0.016	1.05 (1.02, 1.09)	0.002
Male Sex	-0.821	0.358	.44 (0.22, 0.89)	0.022
Previous stroke	0.945	0.439	2.58 (1.08, 6.08)	0.031

stroke and they could not be accommodated through the regular rehabilitation programs within the city. In many cases, conventional wisdom would have denied them access to a formal rehabilitation program, thereby greatly diminishing their likelihood of returning home. While recent research has confirmed the value of triaging patients based on stroke severity into the appropriate level of stroke rehabilitation,<sup>18</sup> there are limitations in relying on ADL assessment exclusively to determine appropriate rehabilitation potential. In part, this is because groups of patients often behave differently compared to individuals. Ween et al<sup>18</sup> suggested that, patients with severe strokes (early admission FIM<sup>TM</sup> score < 40) almost always required long-term care in a nursing home facility. The authors recommended that these patients should likely go to a slower paced or less intensive rehabilitation facility, including geriatric reactivation units. However, the results from the present study would suggest that more severely impaired patients also benefit from intensive rehabilitation although the patients may not be directly comparable since the admission FIM<sup>TM</sup> scores of patients in this study were assessed at an average of 57 days post stroke and not earlier.

Comparisons between the results of this study and others are difficult since we are not aware of any published reports detailing the outcomes of more profoundly disabled stroke patients admitted to a specialized rehabilitation program. Most published reports focus on subgroups from heterogeneous samples of stroke patients, using different criteria to define "severe stroke" and included patients who arrived at a rehabilitation program within a shorter timeframe.<sup>8,9,12</sup> Several authors have reported improved outcomes of more severely disabled patients receiving specialized inpatient stroke rehabilitation, compared to treatment in the community or on general medical wards. Kalra et al<sup>8,9</sup> reported shorter lengths of stay, reductions in mortality and an increase in the proportion of patients returning home, for severe stroke patients (Orpington Prognostic Score of >5) receiving care on a specialized inpatient unit. Among patients with an initial Barthel Index score less than 50, Ronning and Guldvog<sup>12</sup> reported greater functional improvement for patients receiving in-patient tertiary-care rehabilitation compared with those receiving ad hoc care in their local community (median Barthel Index score of 90 vs. 73). Jorgenson et al<sup>10,11</sup> reported that, of the of 1,241 stroke patients who received care in two different medical districts of

Copenhagen, the patients who benefited most were those with the most severe strokes (Scandinavian Stroke Scale score of < 15 points). The relative risk of one and five-year mortality were reduced by 40% and 70% respectively for the severe stroke patients. The authors attributed the marked improvement in outcome to the interdisciplinary coordinated rehabilitation approach with early mobilization rather than acute intensive monitoring. However, Jorgensen et al.<sup>10</sup> also found that only 14% of very severe stroke patients (Scandinavian Stroke Scale [SSS] score of <15) and 34% of patients with severe strokes (SSS 15-29) were able to return home following rehabilitation. In contrast, 100% of severe stroke patients (admission FIM scores of < 40) studied by Nolfe et al<sup>19</sup> returned home following a 60-day inpatient rehabilitation stay, although it is unclear if additional, live-in family or caregiver assistance was also required to achieve this outcome. Such a high rate of return home suggests that social and cultural differences may also influence the decision to send a severely disabled patient home, or that alternative destination opportunities were limited.

Certain elements of rehabilitation, generally thought to be responsible for the improved outcomes associated with specialized rehabilitation (regardless of initial stroke severity), have been previously identified<sup>20</sup> and include: better skilled and educated staff members, better integration and organization of services, higher intensity of therapies and more aggressive attention to the treatment and prevention of medical issues. However, there is still much debate as to the respective contributions of each of these elements and it appears that stroke rehabilitation has a greater effect than the sum of its individual parts. For example, Chen et al.<sup>21</sup> reported that although admission function, length of stay and therapy intensity collectively contributed to greater functional gains, length of stay and therapy intensity did not always predict those gains. For the more severely impaired patients, while the benefit of stroke rehabilitation is apparent, the means by which that benefit is achieved is not as clear. In addition to the usual characteristics associated with rehabilitation units, patients examined in this study may have benefited from the opportunity to remain for an extended period of time to maximize their rehabilitation potential and also from access to the independent living unit, which simulated the home environment and provided a means by which to "practice". The emphasis on community reintegration and education and caregiver support, as well as repeated

opportunities for skill practice, likely also contributed to the positive patient outcomes. The average length of stay on the rehabilitation unit was more than double that of the other two units in the city, which typically accepted “middle-band” stroke patients. The fact that these patients were almost two months post stroke onset reduced the possibility that the gains could have been attributed to spontaneous neurological recovery or that such recovery in the absence of rehabilitation would have resulted in half of the patients being discharged home.

In our study, the logistic regression model could only explain a small amount of the variability in discharge destination. This was a disappointing finding given that this model was restricted to a more homogenous group of patients than others that have been reported. Although many models to predict discharge variables have been published, which include a broad range of predictor variables, age and admission ADL scores have been consistently shown to most accurately predict discharge disposition. The majority of these studies have included patients across the continuum of stroke severity.<sup>4,13-15,18</sup>

The generalizability of the results of this study are limited by the non-standardized eligibility criteria for admission into the program and because the program itself was highly individualized. However, in many institutions, acceptance into conventional rehabilitation programs intended for patients with moderately severe disability (“middle-band” patients) is also often at the discretion of the admitting physician, and eligibility criteria are also often less than rigid and firmly established. This rehabilitation program, like the majority of others, was tailored to patients’ individual needs and tolerances, and the unique contribution of each of the components, which enabled patients to achieve their significant gains, remains unknown. We can assume that through a small, well-integrated program, providing an “enriched” supportive environment and a number of opportunities for repeated practice, many severely impaired patients were able to achieve a greater than anticipated level of independence. Staff members were active participants in the development and refinement of the program, as required, and were committed to its success. We may also speculate that therapists who had the opportunity to work with a homogeneous group of patients, developed greater expertise themselves and became more effective and efficient at providing care.

Ideally the outcomes of patients treated on the specialized unit should be compared to a similar group of patients who received usual care; therefore, the authors cannot be confident that, however unlikely, similar results could have been achieved in a significant number of patients discharged directly to a nursing home or a chronic care facility. We have no information on the rehabilitation outcomes of discharge destinations of patients not selected for the program. Potentially influential factors such as marital status or the availability of a dedicated caregiver were not included in the regression model.

The results of this study indicated that selected patients with severe levels of impairment resulting from stroke can be successfully rehabilitated within a specially designed rehabilitation unit that used an integrated patient-centred approach to provide therapies tailored to the needs of individual patients. The results may further suggest that resources need to be made available to accommodate the rehabilitation needs of individuals with more severe strokes. Patients made considerable gains in the areas of self-care and mobility and almost half were

discharged home. Higher admission FIM™ scores, younger age, absence of previous strokes and male gender were the variables that predicted discharge home.

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