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Managing the Stroke Rehabilitation Triage Process

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Abstract

The challenge of constructing an exemplary stroke rehabilitation system is balancing the attempt to maximize patient outcomes while controlling costs. This review, using findings from Chapters 3, 5, 7, 21, and 22 and from evidence-based consensus opinions, presents research on the stroke rehabilitation triage process. Evidence on patient screening, establishing assessment criteria, stroke severity, and unit location is reported. As well, a potential stroke rehabilitation triage system is proposed.

Key Points

- Screening assessments for rehabilitation should be performed as soon as possible.
- Patients with stroke who are eligible for rehabilitation must be able to learn and have sufficient endurance to participate.
- Eligible patients with stroke should be engaged in rehabilitation as soon as they are able to do so. However, higher doses of long-term mobilization in the initial weeks can be harmful, while shorter and more frequent mobilization can improve outcomes.
- The most powerful predictor of rehabilitation outcomes is initial stroke severity followed by age.
- Mild strokes benefit the least from stroke rehabilitation because of a "ceiling effect". While moderate to severe strokes improve the most from stroke rehabilitation, increasing stroke severity is ultimately associated with poorer outcomes.
- Older age can negatively impact stroke recovery, although its contribution is small compared to stroke severity. Overall, age is also not considered to be a strong predictor of functional recovery after stroke.
- Younger patients with stroke account for a small percentage of individuals with stroke. These patients typically do well with rehabilitation, making significant functional gains, and nearly all are discharged home.
- Very elderly patients with stroke should be considered candidates for rehabilitation, regardless of stroke severity, and each case needs to be considered on the basis of individual characteristics and potential. Factors such as premorbid fitness, cognitive functioning, family/community support, and comorbidities are considered important in these cases.
- Patients with mild stroke can be rehabilitated in an outpatient setting by an interdisciplinary stroke rehabilitation team. However, evidence for superiority of home-based or hospital-based outpatient stroke rehabilitation is conflicting.
- Wherever possible, based on best evidence, patients with moderately severe strokes should receive rehabilitation on stroke specific rehabilitation units. However, in practice, rehabilitation on a stroke specialized unit does not guarantee better outcomes, as other factors may also be important, such as continuity of care.
- Patients with severe strokes may be better managed on specialized stroke rehabilitation units.

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4.1 Determining Stroke Rehabilitation Admission

4.1.1 Screening Assessment

A screening examination for rehabilitation should be performed as soon as the patient's medical and neurological condition permits, by a person experienced in rehabilitation (Post-Stroke Rehabilitation Guideline Development Panel U.S. Department of Health and Human Services Public Health Service Agency for Health Care Policy and Research, 1995; Winstein et al., 2016). The screening examination should incorporate medical information, neurological examination, use of a well-standardized disability instrument, and a mental status screening test. Asberg and Nydevik (1991) felt that the optimal timing for stroke rehabilitation assessment was 5-7 days post stroke, although more recent trends have seen assessments reduced to being done within the first 3-5 days. The importance of a proper screening assessment was demonstrated in a study conducted by Edwards et al. (2006) who reported that screening measures detected significantly more impairments than what was documented in patient charts at discharge. The authors suggested that systematic screening and assessments are required, even if specific deficits are not immediately noticeable upon observation (Edwards et al., 2006).

Screening for cognitive deficits has also been found to be of clinical value. Dong et al. (2013) revealed that assessment using the Montreal Cognitive Assessment (MocA) and Mini-Mental State Examination (MMSE) were both predictive of functional outcome at 3-6 months post stroke, according to the Modified Rankin Scale (mRS). A systematic review by Burton et al. (2015) found that the MoCA was the most psychometrically valid and clinically feasible screening tool for cognitive impairments post stroke, while the MMSE was best for dementia screening. Early screening assessments also help with identifying mild and moderate patients suitable for early supported discharge, which can improve functional recovery and increase hospital capacity (Meyer et al., 2016). Outpatient rehabilitation and early supported discharge are discussed further in Chapter 7.

Conclusions Regarding Screening Assessment

Screening assessment for rehabilitation should be performed as soon as possible following stroke.

4.1.2 Threshold Admission Criteria

Threshold criteria for admission to a comprehensive rehabilitation program include medical stability, the presence of a functional deficit, the ability to learn, as well as enough physical endurance to sit unsupported for at least one hour and to participate actively in rehabilitation (Post-Stroke Rehabilitation Guideline Development Panel U.S. Department of Health and Human Services Public Health Service Agency for Health Care Policy and Research, 1995). Admission to an interdisciplinary program should be limited to patients who have more than one type of disability and who therefore require the services of two or more rehabilitation disciplines. Patients with a single disability can benefit from individual services, but generally do not require an interdisciplinary program (Post-Stroke Rehabilitation Guideline Development Panel U.S. Department of Health and Human Services Public Health Service Agency for Health Care Policy and Research, 1995). Determining the most appropriate form of rehabilitation involves taking into account many different factors, including severity of deficits, activity limitations, cognitive ability, psychological status, available caregiver support, medial comorbidities, and ability to participate in a rehabilitation program; evaluation of a patient’s rehabilitation needs is best performed by an experienced interprofessional team (Winstein et al., 2016).

Conclusions Regarding Threshold Admission Criteria

Patients with stroke who are eligible for rehabilitation must be able to learn and have sufficient endurance to participate.

4.1.3 Timing of Admission to Stroke Rehabilitation

There is a growing literature on the benefits of early admission to rehabilitation. Biernaskie et al (2004) performed a randomized controlled trial (RCT) using a rat model to establish the effect of rehabilitation timing on outcomes post stroke. A small focal lesion was placed on the rats' brains, which were then exposed to an enriched environment with rehabilitative training (treatment) or to social housing (control) for five weeks beginning at days 5, 14, or 30 post stroke. Animals who received enriched training at day 5 demonstrated a marked improvement in recovery, which was accompanied by an increased complexity of dendritic branching in the unaffected areas, when compared to those who began rehabilitation at day 30. The differences in cortical reorganization and functional recovery between animals in the social housing group and those who began rehabilitation at day 30 were similar. The authors noted that previous research (Barbay et al., 2001) also demonstrated a time dependent rehabilitation induced map reorganization following ischemic injury. The remaining preserved cortical regions were the most responsive to rehabilitation training earlier rather than later post stroke. As well, Schallert et al. (2003) noted that the brain appears to be "primed" for recovery early following stroke, and so rehabilitation therapies will be the most effective at this point.

Animal studies suggest that there is a time window where the brain is "primed" for maximal response to rehabilitation therapies, such that delays in initiating rehabilitation are detrimental to recovery (Biernaskie et al., 2004). The effects of post stroke training are generally greater when started early after a stroke, perhaps because of a "sensitive" period of enhanced neuroplasticity. Clinical studies have shown an association between early admission to rehabilitation and better functional outcomes (Bai et al., 2012; Paolucci et al., 2000; Salter et al., 2006). One prospective comparative trial by Paolucci et al. (2000) looked at the outcomes of patients with stroke admitted to rehabilitation at different times following stroke. They found that those patients with stroke who received rehabilitation early did better functionally than those whose rehabilitation was delayed. In an RCT conducted by Liu et al. (2014), it was suggested that patients who received early rehabilitation were less likely to experience mortality and obtained higher scores on the BI and the physical and mental components of the SF-36 compared with patients who received standard care only. Moreover, Askim et al. (2014) reported that patients who spent a greater length of time on bed rest exhibited significantly poorer outcome at 3 months post stroke compared to patients who participated in motor activity.

While many clinical practice guidelines recommend early mobilization after stroke (Winstein et al., 2016), the benefit of early rehabilitation has been brought into question by A Very Early Rehabilitation Trial (AVERT) (AVERT Collaboration Group, 2015). In this trial, patients less than 24 hours post stroke were randomly assigned to standard care alone (n=1050) or with very early mobilization (VEM; n=1054) until discharge. The VEM group started mobilization earlier (18.5 vs 22.4 hours post stroke), received more out of bed sessions (6.5 vs. 3.0), and received more therapy (31 minutes/day for 201 minutes total vs. 10 minutes/day for 70 minutes total). More patients in standard care than VEM (p=0.001) had a favourable outcome (mRS=0-2) at 3 months post stroke. Secondary analyses found improved odds of a favourable outcome with increased daily frequency of out-of-bed sessions (Bernhardt et al., 2016). Overall, more frequent and shorter doses of early mobilization improve the chances of regaining independence, while higher doses of long-term mobilization can worsen outcomes.

Conclusions Regarding the Timing of Admission

Eligible patients with stroke should be engaged in rehabilitation as soon as they are able to do so. However, higher doses of long-term mobilization in the initial weeks can be harmful, while shorter and more frequent mobilization can improve outcomes.

4.2 Predictors of Stroke Rehabilitation Outcome

An effective triage system allows patients with stroke to be quickly matched with the appropriate intensity of resources or easily moved to different levels of rehabilitation intensity according to their needs, and is critical to any well-functioning stroke rehabilitation system. Before an objective and transparent triage system can be set up, there must be consistent objective measures of functional abilities and outcomes.

Following stroke, all individuals need care, support, and education, but not all need formal rehabilitation. Approximately 20% of individuals fully recover functional independence by 2 weeks post stroke (Kelly-Hayes et al., 1988). It is estimated that another 20% have such severe functional deficits that they are expected to remain non-ambulatory and continue to require assistance with activities of daily living (ADLs) irrespective of rehabilitation efforts (Pfeffer & Reding, 1998). In the cases of severe stroke, the age of the patient and the presence of a caregiver (Pereira et al., 2014; Pereira et al., 2012) dictates whether rehabilitation will alter the discharge destination or improve function of all abilities to a substantial degree. Between these extremes are individuals with varying degrees of disability, for whom the goal should be to identify the best possible match between their needs and the capabilities of available rehabilitation facilities.

Alexander (1994) noted that the most powerful predictors of functional recovery are initial stroke severity and the patient's age. This finding has been confirmed by Stineman et al. (1998) and Stineman and Granger (1998), although the effect of age diminishes for patients with less initial disability (FIM>60-65), leaving stroke severity as the most powerful predictor. Discharge to inpatient rehabilitation was found to be associated with older age, greater length of stay in intensive care, higher therapy costs, and living in a country of lower poverty; the opposite was true for each of these factors for patients discharged home (Gregory & Han, 2009). Similarly, factors such as older age, impaired cognition, lower functional level, and urinary incontinence were found to be predictors of increased inpatient rehabilitation (Winstein et al., 2016).

A cluster analysis by Buijck et al. (2012) revealed two groups of patients who had received rehabilitation at a skilled nursing facility; those in fair condition and those in poor condition upon admission. These clusters were based on balance, gait, arm function, ADL performance, and neuropsychiatric complaints. Nearly half (46%) of patients in the poor condition cluster were able to be discharged to assisted-living or an independent living program, implying that these discharge destinations are attainable despite stroke severity. In a study of 189 patients with severe stroke admitted to a specialized interdisciplinary stroke rehabilitation unit, Pereira et al. (2014) found that only one patient of the 123 discharged home did not have a caregiver, indicating a near zero likelihood of being discharged home if a caregiver was not present. Moreover, those patients with a caregiver achieved higher FIM gains during stroke rehabilitation than those without a caregiver.

A systematic review with 27 studies found that admission functional level (FIM or BI), stroke severity (National Institutes of Health Stroke Scale; NIHSS), dysphasia, impulsivity, neglect, previous stroke, and age were significant predictors of functional ability after inpatient stroke rehabilitation (M. J. Meyer et al., 2015). Data from four countries showed that baseline NIHSS score was essential for predicting good outcome after stroke, with age also being an important predictor (Rost et al., 2016).

Conclusions Regarding Predictors of Stroke Rehabilitation Outcome

The two most powerful predictors of functional recovery and eventual discharge home are age and initial stroke severity, with the latter being the most important. However, this does not preclude the use of additional factors to determine appropriate stroke rehabilitation destination during triage.

The most powerful predictor of rehabilitation outcomes is initial stroke severity followed by age.

4.3 Levels of Stroke Severity

4.3.1 Levels of Severity and Stroke Rehabilitation

A number of research studies have demonstrated that upper and lower limb motor impairment post stroke resolves within 6 months by "fixed proportion". Fixed proportion states 70% of possible maximum improvement of motor impairment occurs regardless of the initial impairment, as measured by the Fugl-Meyer score, in those patients with relatively intact corticospinal (motor) tract function (Prabhakaran et al., 2008). Byblow et al. (2015) noted that the fixed proportion holds true for patients across all ages and countries with different rehabilitation services. It is important to note that proportional resolution of upper extremity impairment is minimally affected by rehabilitation therapy.

As noted in Chapter 3, animals with small strokes will experience functional and structural recovery occurring spontaneously (without rehabilitation therapy) for weeks to months post stroke. Irreversible structural damage to the corticospinal tract severely limits recovery of the upper limb movement (Stinear et al., 2012; Stinear et al., 2007). 3D kinematics in individuals with subacute and chronic stroke have shown motor recovery associated with rehabilitation is driven more by adaptive or compensatory learning strategies. Most clinical tests (e.g. Action Reaction Arm Test or 6-Minute Walk Test) only assess a patient's ability to accomplish a certain task or function but do not measure impairment. Animals with larger lesions show much less return of function and function that does return may take weeks or months to stabilize. Compensatory movements play an important role with cortical activation and reorganization occurring in more distant cortical areas. In fact, rehabilitation likely promotes largely adaptive or compensatory motor recovery.

Three Levels of Stroke: Mild, Moderate, and Severe

A paradigm for classifying early stroke-related disability was developed by Garraway et al. (1981), which is presented in Table 4.3.1.1.

Table 4.3.1.1 Levels of Severity of Stroke Rehabilitation Patients (Garraway et al. 1981, 1985)

Level of Severity	Mild Strokes	Moderate Strokes	Severe Strokes
Referred to as:	"Upper-Band"	"Middle-Band"	"Lower-Band"
Early FIM Score (Ween et al. 1996)	> 80	40-80	< 40
Early Motor FIM (Stineman 1998)	> 62	38-62	< 38

FIM=Functional Independence Measure

The most powerful predictor of functional recovery is stroke severity (Garraway, 1985; Garraway et al., 1981). Using the Functional Independence Measure (FIM), the first concept of stroke recovery during the acute phase was developed based on three bands of stroke severity: Mild, Moderate, and Severe.

Mild Strokes

Patients with milder strokes have been defined as having an early (first 3-5 days post-onset) FIM score >80. FIM scores tend to increase over time with spontaneous recovery so the FIM score >80 refers to that very early initial phase post stroke onset. Stineman et al. (1998) defined these patients with milder strokes as having a motor FIM >62 at the time of rehabilitation admission. Mild stroke has also been classified on the NIHSS as less than a score of 16 points (Askim et al., 2014). Given that their deficits are lesser, these patients can generally be managed in the community if outpatient resources are available and there are no specific issues to be addressed on an inpatient stroke unit. These patients tend to recover well but their ability to benefit from rehabilitation is limited by a "ceiling" effect.

Moderate Strokes

Garraway et al. (1985; 1981) defined moderate strokes as conscious acutely with a clinically significant hemiplegia/hemiparesis. These patients have been defined as having an early (first 3-5 days post-stroke onset) FIM score of 40-80 and, more specifically, a motor FIM between 38-62 at the time of rehabilitation admission (Stineman et al., 1998). Moderate stroke has also been classified on the NIHSS as a score between 8-16 points (Askim et al., 2014). These patients frequently demonstrate marked improvements in all areas although they are often partially dependent in some areas at the time of discharge. Over 85% are discharged to the community (Stineman et al., 1998), a number that has stayed relatively constant, and it is these patients who appear to improve the most with rehabilitation. The patient with moderate stroke is thought to be the main focus of most inpatient stroke rehabilitation.

Severe Strokes

Garraway et al. (1985; 1981) defined patients with severe stroke as unconscious at onset with severe unilateral or bilateral paresis. Alternatively, patients may be considered more severe if there is serious medical co-morbidity which adds to the overall stroke disability and makes rehabilitation more challenging. Ween et al. (1996) defined patients with severe stroke as having an early FIM score <40, while Stineman et al. (1998) defined it as Motor FIM score <38 at rehabilitation admission. These patients are less likely to achieve functional independence, regardless of treatment, unless they are younger (see below). Patients with severe stroke also have the longest rehabilitation stays as well as a lesser likelihood of community discharge (Stineman et al., 1998). Although the stroke may be so severe they do not progress sufficiently to be discharged home, these patients can still make significant gains and be discharged home with strong family and community supports. These patients do not improve as consistently as patients with moderate stroke, but improvement in this group appears to be more dependent on the availability of stroke rehabilitation.

Stroke Severity and Outcomes

Wang et al. (2015) revealed that patients with severe stroke at admission experienced significantly higher cognitive gains, were at lower risk of transfer to an acute hospital, and were more likely to be discharged into the community when admitted to stroke rehabilitation within 7 days of stroke onset. Further, patients with severe stroke exhibited greater gains in motor ability when admitted within 14 days of onset, whereas patients with stroke of a moderate severity demonstrated significantly greater motor gains when admitted within 7 days. However, there was no association between functional gain and stroke onset among patients with mild stroke. Length of stay was also shorter for patients with severe stroke when admitted within 14 days, within 2 days for moderate strokes, and 7 days for mild strokes (Wang et al., 2015). Stroke severity has also been found to predict quality of life after inpatient rehabilitation, with increased severity associated with lower quality of life at both 6 months and 1 year post stroke (Chang et al., 2016; Chen et al., 2015).

4.3.2 Severity of Stroke and Impact of Rehabilitation

Carey and Seibert (1988), Asberg and Nydevik (1991), Alexander (1994), and Jorgensen et al. (2000) reported that individuals with moderate stroke made the most functional gains, whereas milder strokes were limited by a ceiling effect. While patients with severe stroke can make significant gains in rehabilitation, they are less consistent in their gains. Studies have examined the relationship between stroke severity and rehabilitation outcomes (Table 4.3.2.1).

Table 4.3.2.1 Severity of Stroke and Impact of Rehabilitation

Author, Year Country Study Design Sample Size	Methods	Outcomes
Ween et al. (1996) USA Observational N=536	Consecutive admissions to Braintree Hospital with a primary diagnosis of stroke were prospectively followed. Patients with subarachnoid haemorrhages and strokes requiring cerebral surgical interventions were excluded. All patients included into the study received rehabilitation on general rehabilitation units in the standard, multi-disciplinary fashion. Independent measures suspected of influencing outcomes were assessed 2 or 3 days after admission (age, severity of deficit, lesion types, lesion site, existence of comorbidities, incontinence of bladder, socioeconomic constraints). Dependent measures were determined upon discharge (FIM).	1. Age had a strong influence on FIM change across the whole population while only the 55-64 vs. > 85 age group comparison reached statistical significance. 2. FIM efficiency was found to be significantly different between the 65-74 and 75-85 group. 3. Admission FIM influenced FIM change across the population with significant difference between <40 and 40-59 scores, <40 and 60-80 and <40 and <80 score groups. 4. Large-vessel stroke did significantly worse than small-vessel stroke or haemorrhages. 5. Lesion site influenced FIM change with bilateral and right-sided lesions doing worse than left-sided. 6. Right-sided lesions also had less FIM efficiency than left-sided. 7. No single comorbidity had an isolated effect on any dependent measure. 8. Incontinence reflected severity of deficit. Continence on admission was associated with 84% rate of home discharge while incontinence on admission reduced rate to 55%. 9. Dysphagia alone was associated with diminished FIM change, less FIM efficiency and less likelihood of home discharge.
Oczkowski & Barreca (1993) Canada Observational N=113	Consecutive patients were observed from admission to discharge to determine the use of the FIM as a prognostic indicator of outcome in stroke. Rehabilitation was by a multi-disciplinary team. After initial assessment, rehabilitation goals were set and reviewed and revised every 2 weeks for each patient.	1. Admission to rehabilitation unit occurred a median of 52 days after stroke onset. Rehabilitation was given an average of 64 days. 2. Patients discharged home were younger than those who were institutionalized. 3. Chedoke-McMaster Stroke Assessment and bladder and bowel incontinence on admission were predictive of discharge location. 4. Patients discharged home had significantly higher FIM scores on admission and discharge. 5. Patients discharged to await chronic care had the least change in FIM scores and those awaiting discharge to nursing home placement had similar change as home discharged patients. 6. Patients with any degree of hemianopia, sensory loss, parietal neglect, aphasia or cognitive impairment had

		significantly lower FIM scores than those patients without these impairments. 7. Best predictor of location of discharge was FIM scores at admission, admission postural staging and age. FIM scores of 36 or less never get home, scores of 97 or more inevitably go home.
Jorgensen et al. (2000) Denmark Observational N=1197	**Population:** Mean age=74.3±11.0yr; Gender: Males=551, Females=646. **Intervention:** To describe the neurological and functional recovery in relation to stroke severity. **Outcomes:** Discharge destination, Scandinavian Neurological Stroke Scale (SSS), Barthel Index (BI).	1. Almost all patients with mild stroke, 75% of patients with moderate stroke, 33% of patients with severe stroke, and 14% of the patients with the most severe stroke could be discharged home. 2. Final SSS is strongly related to SSS at admission. 3. Higher BI at admission was associated with reduced BI improvement after rehabilitation, except for those with very severe initial impairment who had less BI improvement.
Andrews et al. (2015) USA Case Control N=64065	**Population:** Age: 45-64=17618, 65-74=16785, 75-84=18707, 85+=10955; Gender: Males=50%, Females=50%. **Intervention:** To examine the association between intensity of rehabilitation services and hospital readmission. **Outcomes:** 30-day hospital readmission, 90-day hospital readmission.	1. Adjusting for demographic characteristics, comorbidities, number of chronic conditions, measures of illness severity, and hospital quality measures, individuals who received higher-intensity therapy had a significantly decreased risk of hospital readmission at 30d (Hazard ratio: no therapy=1.30, medium-low=0.91, medium-high=0.85, high=0.86) and 90d (Hazard ratio: no therapy=1.31, medium-low=0.95, medium-high=0.90, high=0.91) relative to those who received low-intensity therapy.
Jain et al. (2016) USA Case Series N=2909	**Population:** Mean age=69±15.7yr; Gender: Males=1406, Females=1503. **Intervention:** To determine whether the value of the National Institutes of Health Stroke Scale (NIHSS) as a predictor of stroke outcome. **Outcomes:** Mortality, Worsening ambulatory function.	1. After adjusting for confounders, increased admission NIHSS was significantly associated with increased mortality (relative risk=2.34). 2. After adjusting for confounders, increased admission NIHSS was significantly associated with increased worsening of ambulatory function (relative risk=3.28). 3. Age was a significant confounding factor (older patients were less likely to survive, had worsening ambulatory function, and had higher NIHSS score).
Sung et al. (2016) Taiwan Case Series N=7551	**Population:** Mean age=69.5±12.5yr; Gender: Males=4393, Females=3158. **Intervention:** To compare the predictive ability of different stroke severity measures. **Outcomes:** All-cause mortality at 30d, All-cause mortality at 1yr.	1. Higher Stroke Severity Index (SSI) predicted 30d and 1yr mortality. 2. The AUC of the SSI model was higher than models using length of stay, stroke type, secondary diagnoses, or procedure codes.

Ween et al. (1996) prospectively analyzed 536 consecutive stroke rehabilitation admissions to identify the influence of preselected factors on functional improvement and discharge destination. Patients with an admission FIM >80 almost always went home after rehabilitation. It was recommended that patients with early FIM >80 (i.e. mildly disabled) are best managed at home, as long as appropriate supports are in place. Conversely, patients admitted to rehabilitation with FIM <40 almost always required long-term care in a nursing home facility. It was recommended that patients with FIM <40 (i.e. more severely disabled) should likely go to a slower paced or less intensive rehabilitation facility or a decision not made at the time of initial assessment. An admission FIM ≥60 was associated with a larger FIM improvement, but the absence of a committed caregiver at home increased the risk of nursing home discharge. Therefore, it was recommended that intensive rehabilitation units are most likely to be effective for

patients with moderate stroke (early FIM scores between 40 and 80). These patients are generally able to participate fully, show substantial improvement during rehabilitation, and have a high probability of discharge home (Alexander, 1994).

Oczkowski and Barreca (1993) explored the usefulness of the FIM as a prognostic indicator of outcome in 113 patients admitted to a Canadian rehabilitation unit post stroke. Using multiple logistic regression, the authors determined that the best predictors of discharge location were FIM score at admission, admission postural staging, and age; admission FIM score was the most powerful predictor. Three distinct groups of stroke survivors were identified. Patients with admission FIM ≤36 showed minimal improvement, remained severely disabled, and typically required long-term institutionalization, particularly in the absence of an extremely supportive and healthy caregiver. Patients with admission FIM > 96 also tended to show relatively small FIM gains and almost invariably were able to return home. The relatively small change in scores seen in this group of patients could be in part attributed to the ceiling effect. Patients with admission FIM scores between 36 and 96 exhibited the greatest overall FIM gains. However, discharge destination was difficult to predict due to other factors such as comorbidities, cognitive and perceptual impairments, and the presence or absence of a supportive caregiver. This study was limited by the almost 2 months to admission.

Jorgensen et al. (2000) conducted the Copenhagen Stroke Study, a prospective analysis of 1,197 consecutive patients admitted to a stroke unit. The initial stroke severity was measured by the Scandinavian Stroke Scale (SSS) at the time of acute admission (Group, 1985). The scale's score ranges from 0-58 points with classifications of very severe (0-14), severe (15-29), moderate (30-44), and mild (45-58). At the time of acute admission, 41% of the patients were mild, 26% moderate, 14% severe, and 19% of very severe severity. Almost all patients with a mild stroke were discharged to their own home. The proportion of patients discharged to their homes occurred in 75% of patients with a moderate stroke, 33% of severe strokes, and only 14% of the most severe strokes. For those patients who had suffered a severe stroke, one third had died, one third were discharged back to their own homes, and one-third had to be discharged to a nursing home despite rehabilitation. Interestingly, Jorgensen et al. (2000) noted that the mean gain in BI score from admission to discharge was 16 points, but the gain in BI score varied widely and was related to the level of initial disability. In patients with very severe initial stroke disability, the average gain was 24 points, 41 points for patients with severe stroke, 27 points for those with moderate stroke, and 8 points for those with mild stroke. The small gain in points seen in the patients with mild strokes likely reflects a "ceiling" effect.

Other measures of stroke severity have also been good predictors of rehabilitation outcome. Andrews et al. (2015) examined the intensity of rehabilitation therapy for acute stroke inpatients. Even though patients receiving higher intensity therapy had higher admission stroke severity, they had a lower risk of hospital readmission compared to patients receiving lower intensity therapy (Andrews et al., 2015). In a community hospital setting, Jain et al. (2016) found that higher NIHSS score at admission was significantly associated with increased likelihood of mortality and worsening of ambulatory function. Sung et al. (2016) reported that a predictive model of 30-day and 1-year mortality rates using the Stroke Severity Index (SSI) significantly outperformed two other models, with one that used length of stay and another that noted ventilation, surgical procedure, hemiplegia, and neurological deficits. The findings indicated that stroke severity can be predictive of future outcomes and allowed for risk adjustment. The authors noted that the SSI not only demonstrated a strong correlation with the NIHSS, but the components of the tool are easy to use and can be taken upon admission or when the patient exhibits a change in clinical condition (Sung et al., 2016).

Conclusions Regarding the Levels of Stroke Severity

There is Level 3 evidence that severity of stroke predicts ability to participate and benefit from stroke rehabilitation.

Mild strokes benefit the least from stroke rehabilitation because of a "ceiling effect". While moderate to severe strokes improve the most from stroke rehabilitation, increasing stroke severity is ultimately associated with poorer outcomes.

4.4 Age as a Modifier in Rehabilitation Triage

Another predictor of functional outcome following stroke is age, although it is considerably more controversial than stroke severity.

4.4.1 Impact of Age on Recovery

As noted in Chapter 3, the impact of stroke recovery with age in animals is not entirely clear. Older animals do exhibit recovery post stroke, although generally recovery is more rapid and extensive, the younger the animal. This observation correlates with a decline in the rate of formation of new neuronal connections or synaptogenesis. Therefore, older animals do improve post stroke but the process takes longer and is less complete. For this reason, age may not be a consistent predictor of functional recovery after stroke. Studies support the concept that age is a critical prognostic factor with an established association between increasing age and poorer outcomes (Table 4.4.1.1).

Table 4.4.1.1 Age as a Modifier in Rehabilitation Triage

Author, Year Country Study Design Sample Size	Methods	Outcomes
Kotila et al. (1984) Finland Case Series N=154	Patients were evaluated at time of admission and then 3 and 12 months post stroke onset. Previous medical, social and occupational history and neurological signs and symptoms were registered.	1. Patients under 65 had significantly better outcomes than those over 65 years and were more often at home, more independent in ADL after 3 months and this difference increased at 1 year.
Bogousslavsky & Pierre (1992) Switzerland Case Series N=NA	From the Lausanne Stroke Registry, young patients with stroke that made up 12.3% of first ever ischemic strokes were divided into two group: group 1 encompassing patients aged 16 to 30 years of age and group 2 encompassing patients aged 31 to 45 years old. Computed tomography, ECG, standard hematologic and other blood tests and extracranial and transcranial Doppler ultrasounds were performed on each patient.	1. Early mortality was not negligible. No disability of minor sequalae was present in 60% of group 1 and 52% of group 2 patients. Severe sequalae were found in 7% and 14% of group 1 and 2 respectively. 2. Prognosis was better for younger patients with at least 75% of patients improving markedly or completely and able to return to previous activities. The annual incidence of recurrent stroke seems to be less than 1%.
Borucki et al. (1992) USA Observational N=71	Inpatients on a stroke rehabilitation unit with no prior history of stroke and who were admitted directly from acute care hospital were randomly assigned for serial follow up and then were divided into 2 age groups: 69 years or less and 70 years or more.	1. Greater proportion of older patients were discharged to a skilled nursing facility or were placed in one between discharge and 24 months. 2. Albeit non-significant, survival tended to be worse for older patients. 3. While age was related to death and skilled nursing facility placement, it had no clinically significant effect on maintenance of rehabilitation gains following ischemic stroke.

Kalra (1994) UK Observational N=245	Patients who remained in hospital on general or geriatric wards 2 weeks after stroke were randomized to a stroke unit or to a general medical ward and then were divided into on older (75 years and over) and younger (under 75 years) age group. Younger and older patients with stroke were comparable for neurological and functional deficits and were distributed equally between the stroke unit and the general wards.	1. Older patients received more occupational therapy in both settings and more physiotherapy. 2. Younger patients on the stroke unit showed better outcome on discharge to home, median Barthel score, median length of hospital stay, compared with those on the general wards. 3. Older patients on stroke unit had better outcome on discharge to home and median Barthel score than those on general wards. 4. Outcomes in older patients with stroke were similar in both settings except for a shorter median length of hospital say on the stroke unit. 5. Outcomes in younger patients managed on general ward were worse than that in older patients with similar prognosis.
Nakayama et al. (1994) Denmark Observational N=363	Consecutive patients with acute stroke were prospectively followed. Upper extremity function and paresis were assessed weekly using the Barthel Index subscores for feeding and grooming and the Scandinavian Stroke Scale (SSS) subscore for arm and hand. Rehabilitation was performed according to the Bobath technique.	1. Patients who gained upper extremity function by compensation were younger, had less severe stroke, smaller and subcortically located lesions and less affection of higher cortical function.
Bagg et al. (2002) Canada Observational N_{Start}=561 N_{End}=561	**Population:** Mean age=71±11.6yr; Gender: Males=302, Females=259. **Intervention:** To examine the relationship between age and functional recovery after stroke. **Outcomes:** Functional Independence Measure (FIM).	1. Correlations between age and FIM score at admission were significant for the FIM full scale (r=-0.16, p<0.001) and, and for the motor (r=-0.14, p<0.001) and cognitive (r=-0.16, p<0.001) domains. 2. Female sex, hemorrhagic stroke was significantly associated with discharge FIM scores in the positive direction. 3. Impaired problem solving was significantly associated with FIM score at discharge and a change in FIM score in the negative direction. 4. Presence of dysphagia was significantly associated with motor FIM score at discharge. 5. Adjusting for A-FIM score at admission (A-FIM) and other clinical factors, age was not found to be associated with a change in FIM scores. 6. There was a weak relationship found between age and functional outcome when other factors (such as clinical variables and FIM score at admission) were accounted for. 7. Results showed that A-FIM explained most of the variation in the statistical model, suggesting that functional status at admission may have an important role for assessing how patients will cope in a rehabilitation setting.
Kugler et al. (2003) Germany Observational N_{Start}=2219 N_{End}=2219	**Population**: Primary study group: Mean age Males=65±12yr, Mean age Females=69±13yr. Gender: Males=55.9%, Females=44.1%. Secondary study group: Mean age Males=66±12yr, Mean age Females=70±13yr; Gender: Males=55.7%, Female=44.3%.	1. Age was significantly associated with stroke mortality rate as indicated by chi-square test for differences between age groups in hospital fatality rate. 2. Weak negative association between age and mean length of stay (LOS) when younger to older patients

	Intervention: To explore the factors and predictors of functional recovery during the very early phase of stroke. **Outcomes**: Relative functional recovery/relative improvement in functional status, Speed of functional recovery over time, Barthel Index (BI), Length of stay (LOS).	were compared. 3. Adults between ages 65-74 and 75-84 had lower functional status at T1, T2, and T3 compared to all other age groups, as indicated by a comparison of the mean Barthel Index scores. 4. Results showed that there was a mean relative improvement in functional status of approximately 54% in all patients, over the period of analysis. A larger mean relative improvement in functional status was found for patients less than 55yr of age, compared to those above 55yr of age (67% v. 50%). 5. There was a statistically significant inverse association between age and functional status (B_{age}=–0.130, p<0.001) 6. After considering LOS in the regression model, there was a significant association between LOS and extent of recovery (β_{LOS}=–0.295, p<0.001) and initial ADL status was shown to have more of an effect on the outcome than without LOS in the model. 7. Considering the entire period of analysis, age had a very small effect on the recovery outcome (β_{age}=–0.080, p<0.001).
Kammersgaard et al. (2004) Denmark Observational N_{Start}=1197 N_{End}=1197	Patients were studied in the community-based Copenhagen Stroke Study and stratified according to age. Age was evaluated as a predictor of both short-term and long-term outcomes. The very old were classified as being ≥ 85 years.	1. 191 patients were 85 years or older. Very old age was associated with more severe strokes, being female, having atrial fibrillation, and having pre-existing disability. 2. Very old age predicted short-term mortality (OR 2.5; 95% CI 1.5-4.2), and discharge to nursing home or in-hospital mortality (OR 2.7; 95% CI 1.7-4.4). 3. Five years after stroke, very old age predicted mortality or nursing home placement (OR 3.9; 95% CI 2.1-7.3), and long-term mortality (HR 2.0; 95% CI 1.6-2.5). 4. However, other factors such as onset stroke severity, pre-existing disability and atrial fibrillation were also significant independent predictors of prognosis after stroke.
Kwah et al. (2013) Australia Cohort N_{Start}=200 N_{End}=114	**Population**: Median Age=78yr; Gender: Males=98, Females=112. **Intervention**: To examine age and National Institutes of Health Stroke Scale (NIHSS) as predictors of recovery of independent ambulation and upper limb function. **Outcomes**: Motor Assessment Scale (Walking, Hand movements, and Advanced hand activities items).	1. Age (p<0.01) and NIHSS (p<0.01) were significant predictors for independent ambulation (Walking item) 2. Age (p<0.05) and NIHSS (p<0.05) were significant predictors for moving a cup across the table (Hand movements item) 3. NIHSS (p<0.01) was a significant predictor for feeding oneself with spoon (Advanced hand activities item)
Kong & Lee (2014) Singapore Observational N_{Start}=163 N_{End}=148	**Population**: Mean Age=63.8±10.7yr; Gender: Males=111, Females=52. **Intervention**: To identify predictors of activities of daily living recovery. **Outcomes**: Modified Barthel Index (MBI).	1. Age (p<0.0001), neglect (p<0.0001), admission Abbreviated Mental Test (p<0.0001), admission National Institute of Health Stroke Scale (p<0.0001), admission MBI (p<0.0001), admission Motricity Index (p<0.0001), and site of stroke (p<0.0001) were significant predictors of MBI at 12mo. 2. Logistic regression only had age remaining

		significant, with younger patients more likely to be functionally independent.
Alonso et al. (2015) Germany Case Series N_{Start}=347 N_{End}=347	**Population**: Mean Age=70.8yr; Gender: Males=164, Females=183. **Intervention**: To identify predictors of short-term outcome. **Outcomes**: Mortality, Modified Rankin Scale (mRS).	1. In-hospital mortality was significantly associated with old age (p<0.001), admission National Institute of Health Stroke Scale (p<0.001), intracerebral hemorrhage (p<0.001), and mechanical ventilation (p<0.001). 2. Lower mRS was significantly associated with lower age (p=0.008) but poor outcome (mRS≤3) was not associated with age.
Meyer et al. (2015) Belgium Observational N_{Start}=532 N_{End}=238	**Population**: Mean Age=69.47±10.28yr. **Intervention**: To identify predictors of functional and motor performance at 2mo, 6mo, and 5yr post-stroke. **Outcomes**: Barthel Index (BI), Rivermead Motor Assessment of Arm function (RMA-A), Rivermead Motor Assessment of Gross Function (RMA-GF), Rivermead Motor Assessment of Leg and Trunk function (RMA-LT).	1. Higher age was significantly associated with worse BI, RMA-GF, and RMA-LT at 2mo, 6mo, and 5y (p<0.001 all). 2. For RMA-A, age was a significant predictor at 5yr (p=0.019) but not at 2mo or 6mo. 3. Increasing stroke severity was significantly associated with worse BI, RMA-GF, RMA-LT, and RMA-A at 2mo, 6mo, and 5y (p<0.0001 all).

In a cohort study of 2,219 patients, Kugler et al. (2003) studied the effect of patient age on early stroke recovery. The authors found that relative improvement decreased with increasing age: patients younger than 55 years achieved 67% of the maximum possible improvement compared with only 50% for patients above 55 years (p<0.001). Similar results were found in a study by Alonso et al. (2015), where functional outcome after rehabilitation was associated with age as younger patients were found to achieve better outcomes compared to the older cohort (p=0.008). Further, Kugler et al. (2003) found that age had a significant but relatively small impact on the speed of recovery with younger patients demonstrating a slightly faster functional recovery (p<0.001).

In a prospective study of 561 patients admitted to an inpatient stroke rehabilitation program, Bagg et al. (2002) found that age alone was a significant predictor of total FIM score and motor FIM score at discharge, but not overall FIM change. At 2 and 6 months post stroke, age was found to negatively influence the level of functional independence along with lower limb motor (S. Meyer et al., 2015). Similarly, Kwah et al. (2013) found that age was a significant predictor of independent ambulation and upper limb motor function recovery at 6 months. At 12 months, age remained a significant predictor of functional independence, suggesting that older patients were less likely than younger patients to gain functional independence (Kong & Lee, 2014). At 5 years, the negative association between age and functional independence together with lower limb motor recovery remained significant (S. Meyer et al., 2015). Secondary analysis of a RCT also found that increasing age was associated with increasing frequency of death or dependency (p<0.001) and decreasing physical function as measured by mRS (p<0.001) (Radholm et al., 2015).

Despite the indication that age may be strongly associated with poorer outcomes, its impact on recovery can be overestimated. For both total FIM score and motor FIM score at discharge, age alone accounted for only 3% of the variance in outcome (Bagg et al., 2002). Furthermore, patients attaining a "good" post-rehabilitation outcome (mRS≤3) were not significantly younger than those attaining a poorer functional outcome (p=0.16) (Alonso et al., 2015). Thus, advanced age alone is not a justifiable reason to deny patients access to rehabilitation given the questionable clinical relevance of that factor (Bagg et al., 2002). The authors concluded that although age had a significant impact on recovery, it was a poor

predictor of functional outcome after stroke and could not be regarded as a limiting factor in the rehabilitation of patients with stroke (Bagg et al., 2002). Age may be associated with greater comorbidity which may account for some of the challenges associated with rehabilitation of older patients.

Conclusions Regarding the Impact of Age on Recovery

There is Level 2 evidence that older patients with stroke have less improvement after stroke rehabilitation compared to younger patients.

Older age can negatively impact stroke recovery, although its contribution is small when compared to stroke severity. Overall, age is also not considered to be a strong predictor of functional recovery after stroke.

4.4.2 Younger Patients with Stroke

The odds of discharge home are 18 times greater if the patient is under 65 than if they are over 85 (Herman et al., 1984). Kotila et al. (1984) compared 77 patients 65 or older with 77 patients younger than 65; younger patients had better outcomes in terms of return to home and ADLs. Bogousslavsky and Pierre (1992) found that 202 of 1638 (12.3%) patients from the Lausanne stroke registry with first ever ischemic stroke were 45 years or younger. They were divided into two groups: (1) age 16-30, n=56 (28%); and (2) age 21-45, n=146 (72%). Prognosis was significantly better for the former group of patients.

Alexander (1994) reported that all patients under 55 years old in his study group were discharged home. More importantly there was a significantly greater FIM change in those patients aged <55 years than for patients >55 years, and even a significantly greater FIM change for groups aged 55 to 74 years than for the group >75 years (Alexander, 1994). Nakayama et al. (1994) reported that older patients with stroke made the same degree of neurological recovery as younger patients but had a much lower degree of functional gain. It was suggested that younger patients had more compensatory abilities than older patients with comparable neurologic impairments. Kalra (1994) also reported that younger patients enjoyed greater functional recovery and higher rates of home discharge than elderly survivors of stroke. These findings parallel the results from Kes et al. (2016), which demonstrated that younger patients with stroke attained considerably better outcomes at discharge when compared to older patients. Younger patients often do well no matter how impaired they are initially and even those with severe strokes (early FIM <40) should be considered appropriate for a comprehensive intensive rehabilitation unit (Alexander, 1994).

Of the 43,163 patients admitted in the Austrian Stroke Unit Registry, only 14.1% were less than 55 years of age (Knoflach et al., 2012). Of those younger patients, 88.2% obtained good outcomes (mRS ≤2) at 3 months post-stroke (Knoflach et al., 2012). The study suggested that regression-adjusted probability of good outcome was highest among patients in the 18-35 age group, and gradually decreased by 3.1-4.2% every 10 years, followed by a steep decline after the age of 75 (Knoflach et al., 2012). Long-term follow-up of functional outcome (mRS) or mortality did not show any significant differences between children and young adults (Goeggel Simonetti et al., 2015). In both groups, low severity was a significant predictor of favourable outcome (children: p=0.003; young adults: p<0.001) (Goeggel Simonetti et al., 2015). Young strokes are discussed further in Chapter 21.

Conclusions Regarding Younger Patients with Stroke

Younger patients with stroke account for a small percentage of individuals with stroke. These patients typically do well with rehabilitation, making significant functional gains, and nearly all are discharged home.

4.4.3 Elderly Patients with Stroke

It is important to recognize that elderly patients do make significant gains in terms of FIM changes (Alexander, 1994; Borucki et al., 1992), but such gains tend to be slower with longer rehabilitation stays and a greater likelihood of discharge to an institution (Alexander, 1994). Very elderly patients tend to be more cognitively impaired and have greater disease comorbidity and poorer social supports, which can add to the challenge of rehabilitation of this population. Elderly patients often do not take to more aggressive intensive therapy approaches, and such an approach may not be the best utilization of resources. Alexander (1994) has shown that patients >75 years with early FIM scores between 40-60 do not appear to benefit as much from intensive rehabilitation and should be considered for less intensive rehabilitation. However, with the high level of fitness and health maintained by many seniors today, the definition of elderly is more fluid and needs to be considered more on a case by case basis.

Borucki et al. (1992) showed that those elderly patients with the ability to function independently outside their homes had a functional outcome not significantly different than younger patients. Similarly, Lieberman and Lieberman (2005) found that patients with stroke over the age of 85 with an admission FIM score of 64 did not differ with respect to the change in FIM scores during rehabilitation, and at discharge from rehabilitation compared to those between the ages of 75 and 84 averaging a score of 66 on FIM at admission. Additionally, the length of hospital stay and the length of rehabilitation were not statistically different between the two groups. The presence of comorbidities must be taken into account as elderly patients with multiple comorbidities have a higher risk of in-hospital death after adjusting for stroke severity and sex (Falsetti et al., 2016).

Conclusions Regarding Elderly Patients with Stroke

Very elderly patients with stroke should be considered candidates for rehabilitation, regardless of stroke severity, and each case needs to be considered on the basis of individual characteristics and potential. Factors such as premorbid fitness, cognitive functioning, family/community support, and comorbidities are considered important in these cases.

4.5 A Triage System

There is a fundamental need for an integrated system of care that spans acute care, inpatient rehabilitation, outpatient and home care service, and supported living options that permit disabled individuals to move among levels of care in response to changing needs. Continuity of care and efforts to maximize functional independence of both patients and caregivers are essential. The goal is to provide a seamless flow of patients across the continuum of care.

One of the most important elements of systematic approach is an appropriate triage system based on the previous evidence discussed in this chapter (Figure 4.5.1). The two most important predictors of functional recovery and eventual discharge home are age and initial stroke severity. Initial stroke severity for the purpose of stroke rehabilitation triage is best measured using a functional outcome measure such as FIM. Patients with early FIM scores >80 can generally be managed in the community if the outpatient rehabilitation therapies are available. Early FIM scores 40-80 are the traditional moderately severe stroke rehabilitation patients, making marked improvement more rapidly and hence

benefiting from intensive rehabilitation. Those patients with early FIM scores <40 are less likely to achieve functional independence and make a slower recovery; although they still benefit from specialized interdisciplinary stroke rehabilitation of similar intensity for patients with moderate stroke. However, for patients with more severe stroke and particularly those that are older, the lack of a committed caregiver is associated not only with lesser gains when compared to those patients with caregivers but also with relatively little chance of being discharged home.

Age is a significant prognostic factor with increasing age leading to poorer outcomes. Younger patients with stroke (<55 years of age) often do well no matter how impaired they are initially and even with severe strokes (FIM <40). Such patients should be considered appropriate for a more intensive stroke rehabilitation program regardless of severity and the presence or absence of a caregiver. The combination of stroke severity and age allows for an objective triage system to slot patients into community-based stroke rehabilitation or more intensive interdisciplinary in-hospital stroke rehabilitation. In reality, an optimal stroke rehabilitation program would provide an individualized rehabilitation therapy program based upon the individual patient's specific needs.

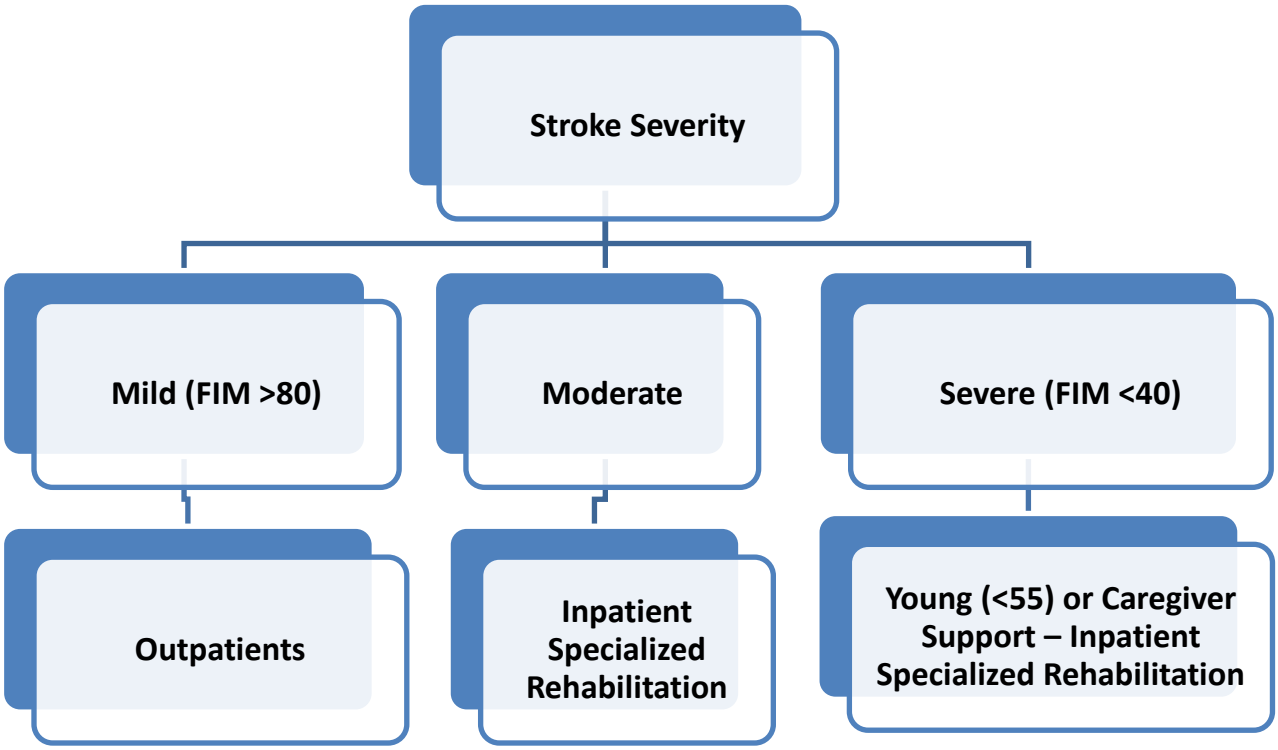

Figure 4.5.1 Triage system based on stroke severity.

4.6 Where Should Stroke Rehabilitation Be Conducted?

Stroke rehabilitation can be conducted in rehabilitation hospitals or rehabilitation units in acute care or rehabilitation hospitals, in nursing facilities with rehabilitation programs, in outpatient facilities, or in the home.

4.6.1 Mild Strokes: Outpatient/Home Care Rehabilitation

Patients with early FIM scores >80 can generally be managed directly in the community if outpatient rehabilitation is available. There is a trend, where feasible, to move rehabilitation out of the hospital and into the community, sooner and to a greater extent than previously. This alternative approach to rehabilitation has been advocated by Edmonds and Peat (1997). The approach is multidisciplinary in nature and takes place where the individual lives; existing community resources are used, including home care, outpatient stroke rehabilitation, and full involvement of family members or caregivers. The patient and their family can potentially be more involved in their health care, having a greater say and more responsibility, for their own rehabilitation. The benefits of this devolution are obvious; it is potentially less costly, more patient-centred, and involves the family/caregivers to a greater extent. However, where similar therapy services have been provided to the home as are provided in the hospital, the cost savings have proven elusive.

The characteristics of the home environment and availability of social support may determine the feasibility of home or outpatient therapy; for outpatient rehabilitation provided at the institution, transportation is often an issue. Studies that have looked at conducting rehabilitation in the home have found little difference in functional outcomes for patients with higher level stroke when offered organized rehabilitation care at home (Widen Holmqvist et al., 1998) but poorer care for moderate or severe stroke sent back to their communities when compared to in-patient rehabilitation programs (Ronning & Guldvog, 1998). The danger with the moderate to severe stroke group is that the skill set, present in hospital rehabilitation units, will not be as high in the community, and that patients and their families are not prepared to be discharged home without undergoing a course of inpatient rehabilitation. An integrated system, whereby the hospital-based rehabilitation program serves as an educational and clinical resource, is important, both for the community support and the rehabilitation program. Outpatient stroke rehabilitation is discussed further in Chapter 7.

Conclusions Regarding Outpatient/Home Care Rehabilitation for Mild Stroke

> ***Patients with mild stroke can be rehabilitated in an outpatient setting by an interdisciplinary stroke rehabilitation team. However, evidence for the superiority of home-based or hospital-based outpatient stroke rehabilitation is conflicting.***

4.6.2 Moderate Strokes: Hospital-Based Inpatient Rehabilitation

Hospital programs are usually the most comprehensive, provide the greatest intensity of therapy, and generally have optimal medical coverage. Expertise in stroke rehabilitation varies with the greatest concentration in formal hospital-based stroke rehabilitation units. Patients with moderate or severe disabilities and sufficient physical endurance to tolerate intense rehabilitation (often at least 3 hours of physically demanding activities per day) are candidates for these more intense hospital programs. The benefits of such specialized stroke rehabilitation units are discussed in Chapter 5.

There is strong evidence that specialized stroke rehabilitation, as provided by an interdisciplinary and stroke-specific team, results in improved functional outcomes when compared to “usual” care as provided on a general medical unit. There is also strong evidence that patients with more severe strokes benefit from stroke rehabilitation to a much greater extent. The evidence in this regard is overwhelming that patients with moderate to severe stroke should be rehabilitated in stroke-specific inpatient units. There is moderate evidence that enhanced outpatient rehabilitation and discharge services, when provided in conjunction with stroke specific inpatient care, results in improvements in functional outcomes and the number of patients discharged home as well as reduced length of hospital stay. As mentioned previously, enhanced rehabilitation/discharge services have the greatest impact on

moderate to severe strokes.

There is currently an abundance of studies that compare and contrast rehabilitation efficiency in a variety of locations; however, few studies have looked at whether different hospital types provide the same level of rehabilitation outcomes. This question was investigated by Asplund et al. (2015), who compared a university hospital, a specialized non-university hospital, and a community hospital to determine significant differences among rehabilitation outcomes. The results demonstrate that mortality and ADL dependency were not significantly different in patients that were rehabilitated in a university hospital compared to those obtained from patients discharged from a non-university hospital (Asplund et al., 2015). Furthermore, the odds of having a poor outcome was similar across sites. Foley et al. (2013) found similar evidence that in Ontario: being rehabilitated in free-standing, specialized stroke rehabilitation units did not produce better outcomes than patients rehabilitated in smaller general rehabilitation units, often located in acute care hospitals. This topic requires further study, but one potential explanation is that rehabilitation provided in the same hospital as acute care offers the opportunity for greater continuity of care, thereby balancing out the benefit seen in transferring patients to a free-standing, specialized stroke rehabilitation unit.

Conclusions Regarding Hospital-Based Inpatient Rehabilitation for Moderate Stroke

> ***Wherever possible, based on best evidence, patients with moderately severe strokes should receive rehabilitation on stroke specific rehabilitation units. However, in practice, rehabilitation on a stroke specialized unit does not guarantee better outcomes, as other factors may also be important, such as continuity of care.***

4.6.3 Severe Strokes

Patients with severe strokes have been shown to benefit from the same intensive, interdisciplinary, stroke-specific care from which patients with moderate stroke benefit; hence even patients with severe stroke (early FIM <40) should be considered as candidates for in-hospital intensive interdisciplinary stroke rehabilitation. Mirkowski et al. (2018) reported that for patients with more severe stroke, having committed caregivers made a better functional improvement than those without a committed caregiver. Pereira et al. (2014) demonstrated that the lack of a committed caregiver almost guaranteed that the patient would not be discharged home, calling into question the need to rehabilitate those patients with severe stroke who do not have a caregiver. One exception to this rule are younger patients (<55 years old), who seem to do better in stroke rehabilitation and may still achieve significant enough gains to achieve greater discharge independence than an older cohort with stroke of similar severity.

Patients with severe stroke can achieve impressive rehabilitation goals when provided with individualized care in a highly specialized stroke rehabilitation unit for an extended period of time. A group of 196 non-ambulatory patients, most with FIM scores below 40, were admitted to an enriched multidisciplinary rehabilitation program designed for patients with severe stroke for a period of close to 3 months. The patient-centred and goal-oriented approach incorporated special features such as an independent living unit, access to a rehabilitation therapist and recreation specialist, and family support group. Upon completion of the program, 43% of patients were able to return home and 28% were no longer wheelchair dependent (Teasell et al., 2005).

Studies have shown that specialized stroke rehabilitation units are associated with lower mortality compared to general medical wards for patients with severe stroke (Pereira et al., 2012). Increased functional gains, reduced length of stay, and increased discharge to the community have also been reported (Pereira et al., 2012). However, the proportion of patients with severe strokes that are able to

be discharged home after rehabilitation ranges from 43% to 63% (Pereira et al., 2012). Slow stream rehabilitation has been developed to improve the outcomes of patients with severe stroke who may require a longer period of time to recover. These programs involve low intensity rehabilitation for longer durations, improving functional outcomes for those that cannot tolerate traditional therapy (Leung et al., 2016). Rehabilitation of patients with severe stroke is discussed further in Chapter 22.

Conclusions Regarding Rehabilitation for Severe Stroke

Patients with severe strokes may be better managed on specialized stroke rehabilitation units.

Summary

1. ***The two most powerful predictors of functional recovery and eventual discharge home are age and initial stroke severity, with the latter being the most important. However, this does not preclude the use of additional factors to determine appropriate stroke rehabilitation destination during triage.***

2. ***There is Level 3 evidence that severity of stroke predicts ability to participate and benefit from stroke rehabilitation.***

3. ***There is Level 2 evidence that older patients with stroke have less improvement after stroke rehabilitation compared to younger patients.***

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