Evidence-Based Review of Stroke Rehabilitation

Executive Summary

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EVIDENCE-BASED REVIEW OF STROKE REHABILITATION

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(7th Edition)

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Executive Summary

The Stroke Rehabilitation Evidence-Based Review (SREBR) reviews current practices in stroke rehabilitation. The purpose of the Evidence-Based Review of Stroke Rehabilitation was to fulfil the 12th recommendation of The Stroke Rehabilitation Consensus Panel Report that supported the continuing review of stroke rehabilitation research with the “purpose of maintaining timely and accurate information on effective stroke rehabilitation, identifying ideas for further research, supporting continuous peer-review and encouraging improved evidence-based practice.” The aim of the SREBR was to:

- Be an up-to-date review of the current evidence in stroke rehabilitation.
- Provide a comprehensive and accessible review to facilitate best-practice.
- Provide specific conclusion based on evidence that could be used to help direct stroke care at the bedside and at home.

Methods

A literature search using multiple databases (MEDLINE, EBASE, MANTIS, PASCAL and Sci Search) was used to identify all potential trials published from 1970-2001, regardless of study design. The search was restricted to the English language and excluded animal studies. Search terms included, but were not restricted to: “stroke”, “cerebrovascular accident”, “cerebrovascular disorder”, “rehabilitation”, “physiotherapy”, “occupational therapy”, “speech therapy”, “recreation therapy”. From 2001 onwards, a single database (MEDLINE) was used exclusively.

The initial literature search identified approximately 2,500 abstracts. A single investigator (RT) reviewed both the title of the citation and the abstract to determine its suitability for inclusion and to assign it to one of 17 treatment categories, which were established a priori. Meta-analyses, systematic reviews and review articles were identified at this point and while they were not used in our review, studies cited with these works that were not identified in the original literature search, were also sought, through hand searching. The review was restricted to published works. Although the review was not confined to the results from randomized controlled trials (RCT), these articles received priority when formulating conclusions.

Since its original publication in April 2002, the SREBR has undergone six major revisions and now includes articles published up to June 2005. To date, we have included 580 RCTs. Two additional modules have also been added since its original publication; secondary prevention and a detailed review of outcome measures most commonly used in stroke rehabilitation.

Data Extraction and Quality Assessment Tool

Two abstractors, each blinded to the others’ results reviewed each article independently. Reviewers collected data relating to the study methodology,
identification of outcome measures, results, and final conclusions and also quantitatively evaluated the study’s methodological quality using the Physiotherapy Evidence Database (PEDro) scale, developed by the Centre for Evidence-Based Physiotherapy (CEBP) in Australia.

The PEDro Scale consists of 10 quality ratings each receiving either a yes or no score:

1. Subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received).
2. Allocation was concealed.
3. The groups were similar at baseline regarding the most important prognostic indicators.
4. There was blinding of all subjects.
5. There was blinding of all therapists who administered the therapy.
6. There was blinding of all assessors who measured at least one key outcome.
7. Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups (*).
8. All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome was analysed by "intention to treat".
9. The results of between-group statistical comparisons are reported for at least one key outcome.
10. The study provides both point measures and measures of variability for at least one key outcome.

(*) For the purposes of this review, follow-up was considered adequate if all of the subjects that had been originally randomized could be accounted for at the end of the study period.

The maximum score a study could receive was 10. Two independent raters reviewed each article. Scoring discrepancies were resolved through discussion

Formulating Conclusions Based on Levels of Evidence

The levels of evidence used to summarize the findings are based, in part on the Eastern Ontario/Queen’s Evidence Based Report, which in turn were based on the levels of evidence used by the United States Agency for Health Care Policy and Research (AHCPR) Guidelines for Stroke Rehabilitation. Three levels of evidence were considered; 1a (strong), 1b (moderate) and 2 (limited). The following definitions of evidence were used:

- **Level 1a (Strong):** The findings were supported by the results of 2 or more RCTs of at least “fair” quality.
- **Level 1b (Moderate):** The findings were supported by a single RCT of a least “fair” quality.
- **Level 2 (Limited):** The findings were supported by at least one non-experimental study (non-randomized controlled trial, cohort studies etc.).
• **Level 3 (Consensus):** In the absence of evidence, agreement by a group of experts on the appropriate treatment course. Consensus opinion is regarded as the lowest form of evidence. As such, it is arguably not considered evidence at all.

• **Level 4 (Conflicting):** Disagreement between the findings of at least 2 RCTs. Where there were more than 4 RCTs and the results of only one was conflicting, the conclusion was based on the results of the majority of the studies, unless the study with conflicting results was of higher quality.

Using this system, conclusions were easily arrived at when the results of multiple studies were in agreement. However, interpretation became difficult when the study results conflicted. In cases where RCTs also differed in terms of methodological quality, the results of the study (or studies) with the higher PEDro score(s) were more heavily weighted to arrive at the final conclusions. However, there were still some instances where interpretation remained problematic. For instance, the authors needed to make a judgment when the results of a single study of higher quality conflicted with those of several studies of inferior quality. In these cases we attempted to provide a rationale for our decision and to make the process as transparent as possible. In the end the reader is encouraged to be a “critical consumer” of all of the material presented.

The following brief summaries highlight the information provided in the SREBR and provide conclusions regarding treatments involved in stroke rehabilitation. The entire evidence-based review is available at:

[http://www.ebrsr.com](http://www.ebrsr.com)
Interdisciplinary Inpatient Stroke Rehabilitation

Acute Rehabilitation
There is strong evidence that continuous monitoring for the first several days following stroke results in overall reduced length of stay, but there is conflicting evidence of a benefit with regard to mortality, the need for eventual institutionalization or improved functional outcome when compared to a regular acute stroke unit care. There is moderate evidence that mortality is reduced for patients with severe stroke. There is strong evidence that care on an acute stroke unit is not associated with reductions in mortality, improved functional outcome or need for institutionalization, compared to care received on a general medical unit.

Combined Acute and Rehabilitation Rehabilitation
There is strong evidence that stroke units, which combine acute and rehabilitative care, are associated with improved functional outcome, but do not reduce the need for eventual institutionalization. There is conflicting evidence that stroke units are associated with reductions in mortality or length of hospital stay.

Subacute Rehabilitation
There is conflicting evidence that specialized rehabilitation provided in the subacute phase reduces stroke-related mortality, compared to conventional care. There is strong evidence from studies, which stratified according to stroke severity, that for the subset of more severe stroke patients, specialized stroke rehabilitation reduces mortality and results in improved functional outcome. There is strong evidence that the subset of patients with mild or severe stroke achieve the similar levels of functional outcome whether they receive conventional or specialized stroke rehabilitation. There is conflicting evidence that specialized stroke rehabilitation, provided during the subacute phase, reduces length of inpatient hospital stay, compared to conventional care. There is conflicting evidence that the need for institutional care is reduced for the subset of patients with mild or moderate stroke. There is moderate evidence that enhanced rehabilitation and discharge services result in improvements in functional outcomes for patients with moderate to severe strokes.

Elements of Stroke Rehabilitation

The Role of Rehabilitation in Recovery
There is limited evidence that the improvement in disability seen in stroke rehabilitation cannot be explained on the basis of natural recovery of the neurological impairment alone.

Remedial vs. Compensatory Rehabilitation
There is limited evidence that neurological impairment (remedial) focused rehabilitation results in longer lengths of hospital stay when compared to a functionally (compensatory) oriented rehabilitation approach.
Hemorrhagic Strokes
There is limited evidence that patients with hemorrhagic strokes improve more rapidly in rehabilitation than those with ischemic strokes.

Care Pathways in Stroke Rehabilitation
There is strong evidence that care pathways do not improve stroke rehabilitation outcomes. There is moderate evidence that care pathways do not reduce hospital costs or decrease hospital lengths of stay.

Early Admission to Stroke Rehabilitation
There is limited evidence that early admission to stroke rehabilitation directly results in improved functional outcomes. There is strong evidence that early mobilization; a component of stroke unit care is associated with improved outcome. Stroke patients should be admitted to stroke rehabilitation units as soon as they are medically stable, until the results of an RCT determines otherwise.

Intensity of Therapy
There is strong evidence that greater intensity of therapy results in improved functional outcomes over the short-term (4 weeks -6 months). However, the overall beneficial effect was modest. Most of the studies also found the positive benefits were not maintained consistently over time. There is limited evidence that the same therapy delivered more intensely over a shorter period of time results in improved functional outcomes and is cost effective. There is conflicting evidence as to whether language therapy is efficacious in treating aphasia post stroke. The positive trials provided more intense therapy over a relatively short period of time whereas the negative trials provided much less intense therapy over a much longer period of time.

Duration of Rehabilitation Gains
There is strong evidence that the relatively greater functional improvements made by patients rehabilitated on specialized stroke units when compared to general medical units are maintained over the short-term and long-term. There is strong evidence that functional outcomes achieved through stroke rehabilitation are maintained and actually improve for up to one year. There is moderate evidence that these same functional gains decline after five years.

Outpatient Stroke Rehabilitation
Early Supported Discharge
There is strong evidence that high-level stroke patients discharged early from an acute hospital unit can be as successfully rehabilitated in the community by an interdisciplinary stroke rehabilitation team. Such programs can reduce hospital lengths of stay by approximately one week. There is conflicting evidence that the costs associated with home intervention are lower when compared to usual care. At present it is not known whether severe to moderate stroke patients can be managed exclusively with early supported discharge programs.
Outpatient Rehabilitation
There is *moderate* evidence that hospital-based outpatient rehabilitation improve outcomes when compared to routine care over the short-term. However, the benefits are not maintained long-term. In contrast, there is *strong* evidence that additional home-based rehabilitation does not result in improved functional outcomes when compared to routine care. There is *conflicting* evidence as to whether hospital-based or home-based outpatient rehabilitation therapies are superior. There is *limited* evidence that subgroups of stroke patients may benefit from different outpatient treatment approaches; for elderly frail stroke patients, day hospital services may reduce death and institutionalization, while for younger stroke patients, home-based outpatient therapy may improve functional and quality of life outcomes.

Leisure Therapy and Social Support
There is *conflicting* evidence that leisure and/or occupational therapies in chronic stroke patients improves functional outcomes. There is *moderate* evidence that outpatient social support interventions improve stroke outcome. Nevertheless, the association between strong social support, particularly emotional support provided by family and friends, is very impressive.

Secondary Prevention

Hypertension
There is *strong* evidence that a reduction in blood pressure is associated with a decreased risk of stroke particularly among patients with a previous history of intracerebral haemorrhage. There is *strong* evidence that the addition of a Ca-antagonist to a regimen that may include ACE-inhibitors or β-blockers and a diuretic decrease the risk of stroke events in both diabetic and non-diabetic stroke patients. There is also *moderate* recent evidence that immediate treatment of blood pressure following stroke serves to reduce the risk of recurrent stroke. There is *moderate* evidence that antihypertensive therapy post-stroke is associated with a reduction of risk for functional disability and dependency.

Although hypertension is the most significant risk factor for stroke, only a small percentage of persons with the condition achieve adequate control. Canadian Heart and Stroke Foundation guidelines suggest that blood pressures be maintained below 140/90 mmHg; for diabetes, it should be less than 130/80 mmHg. For patients with renal dysfunction and > 1 gram/day proteinuria, blood pressure should be kept below 125/75 mmHg. Antihypertensives are used to treat hypertension.

Management of Diabetes
Diet and medications should both be used to establish and maintain optimum glycemic control, to prevent microvascular complications. There is a lack of evidence as to whether tight glycemic control prevents the recurrence of stroke. There is *strong* evidence that treatment of hypertension among diabetic patients reduces the risk of stroke.
**Hyperlipidaemia**
The relationship between hyperlipidemia and stroke is complex and has not been fully clarified. It seems likely that elevated concentrations of total serum cholesterol, triglycerides and LDL are associated with an increased risk of non-haemorrhagic stroke. There is *strong* evidence that statins are an effective treatment intervention to lower cholesterol and reduce risk of stroke and TIA. There is *moderate* evidence that gemfibrozil also reduces risk while increasing HDL cholesterol and lowering triglyceride concentrations.

**Infection**
There is *limited* evidence that stroke is associated with infection and chlamydia pneumoniae infection in particular. There is *strong* evidence that the use of a chlamydia pneumoniae reactive antibiotic (in seropositive patients with coronary artery disease) has no significant effect on the risk of stroke.

**Physical Activity**
There is *limited* evidence that increasing physical activity is associated in a graded manner with reduction in risk of stroke (both ischemic and haemorrhagic). Even moderate levels of physical activity are associated with a significant stroke risk reduction (20%).

**Diet**
There is *strong* evidence that a low-fat, low-cholesterol diet rich in fruits, vegetables, legumes, and ω-3 fatty acids is effective in reducing blood pressure and serum cholesterol in patients with previous angina, MI or risk factors for coronary artery disease. Insomuch as reduction of blood pressure reduces stroke risk, a low fat, low sodium diet may be regarded as beneficial for this purpose.

There is *strong* evidence that consumption of a Mediterranean-type diet is associated with a reduction in coronary events. There is *moderate* evidence that a low-fat, low-cholesterol diet of the Mediterranean type reduces risk of cardiovascular outcomes including stroke.

**Anti-oxidants**
There is potentially conflicting evidence with regard to the effectiveness of a combination of antioxidants in retarding the progression of atherosclerosis as measured by the intima-media thickness (IMT) of the common carotid artery. However, there is also *strong* evidence that the use of antioxidants has no effect in the prevention of stroke events. There is *moderate* evidence that polyunsaturated fatty acid (PUFA) may reduce stroke risk.

**Homocysteine**
There is *limited* evidence that elevated homocysteine levels are associated with increased risk of atherosclerotic vascular disease, including stroke, and that levels of folic acid, vitamin B₆, and vitamin B₁₂ are inversely related to plasma homocysteine levels. However, there is *moderate* evidence that treatment with high doses of folic
acid, vitamins B₆ and B₁₂ does not reduce the risk of stroke.

**Smoking**
Smoking increases the risk of both ischemic and haemorrhagic stroke in a positive dose-response manner. Recent *limited* evidence suggests that exposure to environmental smoke increases the risk of stroke. There is *limited* evidence that smoking cessation reduces the risk of a subsequent stroke.

**Alcohol**
There is *limited* evidence that light alcohol consumption (1 – 2 drinks per day) reduces the risk for ischemic stroke while heavy drinking (more than 5 drinks per day) increases it. There is *limited* evidence that alcohol consumption increases the risk for hemorrhagic stroke in a linear, dose-dependent fashion.

**Behavioural Intervention**
There is *moderate* evidence that multi-factorial behavioural intervention can substantially reduce the risk of stroke even within a high-risk population. An understanding of how behavioural change occurs is necessary to ensure optimization of promotion of healthy lifestyles.

**Atherosclerosis and Noncardiac Embolism**

**ASA**
There is *strong* evidence that ASA therapy reduces the risk for recurrent stroke. In patients with acute stroke, aspirin therapy reduces the risk for recurrent ischemic stroke or death by 13%. Aspirin reduces the risk for serious vascular events in patients with a history of previous TIA or minor stroke by 22% with long-term therapy. Doses of 75 – 150 mg/day are sufficient to produce the most effect with least risk. Therapy should be initiated as soon as is safe following the onset of the stroke event and maintained over the long-term.

**Theinopyridines (Ticlopidine and Clopidogrel)**
There is *strong* evidence that theinopyridines are more effective than ASA in reducing the risk of vascular complications, particularly among patients with a history of prior TIA or stroke. However, ticlopidine is associated with a poor safety profile in terms of associated adverse events. There is *moderate* evidence that clopidogrel is similar to aspirin with regard to safety, but as effective as ticlopidine in reducing the risk of recurrent stroke.

**Combination Therapies**
There is *moderate* evidence that clopidogrel in combination with ASA is more effective than ASA alone in preventing stroke among patients with unstable angina and non-Q-wave MI only. There is *moderate* evidence that clopidogrel when combined with ASA is not more effective than clopidogrel alone in preventing recurrent stroke, myocardial infarction, vascular death or rehospitalization for acute ischemic events and is associated with increased bleeding events. There is *moderate* evidence that
dipyridamole in combination with ASA is more effective than either agent used on its own in the prevention of recurrent stroke. There is *moderate* evidence that clopidogrel in combination with ASA provides more effective platelet inhibition than either ASA alone or ASA in combination with dipyridamole.

**Miscellaneous Antiplatelet Therapies**
There is *strong* evidence that Triflusal is not inferior to ASA in the prevention of stroke and is associated with fewer bleeding incidents. There is *moderate* evidence that the use of Glycoprotein IIb/IIIa inhibitors (Lotrafiban) in the secondary prevention of stroke is associated with excessive bleeding incidents.

**Anticoagulants for Secondary Prevention of Noncardioembolic stroke**
There is *conflicting* evidence with regard to the use of oral anticoagulant therapy in noncardioembolic stroke. There is *strong* evidence that treatment with oral anticoagulant therapy is associated with higher risk for adverse events. High intensity therapy is associated with significant risk of major bleeding events and intracerebral haemorrhage.

**Cardiac Abnormalities**

**Atrial Fibrillation**
Atrial Fibrillation has been associated with an increased risk of cardioembolic stroke. There is *strong* evidence that the use of anti-coagulation therapy, particularly with adjusted dose warfarin, substantially reduces the risk of primary and secondary stroke in individuals with atrial fibrillation. There is *moderate* evidence that the antiplatelet Indobufen may be as effective as warfarin, but is associated with a reduced risk of bleeding events. There is also *strong* evidence that treatment with the direct thombin inhibitor ximelagatran/melagatran is not inferior to treatment with warfarin. While associated with fewer bleeding events, ximelagatran treatment requires monitoring of liver function for the first six months of treatment.

Other Cardiac Abnormalities
A variety of cardiac abnormalities increase the risk of cardioembolic strokes. As demonstrated in the previous discussion of atrial fibrillation, there is *strong* evidence that this risk is decreased with anticoagulation therapy, primarily adjusted-dose warfarin. There is additional *moderate* evidence to support the effectiveness of anti-coagulant therapy in reducing the risk of stroke subsequent to myocardial infarction.

**Carotid Artery Occlusion**

**Reperfusion Interventions**
There is *strong* evidence that carotid endarterectomy is an effective and durable means by which to reduce the risk of stroke in individuals with symptomatic carotid artery stenosis of 70 – 99%. While there is *strong* evidence that the procedure is effective in reducing the risk of stroke in individuals with asymptomatic stenosis of ≥ 60%, the risks associated with the procedure outweigh the benefit if they exceed 3%.
There is strong evidence that carotid angioplasty and stenting has a similar 30-day risk for complications as carotid endarterectomy and can be used for subgroups of patients not usually considered to be appropriate candidates for surgery. While a higher risk for embolic complications exists with CAS, ongoing development of technology and experience have improved results. There is moderate evidence that the use of cerebral protection devices reduces the risk associated with CAS. There is moderate evidence that carotid artery stenting with emboli protection is not inferior to CEA when used in high risk groups.

Mobility/Lower Extremity

Remedial vs. Compensatory Rehabilitation
There is strong evidence that the Bobath approach is not superior to other therapy approaches. There is conflicting evidence that the Motor Learning Approach is superior to the Bobath approach for achieving improvements in functional outcome. There is moderate evidence that a Motor Learning Approach reduces length of hospital stay.

Intensity of Training
There is strong evidence that enhanced therapy is associated with improvements in gait. There is strong evidence that these improvements are achieved and maintained for up to three months, but not sustained for longer periods of time.

Strength Training and Cardiovascular Conditioning
There is strong evidence that strength training increases walking distance post stroke. There is moderate evidence that progressive strength training can improve ADL function. Collectively, this constitutes strong evidence that strength training increases walking distance. There is strong evidence that cardiovascular training post stroke improves outcomes.

Functional Electrical Stimulation
There is strong evidence that functional electrical stimulation and gait retraining results in improvements in hemiplegic gait.

Assistive Devices
There is moderate evidence that a quad cane is more effective than a standard cane for reducing postural sway. There is limited evidence that walking with a cane can improve hemiplegic gait.

Treadmill Training and Partial Weight Support
There is conflicting evidence that treadmill training alone (without partial weight support) is better than conventional therapy. There is conflicting evidence that partial body weight support results in improved walking and motor recovery when compared to conventional therapy. There is moderate evidence that partial body weight support is of no greater benefit than aggressive braced assisted walking. Treadmill training when combined with other gait specific activities improves gait.
Biofeedback
There is *strong* evidence that EMG biofeedback training improves gait and standing post stroke.

Balance Training
There is *strong* evidence that balance training post stroke improves outcome. There is *conflicting evidence* as to what form of balance training yields the most effective result.

Ankle Foot Orthoses
There is *limited* evidence that ankle foot orthoses alone improve various parameters of gait in hemiplegic strokes. There is *moderate* evidence that ankle foot orthoses combined with posterior tibial nerve deinnervation improves gait outcomes in hemiplegic strokes.

Task-Specific Training
There is *strong* evidence that task-specific gait training improves gait post stroke.

Deinnervation of Spastic Muscles
There is *strong* evidence that deinnervating lower extremity muscles with Botulinum toxin reduces spasticity but *conflicting evidence* as to whether such deinnervation impacts on functional outcomes.

Anti-Spastic Medications
There is *conflicting evidence* that Dantrolene sodium is effective in treating post-stroke spasticity compared to placebo. There is *moderate* evidence that ketazolam, diazepam and tolperisone are more effective when compared to placebo in treating post-stroke spasticity. There is *limited* evidence that Tizanidine is not superior to oral Baclofen. There is *moderate* evidence that intrathecal baclofen can reduce spasticity in the chronic stages of stroke.

Upper Extremity Interventions

Neurodevelopmental Techniques
There is *strong* evidence that neurodevelopmental techniques are not superior to other therapeutic approaches. There is *moderate evidence* that compared to Bobath, Motor Relearning Programme may be more beneficial to short-term motor functioning, but not to long-term motor functioning.

Additional/Enhanced Therapy
There is *conflicting evidence* that enhanced therapies improve short-term upper extremity function.
Repetitive Task Specific Therapy
There is strong evidence that repetitive task specific training techniques improves measures of upper extremity function.

Sensorimotor Training
There is conflicting evidence that sensorimotor training improves upper extremity function, compared to traditional techniques. However, there is moderate evidence that patients with right hemiparesis do benefit from sensorimotor training. There is strong evidence that sensorimotor training with robotic devices improves upper extremity functional outcomes, and motor outcomes of the shoulder and elbow. There is strong evidence that robotic devices do not improve motor outcomes of the wrist and hand.

Constraint Induced Movement Therapy
There is strong evidence of significant benefit of CI movement therapies in comparison to traditional therapies. However, functional benefits appear to be confined to a subset of stroke patients with some active wrist and hand movements, particularly those with sensory loss and neglect.

Hand Splinting
There is strong evidence that hand splinting does not improve motor function or reduce contracture formation.

Spasticity Treatment

Botulinum Toxin
There is strong evidence that treatment with Botulinum Toxin significantly decreases spasticity in the upper extremity in stroke survivors and that this is associated with decreased spasticity, increased range of motion, with subsequent improvements in upper extremity function.

Combination of Botulinum Toxin and Physical Therapy
There is strong evidence that a combination of physiotherapy and Botulinum Toxin Injection is associated with improved upper extremity function.

EMG/Biofeedback
There is strong evidence that EMG/Biofeedback therapy is not superior to other forms of treatment.

Functional Electrical Stimulation (FES)
There is strong evidence that FES treatment improves upper extremity function.

Painful Hemiplegic Shoulder

Shoulder Subluxation
Shoulder subluxation occurs early in the course of recovery as a consequence of early
flaccidity of supporting shoulder musculature, but not scapular rotation. Shoulder subluxation may be a cause of shoulder pain but current evidence suggests it is not the primary cause of the pain.

**Spastic Contracted Shoulder**
There is a significant correlation between spasticity and a painful frozen or contracted shoulder. There appears to be an important role for the subscapularis muscle and to a lesser extent pectoralis major musculature, which develops greater tonic activity with subsequent muscle imbalance.

**Shoulder Pain and Functional Outcome**
There is an association between hemiplegic shoulder pain and poorer functional outcomes, which may simply reflect an association with more severe strokes.

**Positioning/Support**
There is *consensus* evidence that proper positioning of the hemiplegic shoulder helps to avoid subluxation. However, there is *moderate* evidence that prolonged positioning does not negatively influence active and passive range of motion or level of pain. There is *limited evidence* that shoulder slings prevent subluxation associated with hemiplegic shoulder pain, although the superiority of a specific device has not been established.

**Exercise**
There is *moderate evidence* that the use of overhead pullies is associated with increases in hemiplegic shoulder pain and should be avoided. In contrast, there is *moderate evidence* that a gentle range of motion program by a therapist results in less hemiplegic shoulder pain.

**Corticosteroid Injections**
There is *moderate evidence* that corticosteroid injections do not improve shoulder pain or range of motion in hemiplegic patients. There is *limited evidence* that oral non-steroidal anti-inflammatories can reduce pain during therapy sessions.

**Functional Electrical Stimulation (FES)**
There is *strong evidence* that FES improves muscle function, pain, subluxation and range of motion of the hemiplegic shoulder.

**Motor Block & Surgical Resection of Shoulder Muscles**
There is *limited evidence* that surgically resecting the subscapularis and pectoralis tendons improves outcomes in stroke patients with painful hemiplegic shoulder. As well, there is *limited evidence* that motor blocks of the suprascapular and pectoralis muscles treat muscle imbalance, pain and decreased range of motion of the hemiplegic shoulder.

**Shoulder Hand Syndrome**
Shoulder hand syndrome is a poorly understood clinical entity. Most cases improve with time. There is *moderate evidence* that oral corticosteroids improves shoulder hand
syndrome for at least the first 4 weeks.

Cognitive Disorders and Apraxia

Cognitive Rehabilitation

Remediation of Attention Deficits
There is strong evidence that remediation of attention has a positive effect on specific, targeted outcomes.

Remediation of Memory Deficits
There is conflicting evidence with regard to the effectiveness of compensatory memory strategies.

Remediation of Executive Functioning and Problem-Solving Deficits
There is no evidence regarding remediation of executive functioning and problem solving post-stroke.

Pharmacotherapy

Aspirin
ASA is commonly used in the treatment of vascular dementia. There is moderate evidence that ASA is effective in stabilizing and/or improving cognitive outcomes in patients with multi-infarct dementia.

Cholinesterase Inhibitors
There is strong evidence that donepezil taken for 24 weeks improves cognitive function in patients with probable or possible vascular dementia. There is limited evidence that treatment with rivastigmine is associated with more stable cognitive performance and improved behavioural outcomes among patients with subcortical vascular dementia. There is moderate evidence that treatment with galantamine is associated with improvements in cognitive and functional ability. However, the benefits associated with treatment with galantamine are more clearly demonstrated among patients with mixed dementia than vascular dementia.

Nimodipine
There is moderate evidence that treatment with nimodipine is beneficial for memory. There is also moderate evidence that treatment with nimodipine may slow cognitive deterioration and improve semantic and phonetic fluency among patients with subcortical vascular dementia.

Memantine
There is strong evidence, based on the results of 2 RCTs, that treatment with memantine is associated with stabilization or improvement of cognitive function.
Alternate Medications
There is moderate evidence that long-term treatment with citicoline has no effect on cognitive function. There is moderate evidence that treatment with pentoxifylline is associated with decreased cognitive deterioration in patients with multi-infarct dementia.

Pharmacotherapy for the Prevention of Vascular Dementia
There is moderate evidence that a combination of nitrendipine, enalapril, and hydrochlorothiazide decreases the incidence of cognitive decline and dementia in stroke survivors. There is also moderate evidence that a combination of perindopril and indapamide also decreases the incidence of cognitive decline and dementia in stroke survivors.

Post Stroke Delirium
There is no evidence regarding the prevention or remediation of delirium post-stroke.

Post stroke Apraxia
There is moderate evidence that strategic training is effective in the treatment of apraxias post-stroke.

Perceptual Disorders

Treatment of Perceptual Deficits
There is strong evidence that perceptual training interventions improve perceptual functioning. There is moderate evidence that a transfer of training approach is no more effective than a functional approach to perceptual training.

Treatment of Neglect

Visual Scanning
There is strong evidence that treatment utilizing primarily enhanced visual scanning techniques improves visual neglect post-stroke with associated improvements in function.

Computer-based Rehabilitation
There is moderate evidence that computer-based visual scanning training does not remediate visual neglect. There is limited evidence that virtual reality training may help to improve awareness of neglected space.

Limb Activation
There is strong evidence that limb activation therapies improve neglect. Little information is available with regard to duration of effect or the effect of treatment on functional ability.

Sensory Stimulation Interventions
There is conflicting evidence that external sensory stimulation interventions are
beneficial in the treatment of neglect.

**Feedback Strategies**
There is *strong* evidence that the use of feedback strategies is beneficial in the treatment of neglect. More study is required to establish the degree to which treatment effects generalize to other behaviours and to determine the durability of effect.

**Prismatic Adaptation**
There is *strong* evidence that treatment with prisms is associated with an increase in visual perception scores in stroke patients with homonymous hemianopsia and visual neglect, but is not associated with improvement in ADL scores. There is limited evidence that the benefits of prism adaptation may extend past the end of treatment and may benefit various aspects of perceptual performance.

**Eye-patching and Hemi-spatial Glasses**
There is *moderate* evidence that monocular, opaque patching to improve neglect produces inconsistent results. However, there is also *moderate* evidence that the use of bilateral half-field eye patches improves visual neglect and functional ability.

**Caloric/Vestibular Stimulation**
There is *limited* evidence that caloric stimulation has a transient, positive effect on visuospatial neglect. Its applicability as a treatment intervention has not been evaluated.

**Vestibular Galvanic Stimulation**
There is very *limited* evidence that galvanic stimulation is as effective as caloric stimulation in improving neglect. Its effectiveness as part of a treatment intervention has not been assessed.

**Optokinetic Stimulation**
There is *limited* evidence that optokinetic stimulation improves personal position sense in patients with neglect. There is *moderate* evidence that the addition of optokinetic stimulation to a neglect-specific rehabilitation program has no effect.

**Trunk Rotation Therapy**
There is *limited* evidence that trunk rotation reduces visual neglect. There is *moderate* evidence that trunk rotation when combined with visual scanning is of benefit in the treatment of spatial neglect.

**Neck Muscle Vibration**
There is *moderate* evidence that neck muscle vibration therapy in association with visual exploration training is effective in improving both symptoms of neglect and performance of ADLs. There is *limited* evidence that muscle therapy alone is associated with reduction of neglect. The effect of treatment may be sustained for periods in excess of one year.
TENS Treatment
There is limited evidence that TENS treatments improve neglect post stroke.

Dopaminergic Medications
There is limited evidence that dopamine agonist therapy reduces the symptoms of neglect. There is limited evidence that carbidopa L-dopa improves both neglect and functional ability.

Aphasia Post Stroke

Language Therapy
There is conflicting evidence as to whether language therapy is efficacious in treating aphasia following stroke. The failure to consistently identify a benefit may be due to the low intensity of Speech Language Therapy (SLT) applied in the negative studies (when compared to higher intensity in positive studies) and the fact some studies had aphasic patients from causes other than stroke. However, the most comprehensive meta-analysis concluded that language therapy for aphasia had a significant positive impact on aphasia recovery in the acute phase and to a lesser extent during the chronic phase. It also revealed that improvement was tied to the intensity of therapy, with severe aphasics benefiting the most.

Trained Volunteers
There is strong evidence that trained volunteers can be trained to provide speech and language therapy and achieve similar outcomes. This could serve as an effective adjunct to speech and language pathologists’ treatment, when conducted under their supervision.

Group Aphasia Therapy
There is moderate evidence that group intervention results in improvements on communicative and linguistic measures among patients with chronic aphasia. There is moderate evidence that group therapy results in less improvement in graphic (writing) elements of aphasia when compared to individualized therapy. There is limited evidence that participation in group therapy results in improved communication.

Forced-Use Aphasia Therapy
There is moderate evidence that forced-use aphasia therapy results in greater language performance in chronic aphasics over a short period of time.

Computer-Based Therapy
There is strong evidence that computer-based interventions can improve language skills assessed at the impairment level. There is limited evidence that improvements made via computer-based interventions generalize to functional communication.

Community-Based Therapy Programs
There is limited evidence that a community-based program improves language
outcomes at both the impairment and disability level independent of severity, setting, diagnostic type or stage of aphasia. There is moderate evidence that an in-home program administered by trained volunteers improves language outcomes at the impairment and functional levels.

Filmed Language Instruction
There is limited evidence that supplementary, filmed language instruction is of no benefit to aphasic patients.

Family and Patient Education
There is limited evidence that participation in educational seminars results in improved knowledge, participation in social activities and family adjustment. Further examination of the role of education is warranted.

Deficit-Specific Therapy
There is moderate evidence that task-specific semantic improves semantic activities and that task-specific phonological treatment improves phonologic outcomes. There is limited evidence that target-specific therapy demonstrates no benefit for patients suffering from global aphasia. There is limited evidence that specific therapy for alexia improves language function.

Drug Treatments
There is strong evidence of a significantly positive impact of the drug Piracetam on aphasia recovery in stroke patients also receiving language therapy over the short-term. In contrast, there is strong evidence that Bromocriptine does not improve aphasia recovery post stroke. There is moderate evidence that dextroamphetamine improves aphasia recovery when combined with language therapy. In contrast, there is moderate evidence that Dextran 40 when given to acute stroke patients results in worse outcomes than the non-treatment control. Bifemelane, a cholinergic treatment, has not been sufficiently studied to draw any meaningful conclusions. There is moderate evidence that the use of Moclobemide does not enhance aphasia recovery.

Dysphagia and Aspiration Following Stroke

Incidence of Dysphagia/Aspiration
The incidence of dysphagia appears to be quite high following acute stroke, with between one-third to two-thirds of all stroke patients affected. VMBS studies are the “gold standard” for diagnosing dysphagia and aspiration. The incidence of aspiration in the acute phase of stroke varies from 21-42% and decreases to less than 12% by 3 months post stroke. Between one-third and one-half of patients who aspirate following stroke are silent aspirators.

Aspiration and Pneumonia
Aspiration appears to be associated with an increase in the incidence of pneumonia. The risk of developing pneumonia appears to be proportional to the severity of
aspiration.

Assessment of Dysphagia
There is consensus opinion that acute stroke survivors should be NPO until swallowing ability has been determined. There is consensus opinion that a trained assessor should screen all acute stroke survivors for swallowing difficulties as soon as they are able. There is consensus opinion that a speech and language therapist should assess all stroke survivors who fail swallowing screening and identify the appropriate course of treatment. There is consensus opinion that an individual trained in low-risk feeding strategies should provide feeding assistance or supervision to all stroke survivors. There is consensus opinion that a dietician should assess the nutrition and hydration status of all stroke patients who fail swallowing screening. There is limited evidence that individual’s with dysphagia should feed themselves to reduce the risk of aspiration. There is consensus opinion that dysphagic stroke patients typically require diets with modified food and liquid textures.

Feeding Assistance
There is consensus opinion that an individual trained in low-risk feeding strategies should provide feeding assistance or supervision to all stroke survivors.

Dietary Modifications
Although dietary modifications have been used to help reduce the incidence of aspiration and their consequences, the evidence to support their use is lacking. For patients on modified diets there is consensus opinion that a dietitian should be consulted to ensure that the modified diet is nutritionally adequate and appropriate, and to consult the stroke survivor or substitute decision-maker, to ensure that the modified diet is as appealing as possible.

Nifedipine
There is moderate evidence that Nifedipine improves specific aspects of swallowing mechanics following stroke.

Head Rotation and Thermal Stimulation
There is limited evidence that head rotation can improve swallowing function in lateral medullary stroke patients. There is moderate evidence that thermal stimulation does not improve swallowing function post stroke.

Dysphagia Therapy
There is moderate evidence that a short course (two weeks) of formal dysphagia therapy does not improve clinical outcomes.

Feeding Tubes
There is consensus opinion that enteral tube feeding be used in stroke patients who are high-risk dysphagics or who cannot meet their nutritional need orally. Enteral feeding should be considered after a stroke survivor has been NPO for 48 hours. There is consensus opinion that if dysphagia is severe and expected to last more than 6 weeks,
a gastrostomy or jejunostomy feeding tube may be indicated. There is strong evidence that intragastric feeding devices are associated with fewer mechanical failures compared to nasogastric feeding tubes.

Nutritional Interventions Following Stroke

Nutritional Status
The incidence of malnutrition varies from 8 to 49% post stroke, depending on the timing of the assessment and the criteria used to define malnutrition. Unfortunately, there is no “gold standard” for the assessment of nutritional status. There is an absence of literature examining the nutrient intakes of stroke patients. Therefore, there is no evidence to suggest that nutrient intake following stroke is altered, although data extrapolated from a mixed geriatric population suggests that energy and protein intakes may be reduced.

Changes in Body Metabolism
There is limited evidence that stroke does not result in short term elevations of metabolic rate. There is evidence that an acute phase response accompanies stroke, although its contribution to the development of malnutrition is unclear. There is an absence of literature to confirm or refute the development of significant gastrointestinal impairments following stroke.

Feeding Tubes
There is strong evidence that intragastric feeding is associated with fewer complications than nasogastric feeding. The one-year survival rate of patients with gastrostomy feeding tubes varies widely from 16% to 70%. On average, feeding tubes are placed within the first month following stroke. Among patients with feeding tubes discharged to the community, Aspiration pneumonia was reported in 6-18% of patients.

Total Parenteral Nutrition
There have been no studies that have evaluated the efficacy of Total Parenteral Nutrition (TPN) in the treatment of stroke patients.

Oral Supplementation
There is moderate evidence that routine oral sip supplementation does not improve functional outcomes or decrease mortality following stroke. However, however, it can improve energy and protein intakes and improve their nutritional parameters.

Medical-Nursing Complications Post Stroke

Bladder & Bowel Management
There is moderate evidence that a functionally oriented rehabilitation approach results in significantly less bladder incontinence than a Bobath conventional approach. The use of indwelling catheters in stroke patients has not been well studied. There is consensus
opinion that indwelling catheters should be limited to those patients with intractable urinary retention, skin breakdown, continuous wetness and the need for urinary monitoring. There is moderate evidence that a nursing evaluation/intervention program can be effective in reducing constipation long-term following stroke. There is moderate evidence that a morning bowel routine is more effective than an evening bowel routine.

**Deep Vein Thrombosis (DVT)**
The incidence of DVT which are both clinically apparent and silent may be 30% or higher acutely post stroke. This rate may fall to 10% or lower in patients in the sub-acute phase of stroke receiving rehabilitation. There is strong evidence that anticoagulation significantly reduces the incidence of deep vein thrombosis (DVT), when compared to placebo. There is strong evidence that low molecular weight heparin is better than unfractionated heparin in reducing DVTs. There is moderate evidence that heparin is no better than pneumatic compression in preventing DVTs. There is moderate evidence that graded compression stockings do not reduce the development of DVTs.

**Seizures**
There is no research specific to the treatment of post stroke seizures. There is consensus opinion that patients who have experienced seizures post stroke should be given preventative anticonvulsant medication to prevent seizure reoccurrence.

**Osteoporosis**
There is moderate evidence that vitamins D and K and sunlight therapy reduces osteoporosis in hemiplegic stroke patients. There is also moderate evidence that Ipiflavone was more effective than vitamin D in reducing osteoporosis in hemiplegic stroke patients. There is strong evidence that treatment with bisphosphonates (risedronate and etidronate can preserve bone mineral density following stroke. There is moderate evidence that risedronate, and a combination of folate and vitamin B₁₂, can prevent hip fracture in elderly women following stroke.

**Central Pain States**
There is conflicting evidence that amitriptyline treatment results in pain reduction in central pain states post stroke. There is moderate evidence that lidocaine treatment results in short-term pain relief. There is moderate evidence that intravenous morphine reduces some components of post stroke pain in a minority of patients. There is moderate evidence that Lamotrigine may be an alternative to tricyclic antidepressants in the treatment of central pain. There is limited evidence that motor cortex stimulation can provide long-term effective pain relief.

**Post Stroke Depression**

**Location of Lesion**
There remains a wide diversity of findings in studies looking at the relationships between stroke location and depression. Not all studies have confirmed this
relationship and more recent meta-analyses have failed to establish a definitive relationship between the site of the brain lesion and depression.

**Depression, Functional Deficits, Cognition and Mortality**
The negative effect of depression underscores the need for early detection and treatment of post-stroke depression. Identification and treatment of post-stroke depression early in the acute phase may serve to enhance functional recovery. Early attention to issues of social withdrawal or impaired social functioning may help deter later depression and provide an opportunity for patients to resume pre-stroke activities. Post-stroke depression appears to have a negative impact on cognition; however, this relationship is poorly understood. The presence of depressive symptomatology post stroke has been associated with an increased risk for mortality.

**Prevention of Post Stroke Depression**
There is *conflicting* evidence of whether early initiation of antidepressant therapy to prevent post-stroke depression is effective.

**Heterocyclics**
There is *strong evidence* that heterocyclic antidepressants improve depression post stroke. Side effects of heterocyclic antidepressants are frequent in elderly stroke patients.

**Serotonin Reuptake Inhibitors**
There is *strong evidence* as to serotonin reuptake inhibitors effectiveness in the treatment for post stroke depression.

**Selective Noradrenaline Reuptake Inhibitors**
There is *moderate* evidence that reboxetine, a selective noradrenaline reuptake inhibitor, is effective in reducing retarded post-stroke depression.

**Methylphenidate**
There is *moderate evidence* that methylphenidate is more effective than placebo in improving depression and functional recovery post stroke. Methylphenidate acts more quickly than more traditional antidepressants.

**Pharmacologic Treatment, Functional Recovery and Mortality**
There is *conflicting* evidence regarding the impact of the pharmacologic treatment of depression on functional recovery post stroke. There is *moderate* evidence that early treatment with antidepressants post stroke is associated with improved long-term survival.

**Electroconvulsive Therapy (ECT)**
There is *limited evidence* that ECT is a safe and effective treatment in post stroke patients.
Transcranial Magnetic Stimulation
There is moderate evidence that repetitive transcranial magnetic stimulation is an effective, well-tolerated treatment for drug-resistant post-stroke depression.

Cognitive Behavioral Therapy
There is moderate evidence that cognitive behavioural therapy is ineffective as a treatment for post-stroke depression.

Music Therapy
There is limited evidence that music therapy improves post-stroke depression.

Speech Therapy
There is moderate evidence that speech therapy does not improve post-stroke depression or overall psychological wellbeing.

Community Reintegration

Social Support
The presence and size of social support networks as well as the perceived effectiveness of social support networks have a positive influence on physical recovery and quality of life post stroke. Higher levels of support are associated with greater functional gains, less depression and improved mood and social interaction. The size and perceived effectiveness of social support networks are important predictors of discharge destination.

There is strong evidence that interventions designed to increase social support by accessing community based support services help stroke survivors to increase social activity, although there is also strong evidence that the use of a social worker or outreach nurse to implement this type of strategy is ineffective. There is moderate evidence that interventions targeting informal social networks improve quantity and quality of relationships. There is moderate evidence that a targeted program of psychosocial intervention directed at the stroke survivor and his/her family has no effect on functional outcome.

Effects of Caregiving
Commonly identified effects of caregiving on the caregiver include decreased health (both physical and mental), decreased social contact and activity, increased risk for depression, increased carer stress, strain or burden and an overall decrease in quality of life. Decreased social contact and activity may contribute to increased carer strain, increased risk of depression and decreased life satisfaction. Age, severity of stroke and stroke-related impairments, functional status and cognitive status have been reported as influencing caregiver outcomes. Support provided by caregiving peers may have a positive effect on the caregiver. It is important to include both the caregiver and stroke patient in social support interventions.
Family Functioning
Perceived family dysfunction is common post stroke. Family function affects treatment adherence, performance of ADLs and social activity. Stroke patients do better with well-functioning families characterized by effective communication, good problem solving or adaptive coping, and strong emotional interest in each other.

Education/Information Provision
There is strong evidence of a positive benefit associated with the provision of information and education through a variety of intervention types. Education sessions may have a greater effect on outcome than the provision of information materials alone. There is strong evidence that skills training is associated with a reduction in depression. There is moderate evidence that training in basic nursing skills improves outcomes of depression, anxiety and quality of life for both the caregiver and the stroke patient.

Social and Leisure Activities
Deterioration in social and leisure activities is common post-stroke and is greatest in women, the young and those who are better educated. Perceptions about how others view their disabilities and perceptions about how they will be able to cope post-stroke may influence the degree of social isolation experienced.

Leisure Therapy
When considered individually, there appears to be conflicting evidence as to the benefit of leisure therapy post-stroke and following discharge. However, a recent meta-analysis using pooled data from the same RCTs reported a modest improvement in leisure activity associated with leisure therapy.

Sexual Activity
A decrease in sexual activity is common post-stroke, although there is general agreement that sexual drive is still present. The main barriers to sexual activity are physical impairments and psychological factors, in particular a changed body image and lack of communication. Hypersexuality post-stroke is rare and not well understood. There were no studies of treatment of sexual dysfunction identified. There is consensus opinion that sexual issues should be discussed during rehabilitation and addressed again after transition to the community when the stroke survivor and significant other are ready.

Driving
Patients for whom there is concern about their ability to drive need to be identified and proper assessment and treatment initiated. Determination of ability to drive should not rely solely on neuropsychologic testing or road test evaluation. Rather, a 2-step process is recommended in which the patient is first screened for readiness to participate in an on-road evaluation. There is moderate evidence that a visual attention-retraining program does not improve the driving performance of patients with stroke. Further research is required to identify interventions that would help improve driving abilities post stroke.
Return to Work
A substantial proportion of stroke survivors who were employed prior to the stroke event do not return to work. Factors influencing return to work include the degree of physical and cognitive impairment, age, educational level and type of pre-stroke employment. There is consensus opinion that stroke survivors who worked prior to their stroke should be encouraged, if their condition permits, to be evaluated for their potential to return to work.

Miscellaneous Treatments

Acupuncture
There is conflicting evidence that acupuncture is effective in improving stroke outcomes.

Transcutaneous Electrical Nerve Stimulation (TENS)
There is conflicting evidence that TENS improves a variety of motor recovery, spasticity and ADLs.

Reiki Treatment
There is moderate evidence that Reiki Treatment does not improve functional outcomes.

Medications

Amphetamines
There is strong evidence that amphetamines improve motor recovery and/or functional outcomes, particularly when combined with physiotherapy. Although amphetamines exert an anti-depressant effect, it is uncertain the extent to which this effect influences recovery.

Piracetam
There is strong evidence of a significant impact of Piracetam on aphasia recovery in stroke patients also receiving speech and language therapy over the short-term. There is limited evidence that Piracetam increases activation of language processing regions within the brain.

Bromocriptine
There is strong evidence that Bromocriptine does not improve aphasia recovery post stroke.

Selegiline
There is moderate evidence that Selegiline improves stroke impairment scores, but not functional outcomes.

Levodopa
There is moderate evidence that Levodopa improves motor recovery following stroke.
Dextran 40
There is moderate evidence that Dextran 40 results in poorer functional outcome, compared to non-treatment control patients.

Bifemelane
Bifemelane in the treatment of language recovery has not been sufficiently studied to draw any meaningful conclusions.

L-Threodops (L-threo-3,4-dihydroxyphenylserine)
There is moderate evidence that L-DOPS improves functional outcomes post stroke.