EVIDENCE-BASED REVIEW OF STROKE REHABILITATION (17th Edition)

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Executive Summary

The Stroke Rehabilitation Evidence-Based Review (SREBR) reviews techniques, therapies, devices, procedures and medications associated with 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.

Since its original publication in April 2002, the SREBR has undergone seventeen major revisions and now includes articles published up to July 2015. To date, we have included 1, 770 randomized controlled trials (RCTs).

Methods

For the first edition of the SREBR a literature search using multiple databases (MEDLINE, EBASE, MANTIS, PASCAL and Sci Search) was conducted 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, the authors of each of the modules have conducted their own searches. Databases used include EMBASE, CINAHL, PubMED, ProQuest, PsycINFO, AMED, and Scopus. Key terms were tailored to identify potential trials within each subsection of every module. Depending on the breadth of the current evidence, searches may have been restricted to randomized controlled trials, since they are given the greatest emphasis when formulating conclusions. This review was restricted to published works. Although it was not confined to the results from randomized controlled trials (RCT), these articles received priority when formulating conclusions. Systematic reviews and meta-analyses were also

incorporated in the content of the modules. The 17th version of the SREBR contains published literature up to July 2015.

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

There are many systems currently available to summarize a body of knowledge and to establish levels of evidence. Some of these are increasingly complex, requiring a specialized body of knowledge for correct interpretation. With our focus on ease and accessibility, we intentionally chose a system that was simple and straight-forward. The levels of evidence used to summarize the findings are based on the levels of evidence developed by Sackett et al. (2000). For the purpose of this review, a simplified version of the categories used by Sackett et al. (2000) was adopted. Instead of the original 10 scoring categories, we developed a scoring system ranging from a level 1 evidence to a level 5 evidence, and added descriptions to each category to help designate the appropriate level of evidence based on the type of research design. In the Version 4.0 of this grading scheme used in this review, the evidence level of 1 category is further divided into 2 subcategories to distinguish between a single RCT with a PEDro score ≥ 6 (Level 1b), and 2 or more RCTs with PEDro scores ≥ 6 (Level 1a).

The modified Sackett Scale version 4.0 consists of the following levels of evidence:

- **Level 1a**
  - More than one higher RCT with PEDro score ≥ 6. Includes within subjects comparison with randomized conditions and cross-over designs.
- **Level 1b**
  - One higher RCT with PEDro score ≥ 6.
- **Level 2**
  - Lower RCT(s) with PEDro score <6.
  - Prospective controlled trial(s).
  - Prospective cohort (longitudinal) study using at least 2 similar groups with one exposed to a particular condition.
- **Level 3**
  - A retrospective case control study comparing conditions, including historical cohorts.
- **Level 4**
  - A prospective pre-post trial with a baseline measure, intervention, and a post-test using a single group of subjects.
  - A prospective post-test with two or more groups (intervention followed by post-test and no re-test or baseline measures) using a single group of subjects.
  - A retrospective case series usually collecting variables from a chart review.
- **Level 5**
  - An observational study using cross-sectional analysis to interpret relations.
  - A clinical concensus (expert opinion) without explicit critical appraisal, or based on physiology, biomechanics or "first principles".
  - A case report involving one subject.

Meta-analyses, conducted by the authors of this review have also been included in modules 8, 15, 16, 17 and 18.

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) and statistical power (i.e. large sample size) 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 judgement 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.

Levels of Evidence

Levels of evidence were generated based on the modified Sacket's Scale described above for literature presented in modules 4 through to 22, with the exception of module 20 which summarized rehabilitation outcome measures.

Modules

4) Managing the stroke rehabilitation triage process
5) The efficacy of stroke rehabilitation
6) The elements of stroke rehabilitation
7) Outpatient stroke rehabilitation
8) Secondary prevention of stroke
9) Mobility and the lower extremity
10) Upper extremity interventions
11) Painful hemiplegic shoulder
12) Post-stroke cognitive disorders
13) Perceptual disorders
14) Aphasia and apraxia
15) Dysphagia and aspiration post stroke
16) Nutritional interventions following stroke
17) Medical complications post stroke
18) Post-stroke depression and mood disorders
19) Community Reintegration
21) The rehabilitation of younger strokes
22) The rehabilitation of severe stroke

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

4. Managing the Stroke Rehabilitation Triage Process

Predictors of Functional Outcomes

The two most powerful predictors of functional recovery and eventual discharge status home are initial stroke severity and the patient's age, with initial stroke severity being by far the most important. These two alone can be used to determine appropriate stroke rehabilitation triage, although it does not preclude the use of additional factors.

Levels of Severity of Stroke Rehab Patients

Severity of stroke is the most powerful predictor of ability to participate and benefit from stroke rehabilitation. Mild strokes benefit the least because of a "ceiling effect". Moderate to severe stroke improve the most on stroke rehab although the most severe strokes appear to benefit the most when compared to controls.

5. The Efficacy of Stroke Rehabilitation

Acute Stroke Care

There is level 1a evidence that acute stroke care is associated with: 1) a reduction in the odds of death or dependency; 2) a reduction in the need for institutionalization; however, it is not associated with reductions in mortality, or length of hospital stay.

There is level 1a evidence that acute stroke care is not associated with a reduction in functional disability when compared to alternative interventions.

Combined Stroke Units
There is level 1a evidence that combined acute and rehabilitation stroke units are associated with a reduction in the odds of combined death/dependency, the need for institutionalization and length of hospital stay, but are not associated with reductions in mortality alone.

There is level 1a evidence that combined stroke units are associated with improved functional outcome.

Benefits of Sub-acute Rehabilitation
There is level 1a evidence that specialized, interdisciplinary rehabilitation provided in the sub-acute phase is associated with reductions in mortality, and the combined outcome of death or dependency, but is not associated with a reduced need for institutionalization or length of hospital stay, compared to conventional care on a general medical ward.

There is level 1a evidence that for the subset of more severe stroke patients, specialized stroke rehabilitation reduces mortality, but does not result in improved functional outcomes, nor does it reduce the need for institutionalization, compared to conventional care.

There is level 1a evidence that for the subset of patients with moderately severe stroke, specialized rehabilitation improves functional outcomes but does not reduce mortality, compared to conventional care.

There is level 1a evidence that for the subset of patients with mild stroke, specialized rehabilitation does not improve functional outcome or reduce mortality, compared to conventional care.

There is level 1b evidence based a single study that patient with severe or moderately severe stroke who receive treatment on a stroke rehabilitation unit have a lower risk of being dependent, or dead or dependent compared with patients who receive little or no rehabilitation.

Mobile Stroke Teams
Based on the results from meta-analyses, there is level 1a evidence that mobile stroke teams do not reduce mortality, death or dependency combined, the need for institutionalization or the length of hospital stay.

The Efficacy of Stroke Care
There is level 1a evidence that overall, specialized stroke care is associated with reductions in the odds of mortality, the combined outcome of death or dependency, the need for institutionalization and the length of hospital stay.

6. The Elements of Stroke Rehabilitation

Care Pathways in Stroke Rehabilitation
There is conflicting evidence as to whether stroke care pathways improve rehabilitation outcomes.

Timing to Stroke Rehabilitation
There is level 1a evidence that earlier admission to rehabilitation results in improved overall functional outcomes.

There is level 1a evidence that very early mobilization (VEM) post stroke (within the first 24 hours) results in improved outcomes when there are more frequent short in duration out-of-bed sessions and that VEM results in poorer outcomes when early mobilization session are more prolonged.

Intensity of Therapy
There is level 1a evidence that greater intensities of physiotherapy and occupational therapy results in improved functional outcomes.

There is level 1a evidence that the amount of therapy needed to result in a significant improvement in motor outcomes is 17 hours of physiotherapy and occupational therapy over a 10 week period of time.

Intensity of Language Therapy
There is conflicting evidence that greater evidence of aphasia therapy results in improved language outcomes.

Durability of Rehabilitation Gains
There is level 1a evidence that relatively greater functional improvements are made by patients rehabilitated on specialized stroke units when compared to general medical units and the effects are maintained over both the short-term and long-term.

There is level 1a evidence that functional outcomes achieved through stroke rehabilitation are maintained and actually improve for up to one year.

There is level 1b evidence that by five years post-stroke functional outcomes plateau and may decline. By ten years, overall functional outcome scores significantly decline although it is unclear to what extent the natural aging process and comorbidity may contribute to these declines.

7. Outpatient Stroke Rehabilitation

Early Supported Discharge
There is level 1a evidence that stroke patients with mild to moderate disability, discharged early from an acute hospital unit, can be rehabilitated in the community by an interdisciplinary stroke rehabilitation team and attain similar or superior functional outcomes when compared to patients receiving in-patient rehabilitation.

There is level 1a evidence that the cost associated with early-supported discharge is lower when compared to usual care; however, savings are generally not dramatic or consistent across the studies.

Outpatient Rehabilitation Provided Within the First 6 Months of Stroke Onset
There is conflicting level 1a evidence that additional outpatient therapy improves performance of ADLs.

Outpatient Rehabilitation Provided at Least One Year Following Stroke
There is conflicting level 1a evidence regarding the association between home based therapy for chronic stroke survivors and improvements in performance on ADLs and mobility.

Rehabilitation in the Home or in the Hospital
There is level 1a and level 2 evidence that home-based and hospital-based outpatient stroke rehabilitation programs are equally effective in achieving modest gains in ADL following inpatient rehabilitation.

8. Secondary Prevention

Risk Factor Management

There is level 2 and level 4 evidence that urgent assessment and initiation of treatment following transient ischemic attack is associated with reduced hospital costs, length of stay and risk for early stroke.

There is conflicting level 1b evidence that treatment of patients using an accelerated protocol in an emergency department observation unit results in shorter lengths of stay and reduced costs, but does not result in an improved risk for stroke when compared to inpatient admission for transient ischemic attack.

There is level 1a evidence that personalized secondary preventative care management programs may not improve risk factor management.

There is level 1b evidence that the addition of a positive affirmation intervention to educational materials focussed on self-management and level 2 evidence that a detailed history of medication provided to the GP versus only a basic record of medication at discharge may improve adherence to statins, antihypertensive and antithrombotic medications.

There is level 1b and level 2 evidence that a pharmacist-led educational intervention, a stroke prevention group workshop or post-discharge management of risk factors conducted using a model of shared care may improve long-term benefits in terms of blood pressure reduction, reduced lipid levels, reduced body mass and increased physical activity.

There is level 1b evidence that recording stroke-related events with an electronic support tool or pharmacist-led care management with direct prescription of medication (versus nurse-led management) may not improve stroke or cardiovascular risk management.

There is level 2 evidence that specialist nurse follow-up three months post-stroke or administration of the PROTECT program may improve health outcomes and short-term risk of myocardial infarction, respectively.

There is level 1b evidence that standardized discharge orders are not associated with improved secondary prevention treatment at six months' post-discharge.

Hypertension

There is level 1a evidence that incidence of cardiovascular events, fatal or nonfatal stroke and mortality were reduced by commonly used antihypertensive agents. Furthermore, larger reductions of BP were associated with greater reductions in risk.

There is level 1b 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 level 1a evidence that the use of an ACE-I and diuretic together may result in the greatest reductions of stroke, myocardial infarction and all vascular events compared to ACE-Is, diuretics and β-receptor agonists used alone.

There is level 1a evidence that diuretics at high doses, diuretics at low doses (i.e. Thiazides, Chlorthalidone, and Indapamide), beta-blockers, calcium antagonists, ACE inhibitors, angiotensin receptor blockers, and centrally acting drugs are more effective than the control therapy at reducing the relative risk of stroke.

There is level 1a evidence that only Chlorthalidone at low doses and ACE inhibitors are superior to the control therapy at lowering the relative risk of coronary heart disease.

There is level 1a evidence that Chlorthalidone at low doses, beta-blockers, ACE inhibitors, angiotensin receptor blockers, and centrally acting drugs are more effective than the control at reducing the occurrence of heart failure.

There is level 1a evidence that a composite of stroke and coronary heart disease can be significantly lowered by diuretics delivered at high and low doses (i.e. Thiazides, Chlorthalidone, and Indapamide), beta-blockers, calcium antagonists, ACE inhibitors, angiotensin receptor blockers, and centrally acting drugs, relative to control therapy.

There is level 1a evidence that a composite of stroke, coronary heart disease, and heart failure can be significantly lowered by diuretics deliveredd at high and low doses (i.e. Thiazides, and Chlorthalidone), beta-blockers, calcium antagonists, ACE inhibitors, angiotensin receptor blockers, and centrally acting drugs, relative to control therapy.

There is level 1a evidence that cardiovascular death can be significantly reduce by Thiazides at low doses, calcium antagonists, and centrally acting drugs, while all-cause mortality can only be significantly reduced by the use of low dose Indapamide and calcium antagonist, when compared to control therapy.

There is level 1b evidence that combination therapy with telmisartan (angiotensin receptor blocker) and Ramipril (ACE inhibitor) is associated with increased symptoms of hypotension, syncope and renal dysfunction.

Versus placebo, there is level 1b evidence that ramipril (ACE inhibitor) and nitrendipine may reduce the incidence of cardiovascular and stroke events as well as subsequent mortality (particularly among diabetics). Additional level 1b evidence suggests that aspirin may improve odds of stroke among patients with pre-existing ischemic heart disease and BP ≤80mmHg while vorapaxar (PAR-1 receptor inhibitor) may not improve stroke or cardiovascular risk.

There is level 1b evidence that chlorthalidone (diuretic) may be superior to both doxazosin (α-adrenergic blocker) for stroke and cardiovascular risk management.

There is level 1b evidence suggesting that captopril (ACE-inhibitor) may reduce the incidence of stroke when compared to beta-blockers and/or diuretics. Additional level 1b evidence suggests that perindopril (ACE-I) may significantly improve blood pressure while also reducing risk of stroke however, this drug may have no effect on cardiovascular endpoints.

Management of Diabetes and Associated Macrovascular Complications

There is level 1a and level 1b evidence that pioglitazone may not be associated with a relative reduction in the risk of stroke; however, it may be effective at lowering the composite risk of stroke, myocardial infarction, and death.

There is level 1b evidence that in patients with no history of previous stroke, pioglitazone was not effective at reducing the risk of stroke however, in patients with a history of stroke, the use of pioglitazone was associated with a reduction in the risk of a recurrent stroke.

There is level 1a evidence that intense glucose lowering therapy is not significantly different than standard therapy for reducing the risk of stroke. Intensive glucose lowering therapy may only be an effective treatment for type 2 diabetes and for patients with a history of macrovascular events.

There is level 1b evidence that empagliflozin was not significantly different than placebo therapy at reducing the relative risk of stroke; however, more research is needed to identify the mechanism of action of metformin and potential benefits on cardiovascular health.

There is level 1a evidence that metformin has no additional benefits on cardiovascular health other than reducing blood glucose levels for the treatment of type 2 diabetes.

There is level 1a evidence that treatment of hypertension in diabetic patients reduces the risk of stroke. Furthermore, tighter control of blood pressure is associated with greater reduction of risk for stroke

compared to “less tight” therapy; however, greater risk of adverse events may be associated with aggressive therapy.

There is level 1b evidence that perindopril (angiotensin converting enzyme inhibitor, ACE-I) administered with indapamide (diuretic) may not be superior to placebo therapy at reducing the incidence of macrovascular or cerebrovascular events.

There is level 1b evidence that nitrendipine (ca-channel blocker, CCB) improves risk of cardiovascular events and mortality compared to placebo.

There is level 1b evidence that ramipril (ACE-I) alone improves a combined outcome of myocardial infarction, stroke and cardiovascular mortality.

There is level 1a evidence suggesting that ACE-Is may improve the incidence of major vascular events, especially myocardial infarction, when compared to CCBs.

There is level 1b evidence that amlodipine besylate (CCB) or lisinopril (ACE-I) may not reduce the risk of cardiovascular mortality or nonfatal myocardial infarction when compared to chlorthalidone (diuretic) among patients with diabetes.

There is level 1b evidence that treatments with CCB and ACE-I provide no additional benefit over conventional therapy in terms of preventing the occurrence of macrovascular events including stroke in individuals with Type 2 diabetes.

There is level 1b evidence that valsartan (angiotensin receptor blocker) is as effective as amlodipine (CCB) at reduction of risk for macrovascular events or cardiac complications. Use of this amlodipine may be associated with increased risk for hospitalization due to heart failure.

There is level 1a evidence that all hypertensive medications reduce the risk of stroke, especially among patients with diabetes.

There is conflicting level 1b evidence regarding the effectiveness of pravastatin for the prevention of stroke and composite endpoints of coronary and cardiac complications.

There is conflicting level 1b evidence regarding the efficacy of atorvastatin in the secondary prevention of stroke and cardiovascular complications.

There is level 1b evidence that simvastatin may reduce the odds of stroke as well as the incidence of major coronary and atherosclerotic events when compared to placebo.

There is level 1b evidence that a structured care intervention for hyperlipidemia using atorvastatin and strict implementation of guidelines may decrease mortality, coronary morbidity and incidence of stroke versus usual care.

There is level 1a evidence that statin treatment in patients with diabetes may reduce the risk of stroke; however, in patients with diabetes and existing coronary heart disease, statin treatments only reduced the risk of subsequent coronary heart disease but not stroke.

There is level 1a evidence that fibrate treatment may not reduce the risk of stroke or coronary events.

There is conflicting level 1b evidence regarding the effect of gemfibrozil on lowering the risk of stroke in patients with diabetes.

There is level 1a evidence that fenofibrate and simvastatin combination therapy or fenofibrate treatment alone may not be more efficacious in the prevention of stroke and cardiovascular events when compared to simvastatin monotherapy or placebo. Additional level 1b evidence suggests that unaccompanied fenofibrate administration may decrease the risk of nonfatal myocardial infarction.

There is level 1b evidence that bezafibrate may not improve incidence of myocardial infarction or stroke.

Hyperlipidemia

There is level 1a evidence that statin therapy is effective at lowering the risk of further strokes however, it may not reduce the risk of intracerebral hemorrhage.

There is level 1a evidence that intensive statin therapy may be more effective than less intense therapy in reducing risk for ischemic stroke events.

There is level 1a evidence that statin therapy may not reduce stroke-related mortality, however the evidence is unclear regarding its effects on all-cause mortality.

There is level 1b evidence that withdrawal of statin treatment at the time of acute stroke is associated with increased risk for death and dependency when compared to continuous statin use.

There is level 1b evidence that pre-treatment with atorvastatin may not improve ischemic or haemorrhagic stroke outcome when compared to placebo.

There is level 2 and level 3 evidence that pre-stroke treatment with statins may improve functional disability on the Barthel Index but may not improve stroke severity on the National Institutes of Health Stroke Scale when compared to no statin pre-treatment. Conflicting level 2 and level 3 evidence suggests no consistent data for functional independence on the Modified Rankin Scale or mortality up to 6 months.

Macrolide Antibiotics the Prevention of Cardiovascular Events

There is level 1a and level 1b evidence that azithromycin or roxithromycin (macrolide antibiotic) may not decrease the incidence of cardiovascular events

Lifestyle Modification

There is level 1a evidence that engaging in physical activity is associated with substantial benefits in terms of a reduced risk for stroke and cardiovascular disease. A dose-response relationship may exist between exercise and stroke risk. Conflicting level 1a evidence from a meta-analyses of 10 cohort studies suggests that this relationship may only be significant for men.

There is level 1a evidence that moderate to high levels of leisure and occupational activity may be beneficial for a reduced rate of cardiovascular disease compared to low level exercise.

There is level 1b evidence that a detailed, personalized activity program with regular verbal instruction and encouragement does not effectively increase level of physical activity when compared to the provision of basic information regarding physical activity and no training program.

There is level 1a evidence that low-fat, low-cholesterol diets rich in fruits, vegetables and low-fat dairy products are effective in reducing blood pressure when compared to control diets low in fruits and vegetables, and with average fat content.

There is level 1a evidence that Mediterranean type diets (rich in whole grains, fruits, vegetables, legumes, walnuts, almonds and alpha-linolenic acid) may improve blood pressure and reduce risk of cardiovascular events including stroke when compared to a prudent type diet.

There is level 1a evidence that the use of vitamin C and vitamin E together may reduce atherosclerotic progression.

There is level 1a evidence that vitamin E may not affect the incidence of cerebrovascular accidents, and all-cause/cardiovascular mortality while use of β-carotene may be associated with an increase in cardiovascular and all-cause mortality when compared to control.

There is conflicting level 1b evidence suggesting variable efficacy of daily antioxidant vitamins (vitamin E, vitamin C and β-carotene) when used alone on clinical cardiovascular endpoints including stroke, and mortality. Additional level 1b evidence suggests a beneficial effect of combinatorial therapy with ascorbic acid (vitamin C) and vitamin E on stroke risk.

There is level 1a evidence that vitamin B therapy may improve flow-mediated dilation (FMD) in the short-term however, no long-term effects on FMD or carotid intima-media thickness are observed.

There is conflicting level 1a evidence regarding the effect of B-vitamins (folic acid, vitamin B6 and B12) on cardiovascular outcome or risk of stroke.

There is level 1a evidence that supplementation with folic acid and vitamins B_6 and B_{12} is associated with significant reductions in plasma homocysteine levels (tHcy) up to one year from baseline.

There is level 1b evidence that folic acid alone may have no effect on a combined cardiovascular outcome when compared to standard care.

There is level 1b evidence that high dose vitamin B therapy concurrent with antiplatelets may increase risk of stroke versus low dose therapy. There may be no effect on incidence of stroke or a cardiovascular composite endpoint among patients not supplementing vitamin therapy with antiplatelets.

There is level 1b evidence that homocysteine-lowering therapy with B-vitamins may not improve the risk of recurrent stroke, stroke severity or functional outcome when compared to placebo.

There is level 1b evidence that high dose homocysteine-lowering therapy may improve risk of stroke, myocardial infarction or death in patients ≥67 years old versus low dose treatment.

There is level 1a evidence that smoking or exposure to environmental tobacco smoke may increase risk of stroke in a dose-dependent manner.

There is level 1b evidence that an intensive smoking cessation program providing a period of counselling and support may be as effective as a minimal intervention providing a single 30-minute session of counselling only.

There is level 1a evidence that light (1-2 drinks per day) alcohol consumption reduces the risk for ischemic stroke while heavy drinking (>5 drinks per day) and binge-drinking increase the risk of haemorrhagic stroke in a linear dose-dependent fashion.

There is level 1b evidence that a multi-factorial behavioural intervention focussing on eating habits and smoking cessation may substantially improve smoking cessation, mortality, and serum cholesterol and glucose concentrations, and reduce the risk of cardiovascular events.

There is level 1b evidence that a program of e-counselling that promotes self-directed lifestyle change in the area of diet, exercise and smoking cessation may be associated with reductions in systolic blood pressure and total cholesterol.

There is level 2 evidence that the Secondary Stroke Prevention Program (STOP) may improve stroke knowledge, smoking cessation and alcohol use when compared to usual care.

Antiplatelet Therapy

There is level 1a and level 2 evidence that ASA therapy effectively reduces the risk for recurrent stroke and should be initiated as soon as it is safe following the onset of the stroke event and maintained over the long-term.

There is level 1a evidence that treatment with clopidogrel may be as effective as ticlopidine in terms of prevention of secondary vascular events, including stroke.

There is level 1b evidence that clopidogrel may be similar to ASA with regard to safety.

There is level 1a evidence that treatment with ticlopidine may be associated with a significantly greater risk for adverse events, including hepatic dysfunction, than clopidogrel.

There is level 1a evidence suggesting that cilostazol is superior to aspirin monotherapy in reducing the risk of recurrent stroke and hemorrhagic events however, it is unclear whether its use results in an increased risk of gastrointestinal bleeds.

There is level 1b evidence that the use of Lotrafiban (a glycoprotein IIb/IIIa inhibitor) in the secondary prevention of stroke may be associated with excessive bleeding incidents.

There is level 1a evidence suggesting that administration of clopidogrel and ASA dual therapy is significantly more effective than ASA monotherapy at reducing the risk of stroke, particularly among patients with early (<30d) brain ischaemia.

There is level 1a evidence suggesting that combination clopidogrel and ASA therapy increases the risk of major bleeding relative to ASA therapy alone.

There is level 1a evidence that the use of dipyridamole in combination with ASA may be associated with reduced risk for recurrent vascular events including stroke, non-fatal MI, and non-fatal stroke when compared to placebo.

There is level 1a evidence that dipyridamole in combination with ASA may be more effective than ASA monotherapy when used in the prevention of recurrent stroke.

There is level 1a evidence that use of combination therapy of dipyridamole and ASA may be associated with increased occurrence of headaches and diarrhea when compared to ASA alone.

There is level 1a evidence that combination therapy with dipyridamole and ASA is associated with a lower incidence of bleeding events compared to combination therapy with clopidogrel and ASA.

There is level 1a evidence that clopidogrel in combination with ASA may provide more effective platelet inhibition than ASA in combination with dipyridamole.

There is level 1b evidence that combined ASA + extended release dipyridamole therapy is less likely to cause major bleeding events.

There is level 1b evidence that major bleeding events are more common among patients using aspirin monotherapy compared to those using a combination therapy consisting of aspirin, clopidogrel, and dipyridamole.

There is level 1a evidence that triple antiplatelet therapy with aspirin, clopidogrel and cilostazol is comparable to dual therapy consisting of aspirin and clopidogrel regarding its effect on all-cause death, non-fatal MI, ischaemic stroke, and bleeding events.

There is level 1a evidence that combination therapy of clopidogrel and aspirin or dipyridamole and aspirin has no additional benefit on functional outcomes compared to either ASA or clopidogrel monotherapy.

There is level 1b evidence that early initiation of dipyridamole + ASA therapy has no impact on functional outcome relative to early ASA monotherapy.

Anticoagulants

There is level 1a evidence that treatment with oral anticoagulant therapy of moderate intensity is not superior to antiplatelet therapy in preventing death, recurrent ischemic stroke or myocardial infarction however, it may result in a greater risk for bleeding.

Atrial Fibrilation

There is level 1a evidence that the use of anti-coagulation therapy, particularly with adjusted dose warfarin, may substantially reduce the risk of primary and secondary stroke in individuals with atrial fibrillation.

Anticoagulant Therapy

There is level 1a evidence that treatment with ASA 300 – 325 mg/day may be associated with reduced risk of stroke when compared to no treatment in individuals with atrial fibrillation. However, anticoagulant therapy (dose-adjusted warfarin) may be more effective in preventing strokes among individuals with atrial fibrillation than antiplatelet therapy (ASA).

There is level 1b evidence that oral anticoagulation therapy may be more effective than ASA + clopidogrel in the prevention of stroke in individuals with atrial fibrillation. However, for patients not eligible for oral anticoagulation, ASA + clopidogrel may be associated with reduced risk for stroke when compared to ASA monotherapy.

There is level 1b evidence that use of ASA + clopidogrel may be associated with increased risk for bleeding events compared with ASA monotherapy. Risk for major bleeding events with dual therapy may be similar to that reported for oral anticoagulation with vitamin-K antagonists.

Alternative Therapies

There is level 1b evidence that Indobufen may be as effective as warfarin, but is associated with a reduced risk of bleeding events. It is currently not used in the Canadian clinical practice.

There is level 1a evidence that treatment with the direct thrombin inhibitor ximelagatran/melagatran may not be inferior to treatment with warfarin. Ximelagatran treatment is associated with risk for liver injury and due to concerns with safety, it has been withdrawn from the market and its development terminated.

There is level 1a evidence that a dabigatran may be more effective in preventing stroke than warfarin. With respect to dabigatran prescription, a higher dose (150mg b.i.d) appears to be more effective than a lower dose (110mg b.i.d) at reducing the risk of ischemic stroke however, it also increases the risk of major bleeding. The risk or mortality is comparable amongst the two doses and based on a composite of major ischemic, hemorrhagic, and fatal events, both doses demonstrate a similar net clinical benefit. This effect is observed up to 5 years of treatment.

There is level 1b evidence that treatment with fixed dose rivaroxaban (20 mg p.o. o.d.) is not superior to dose-adjusted warfarin for the prevention of stroke in high risk individuals with atrial fibrillation. Treatment with rivaroxaban may also be associated with less risk for intracranial bleeding when compared with dose-adjusted warfarin.

There is level 1b evidence that treatment with apixaban may be superior to ASA for the reduction in risk of stroke in individuals with AF and for whom a vitamin K antagonist is considered unsuitable.

There is level 1b evidence that treatment with apixaban may be superior to dose-adjusted warfarin for the prevention of stroke or systemic embolism in high risk individuals with atrial fibrillation.

There is level 1b evidence that treatment with apixaban may be associated with reduced risk for death from any cause and for major bleeding events when compared to treatment with dose-adjusted warfarin.

Drug Management

There is level 1a evidence that the use of patient decision aids may be associated with an increase in patient knowledge and a decrease in uncertainty regarding treatment.

There is level 2 evidence that incorporating narrative information in the form of patient anecdotes may help increase patient knowledge and belief in the importance of laboratory testing.

There is level 1b evidence that, among high risk patients with atrial fibrillation, use of patient aids may be associated with a temporary increase in the use of appropriate warfarin-based therapy.

There is level 1a evidence that self-management programs are associated with a reduced risk of thromboembolic events and mortality. However, these programmes are more likely to be feasible for a small, select group of patients only.

There is level 1a evidence that self-testing and self-management programmes may not be associated with increased risk of bleeding events.

There is level 2 evidence suggesting that a coordinated, multidisciplinary approach may result in improved adherence to specific targeted guidelines.

Other Cardiac Diseases

There is level 1a evidence that patent foramen closure does not reduce the risk of recurrent stroke, death or TIA relative to traditional medical therapy in patients with cryptogenic strokes and patent foramen ovale.

Carotid Endarterectomy

There is level 1a evidence that carotid endarterectomy may be an effective procedure to reduce the risk of stroke in individuals with symptomatic carotid artery stenosis of 70-99%.

There is level 1a evidence that carotid endarterectomy may be an effective procedure to reduce the risk of stroke in individuals with asymptomatic carotid artery stenosis of $\geq$ 60% however, the operative risks associated with the procedure outweigh the benefit if they exceed 3%. Current guidelines do not recommend regular revascularization in asymptomatic patients.

There is level 1a evidence that CEA may be an effective procedure to reduce stroke risk in individuals with 50-69% stenosis if done soon after the event (< 14 days). Risk of procedure needs to be weighed on an individual patient basis.

There is level 1b evidence that early CEA may not be associated with increased risk for stroke or death. Pooled analysis suggests that benefits associated with CEA may decrease as time from the qualifying ischemic event increases especially in patients with moderate (50-69%) carotid stenosis.

There is level 1b evidence that nursing-led coordinated case management may be associated with short-term improvements in knowledge of stroke warning signs and self-reported lifestyle and dietary changes.

Carotid Artery Angioplasty and Stenting

There is level 1b evidence that CAS procedures may result in a decrease incidence of carotid territory stroke.

There is level 1a evidence that both CAS and CEA procedures may be equally effective in preventing strokes. Both procedures generate comparable rates of restenosis.

There is level 1b and level 2 evidence that carotid angioplasty with cerebral protection may not provide additional benefits relative to CAS without protection.

There is level 1a evidence that CAS may be associated with a greater 30-day and longer term (≥ 12 months) risk for stroke than CEA.

There is level 1a evidence that CEA may be associated with a greater 30-day risk for myocardial infarction and cranial neuropathy however, in the long-term the risk of recurrent stroke is similar between CAS and CEA.

There is level 1a evidence that the risk for death and stroke may be higher in patients over 70 years of age with symptomatic stenosis treated with CAS compared to those treated with CEA.

9. Mobility and the Lower Extremity

Restorative and Compensatory Rehabilitation
There is level 1a evidence that Motor Learning and Bobath may improve motor recovery but they are not superior to one another.

Intensity of Training
There is level 1a and limited level 2 evidence that early intensive therapy may improve gait and general motor function.

There is conflicting level 1a evidence regarding the effect of augmented physical therapy on gait at follow-up.

Balance Disorders
There is level 1a evidence that whole body and local vibration training programs may not improve balance or gait.

There is level 1a evidence that trunk-specific training may improve balance outcomes.

There is conflicting level 2 evidence regarding the effect of virtual reality balance training on gait and balance outcomes.

There is level 1a and level 2 evidence that feedback training may not improve balance or motor function of the lower limb.

Falls Prevention Training
There is level 1a evidence that exercise-based falls prevention programs may not reduce the rate of falls following stroke.

Task-Specific Training
There is level 1b and limited level 2 evidence that sit-to-stand training may not improve balance or strength of the impaired lower limb when compared to conventional therapy.

There is level 1a and limited level 2 evidence that resistive/strength task-oriented training may improve gait, cadence and lower limb mobility; however, it may not be beneficial for improving balance.

Treadmill Training
There is level 1a and level 2 evidence that treadmill training either in combination with conventional therapy or delivered alone, may improve gait velocity, stride length and lower limb functional mobility; however, it may not improve balance.

There is level 1a and level 2 evidence that partial body weight support treadmill training may not improve gait or balance outcomes compared to conventional or other gait training interventions.

Virtual Reality Training
There is level 1a and limited level 2 evidence that virtual reality combined with treadmill training may improve gait and balance post stroke.

There is level 1a and level 2 evidence that virtual reality-based interventions compared to conventional therapy may improve balance; however evidence is conflicting for gait outcomes.

Auditory and Visual Feedback
There is level 1a and level 2 that auditory feedback may improve gait and muscle activity.

There is limited and conflicting level 1a and level 2 evidence regarding the effect of visual feedback on balance and gait.

EMG/Biofeedback Therapy
There is conflicting level 1a and level 2 evidence regarding the effect of EMG/Biofeedback on lower limb function following stroke.

Bilateral leg Training
There is level 1b evidence that that bilateral leg training with a custom-made device may not improve lower limb motor function.

Motor Imagery/ Mental Practice
There is level 1b evidence that mirror therapy combined with repetitive transcranial magnetic stimulation may improve balance. There is level 1b evidence that mirror therapy compared to conventional therapy may not improve balance or gait outcomes.

There is level 1a and limited level 2 evidence that mental practice/motor imagery may improve gait and balance outcomes.

Hippotherapy
There is level 1a and level 2 evidence that hippotherapy may not improve gait outcomes; however there may be an improvement on foot pressure. The evidence for balance is conflicting.

Rhythmic Auditory Stimulation
There is level 1a and level 2 evidence that rhythmic auditory stimulation training may improve gait and balance outcomes; however there is limited evidence for its effect on ankle range of motion.

Self-Management Programs
There is level 1a evidence that self-management programs may not improve gait and balance.

Caregiver Mediated Programs
There is level 1b evidence that caregiver mediated programs may improve gait and balance outcomes.

Strength Training
There is Level 1a evidence that functional strength training may improve gait speed but may not knee extension and flexion strength.

There is Level 1a evidence that progressive resistance training may improve strength and knee extension but may not gait.

There is level 1b evidence that eccentric resistance training may result in greater muscle activation compared to concentric resistance training but may not improve gait speed.

Cardiovascular Training
There is level 1a evidence that cardiovascular fitness, aquatic therapy, and mobility training programs may improve gait. There is level 1b evidence that home-based cardiovascular exercise programs may also improve gait outcomes.

There is level 1b and level 2 evidence that cycling training interventions may not improve gait.

There is conflicting level 1a evidence regarding supervised exercise training programs compared to unsupervised programs on gait.

There is level 1b and limited level 2 evidence that community or outpatient exercise programs may improve mobility, lower limb strength and flexibility.

There is level 1b evidence that high-intensity circuit training may not improve balance when compared to low-intensity circuit training.

There is limited level 2 evidence that walking exercises on stairs compared to flat surfaces may improve balance post-stroke.

Canes and Walking Aids
There is level 1b and level 2 evidence that quad canes or walkers are significantly better than a one-point cane or no cane for improving gait and balance.

Splinting of Lower Extremity
There is level 1a and level 2 evidence that wearing an AFO may improve gait and range of motion; however, there is limited evidence for its effectiveness on balance.

There is limited level 2 evidence showing no significant difference between brace-assisted walking and partial body weight-supported treadmill training for the improvement of gait outcomes.

There is level 1a evidence that an AFO when combined with posterior tibial nerve denervation, may not improve gait but may improve foot reflexes post-stroke.

Electromechanical Gait Training Devices
There is level 1a and level 2 evidence that the Gait Trainer device may improve gait in the acute phase but not in the subacute or chronic phase of stroke recovery.

There is level 1a and level 2 evidence that the Lokomat may not improve gait and balance in the acute phase of stroke recovery. The evidence is unclear and limited regarding the use of this device in the chronic and subacute stroke phases.

TENS treatment in the lower extremity
There is level 1a and limited level 2 evidence that transcutaneous electrical nerve stimulation may improve gait, spasticity, balance, and ankle joint dorsiflexion range of motion and muscle strength.

Functional Electrical Stimulation in Lower Extremity
There is level 1a and level 2 evidence that FES may improve gait, balance, and range of motion.

There is level 1b evidence that interferential current therapy may improve balance.

There is level 1b and limited level 2 evidence that peroneal nerve stimulation may improve gait and quality of life post-stroke.

There is level 1a evidence that neuromuscular electrical stimulation may not improve gait.

Repetitive Peripheral Magnetic Stimulation
There is level 1b evidence that rPMS may improve foot muscle strength and ankle range of motion.

Medications
There is level 1a evidence that amphetamines may not improve lower limb function.

There is level 1a evidence that methylphenidate not improve motor function following stroke.

There is limited level 2 evidence that L-DOPS may improve functional outcomes post-stroke.

There is level 1b evidence that Levodopa may improve motor recovery.

There is level 1b evidence that ropinirole may not be superior to placebo at increasing gait, functional recovery and activities of daily living post-stroke.

There is level 1b evidence that citalopram may improve neurological function but not functional recovery following stroke.

There is level 1a evidence from high-quality, high-powered studies that fluoxetine may improve motor recovery, ADL functioning may not be enhanced.

There is level 1b evidence that Almitrine in combination with Raubasine may improve functional outcomes post stroke.

There is level 1a evidence that Piracetam may improve lower extremity motor function but not neurological status or ADL performance following stroke.

Spasticity and Contractures
There is level 1b evidence that both a tilt table and night splint may prevent ankle contracture in the early period following stroke.

There is level 1a evidence that treatment with botulinum toxin compared to placebo improves lower limb spasticity, but gains for functional recovery have not been significant.

There is level 1b and limited level 2 evidence that treatment with botulinum toxin compared to phenol may improve lower limb spasticity.

There is level 1b and limited level 2 evidence that treatment with botulinum toxin combined with casting or taping may improve lower limb spasticity but not gait.

There is level 1b evidence that tibial nerve neurotomy (TNN) treatment to the soleus nerve, tibialis posterior, and the flexor hallucus longus, may be more effective for the improvement of spasticity than botulinum toxin injections in the same muscles.

There is level 1b evidence that thermocoagulation treatment may improve lower limb spasticity, Achilles tendon flexion, and ankle clonus.

There is limited level 2 evidence from one low-quality RCT that treatment with a single injection of phenol or ethyl alcohol may not improve spasticity, range of motion, neurological status or strength of the ankle plantar flexors.

There is conflicting level 1b and level 2 evidence regarding the use of Dantrolene on lower limb spasticity.

There is level 1b evidence that there is no significant difference between treatment with Tizanidine or Baclofen for spasticity.

There is level 1b evidence that Tolperisone may improve spasticity and ADL performance outcomes post-stroke.

There is level 1b evidence that total glucosides from Shaoyao and Gancao offered with rehabilitation exercise therapy may improve lower limb spasticity and functional recovery.

There is level 1b evidence that ITB may improve spasticity in the chronic stages of stroke.

There is level 1a and limited level 2 evidence transcutaneous electrical stimulation may improve spasticity outcomes post-stroke.

There is level 1a and limited level 2 evidence functional electrical stimulation may improve spasticity outcomes post-stroke.

There is limited level 2 evidence that therapeutic ultrasound may reduce alpha motor neuron excitability that is associated with ankle plantar flexor spasticity.

There is level 1b evidence that rehabilitation programs compared to standard medications may improve spasticity for the elbows, fingers and plantar flexion.

There is level 1a evidence that ankle exercises compared to conventional therapy may not improve gait, ankle range of motion or spasticity but may improve balance.

There is level 3 evidence that robotic training may not improve spasticity, gait, or spasticity.

There is level 1b evidence that a single session of isokinetic or isotonic muscle stretch may not improve measures of gait.

Brain Stimulation

There is level 1a and limited level 2 evidence that repetitive transcranial magnetic stimulation may improve ADL performance, gait and balance.

There is level 1a evidence that transcranial direct current stimulation may not improve gait or balance outcomes, but may improve functional recovery and knee extension force.

There is level 1b evidence that galvanic vestibular stimulation may not improve pusher behaviour or lateropulsion.

Acupuncture and Chinese Herbal Medicine

There is level 1a evidence from high-quality, high-powered studies that acupuncture may not improve balance, gait, motricity, spasticity or independent functioning. However, there is limited level 2 evidence from low-quality studies that balance, motor function and performance of activities of daily living may be improved following acupuncture.

There is level 1a evidence that electroacupuncture may not improve motor function or ADL.

There is level 1b evidence that acupressure led by nurses may improve lower limb motor function.

There is level 1a evidence that various Chinese Medicine therapies may not improve lower limb function compared to placebo.

10. Upper Extremity Interventions

Management of the Post Stroke Arm and Hand
There is consensus opinion that in severely impaired upper extremities (less than stage 4) the focus of treatment should be on compensation.

For those upper extremities with signs of some recovery (stage 4 or better) there is consensus that attempts to restore function through therapy should be made.

Neurodevelopmental Techniques
There is level 1a evidence that neurodevelopmental techniques are not superior to other therapeutic approaches.

There is level 1b evidence that when compared to the Bobath treatment approach, Motor Relearning Programme may be associated with improvements in short-term motor functioning, shorter lengths of hospital stay and better movement quality.

Bilateral Arm Training
There is level 1a and level 2 evidence that bilateral training delivered alone or in combination with other therapies (i.e. rhythmic auditory cueing or electrical stimulation) may not be superior to unilateral or conventional therapy at improving upper extremity motor function.

Additional/Enhanced Therapy
There is level 1a evidence that home-based therapy may not be superior to usual care regarding its effect on upper limb motor function.

There is level 1a evidence that additional therapies may not be superior to conventional therapy at improving upper extremity motor function or functional independence; however, limited level 2 evidence suggests that range of motion of the wrist and shoulder may be improved by additional therapies.

Strength Training
There is level 1a evidence from a meta-analysis that strength training increases grip strength following stroke.

There is conflicting level 1b and level 2 evidence regarding the effectiveness of functional training of the upper limbs compared to training of the lower limbs on upper limb motor function.

There is conflicting level 1b evidence regarding the effect of strength training on upper limb motor function and functional independence compared to standard care.

There is level 1b evidence that coupling tDCS with strength training does not appear to have a significant beneficial effect on upper extremity strength.

Repetitive Task Specific Therapy
There is level 1a and limited level 2 evidence that task-related practice may be superior to conventional training at improving upper extremity motor function.

There is level 1b and limited level 2 evidence that task-related training may not be superior to resistive training or bilateral arm training at improving general upper limb motor function; however, it may improve reaching arm movements.

There is limited level 2 evidence that providing individuals with a transfer package which includes instruction for supplementary exercises in addition to delivering task-related practice may improve upper limb motor function.

There is level 1b evidence that combining task practice with active stimulation may improve manual dexterity and reaction time.

Trunk Restraint

There is conflicting level 1a and level 2 evidence regarding the efficacy of trunk restraint therapy on upper extremity function when combined with constraint induced movement therapy or delivered alone.

Sensorimotor Training

There is conflicting level 1a evidence regarding the effect of thermal stimulation on upper extremity motor function.

There is level 1a evidence that muscle vibration therapy may improve upper limb motor function.

There is level 1a evidence that sensorimotor stimulation training may improve sensory discrimination especially when it is delivered at a high frequency and longer duration (i.e. 4 times per week, for 3 hours each visit, compared to 3 times a week or once a week for 0.75 hours or 1.5 hours each visit).

There is level 1a and level 2 evidence that sensorimotor training delivered either by a therapist or by a robotic device may improve manual muscle strength; however, the evidence regarding its effect on upper limb motor function is less clear.

There is level 1a evidence that mesh glove therapy may only improve arm and hand function but not upper extremity function or spasticity.

There is level 1b evidence that intermittent pneumatic compression may improve motor outcomes; however, it may not improve spasticity.

Mental Practice

There is level 1a and level 2 evidence that mental practice/motor imagery therapy may be effective at improving upper extremity motor function; however, the evidence for its effect on activities of daily living is limited and conflicting.

There is level 1b and level 2 evidence that mental practice combined with modified constraint- induced movement therapy may improve upper limb motor function.

There is level 1b evidence that adding EMG to metal activity training may improve general upper extremity function but not range of motion, spasticity or functional independence.

Hand Splinting

There is level 1a and limited level 2 evidence that hand splinting/taping/orthoses may not improve upper extremity motor impairment or reduce contractures.

Constraint Induced Movement Therapy

There is conflicting level 1a and level 2 evidence of the benefit of CIMT in the acute stage of stroke.

There is level 1a evidence that CIMT in the chronic phase of stroke may help improve impaired upper extremity motor function. The evidence regarding the ideal frequency of CIMT is currently unclear.

There is level 1a evidence that mCIMT in the acute phase of stroke may improve upper extremity function; however, level 1b evidence that it may not be superior to bilateral rhythmic auditory training at improving upper extremity motor function.

There is level 1a evidence that mCIMT in the chronic phase of stroke may improve upper limb function relative to conventional therapy.

Mirror Therapy
There is level 1a evidence that mirror therapy in combination with other therapies or delivered alone may improve motor function following stroke.

There is conflicting level 1a evidence regarding the effect of mirror therapy on spasticity.

Feedback Therapy
There is conflicting level 1a evidence regarding the effect of extrinsic feedback on motor function following stroke.

There is level 1b evidence that intrinsic feedback therapy may not improve motor function following stroke.

There is level 1b evidence that a combination of extrinsic and intrinsic feedback may improve motor function when compared to a program with no feedback therapy.

Action Observation
There is conflicting level 1a evidence regarding the effect of action observation on upper motor function.

There is level 1b evidence that a combination of action observation and action practice may improve upper extremity motor function when compared to action observation alone.

Music Therapy
There is level 1b and level 2 evidence that music therapy may improve upper extremity motor function but not muscle strength when compared to conventional rehabilitation.

Telerehabilitation
There is limited level 2 evidence that telerehabilitation programs may improve upper limb motor function.

Exercise Therapy
There is level 1b evidence that increasing exercise intensity may not improve upper limb motor function.

Dressing Approaches
There is level 1b evidence that both functional and neuropsychological approaches improve dressing performance and motor ability.

Peripheral Magnetic Stimulation
There is level 1b evidence that peripheral magnetic stimulation may not improve upper limb motor function; however, it may improve spasticity.

Robotic Devices
There is level 1a evidence that conventional therapy supplemented with therapy involving robotic devices may be beneficial at improving upper limb motor function. More studies are needed to determine whether patients in all stroke recovery stages can benefit from using robotic devices for improving impaired upper limb motor function.

Virtual Reality
There is level 1a evidence that virtual reality may not improve upper limb motor function in the chronic stroke phase.

There is conflicting level 1a evidence regarding the effect of virtual reality in acute-subacute stroke patients on upper limb motor function.

Computer Brain Interface Technology
There is conflicting level 1a evidence regarding the effect of computer brain interface technology on upper limb motor function post-stroke.

Splinting
There is level 1a and level 2 evidence that splinting does not reduce the development of contracture nor reduce spasticity in the upper extremity; however, it may improve passive range of motion.

Stretching Programs to Prevent Contracture Formation
There is level 1b evidence that a nurse-led stretching program may improve range of motion in the upper extremity and reduce pain in the chronic stage of stroke.

There is level 1b evidence that a hand stretching device may improve spasticity in the upper limb.

There is level 2 evidence that supplementing stretching programs with joint stabilization exercises may improve muscle thickness in the affected arm as well as arm function; however, no such effect is found when the stretching programs are delivered alone.

Botulinum Toxin Injections
There is level 1a evidence that treatment with botulinum toxin alone or in combination with therapy significantly reduces spasticity in the upper extremity and overall disability in stroke survivors.

There is inconclusive level 1a evidence regarding the effect of botulinum toxin treatment on upper limb function.

Electrical Stimulation Combined with Botulinum Toxin Injections
There is level 1b evidence that electrical stimulation combined with botulinum toxin injection is associated with reductions in muscle tone.

Nerve Block Treatment
There is level 4 evidence that nerve blocks with ethyl alcohol improves elbow and finger passive range of motion and can decrease spasticity in the upper extremity in stroke survivors.

Physical Therapy
There is level 1a and limited level 2 evidence that physical therapy may not improve motor function or contracture.

Electrical Stimulation Combined with Physical Therapy

There is level 1a evidence that neuromuscular electrical stimulation may not reduce wrist or elbow spasticity.

Shock Wave Therapy
There is level 1b and level 4 evidence that shock wave therapy may reduce tone in the upper extremity and improve range of motion.

Centrally Acting Muscle Relaxants
There is level 1b evidence that tolperisone may reduce spasticity following stroke.

Efficacy of EMG/Biofeedback Therapy
There is level 1a and level 2 evidence that EMG/biofeedback therapy may not improve upper extremity motor function or spasticity.

Transcutaneous Electrical Nerve Stimulation
There is level 1b and level 2 evidence that treatment with TENS may improve hand dexterity and function; however, this effect may not be translated to the upper extremity as a whole.

There is level 1b evidence that TENS may not improve disability or functional independence.

FES/NMES Therapy for Upper Extremity
There is level 1a and level 2 evidence that FES/NMES may improve upper limb motor function, range of motion, and manual dexterity when offered in combination with conventional therapy or delivered alone in subacute stroke. The evidence is also indicative of a beneficial effect on range of motion and manual dexterity when FES/NMES was offered to chronic stroke patients either alone or in combination with other therapies. Despite improvements in both stages of stroke recovery, level 1b evidence indicates that delivering FES early (<6 months) may be more beneficial at recovering impaired motor function than delivering FES after 6 months post-stroke.

There is level 1a and level 2 evidence that both EMG-triggered and cyclic approaches to NMES/electrical stimulation may improve upper limb motor function and range of motion in subacute and chronic stroke patients; however, level 1a evidence indicates no superior benefit of EMG-triggered NMES over cyclic or passive NMES at improving upper limb motor function in chronic stroke patients.

There is level 1b evidence that coupling continuous NMES with repetitive facilitative exercise may be beneficial at improving general upper extremity function and range of motion during elbow extension but not during shoulder or wrist flexion in subacute stroke patients.

The evidence regarding the optimal intensity of FES exercise therapy is currently unclear.

There is level 1b evidence that high frequency NMES may be superior to low frequency NMES at improving endurance of thumb adduction, lateral pinch strength and manual dexterity in chronic stroke individuals.

Motor Cortex Stimulation (MCS)
There is level 1b and level 2 evidence that MCS may improve upper limb function but not grip strength following stroke.

Repetitive Transcranial Magnetic Stimulation
There is level 1a and level 2 evidence that rTMS delivered alone or coupled with physiotherapy or other non-pharmacological therapies may improve impaired arm motor function, hand dexterity, grasp and pinch but not upper limb spasticity.

There is level 1a evidence that low-frequency (1Hz) rTMS delivered on the contralesional hemisphere may improve upper limb motor function but not manual dexterity or grip strength compared to sham stimulation.

There is level 1b evidence that 10Hz rTMS may not be superior to 3Hz rTMS delivered on the lesional hemisphere at improving grip strength.

Theta Burst Stimulation
There is level 1a and level 2 evidence that iTBS may improve hand and arm motor function.

There is level 1a evidence that cTBS may not improve upper extremity motor function following stroke.

Transcranial Direct Current Stimulation
There is level 1a and level 2 evidence that anodal tDCS and cathodal tDCS may improve general upper extremity function but not dynamometric measures such as pinch, grasp, and grip strength.

There is level 1a evidence that anodal tDCS may not be more effective at improving upper extremity motor function compared to cathodal tDCS.

There is limited conflicting level 1a evidence regarding the effect of tDCS when combined with virtual reality on impaired upper limb motor function.

There is level 1a evidence that dual rTMS (cathodal + anodal) stimulation may improve dexterity and grip function.

There is level 1b evidence that coupling strength training with anodal tDCS may not improve wrist strength.

There is level 1b evidence that coupling methylphenidate with tDCS may improve hand function relative to when tDCS or methylphenidate are delivered alone.

There is level 1b evidence that combining tDCS with computer brain interface training may not improve spasticity or upper extremity motor function.

Stimulants
There is level 1a evidence that delivering stimulants in combination with additional therapy may improve upper extremity function; however, level 1b evidence suggests that grip strength may not improve.

There is Level 1b evidence that stimulants may only be effective at improving impaired upper limb function in the short term.

Levodopa
There is level 1b evidence that Levodopa may not improve arm and hand function however, level 2 evidence suggests that reaction time may be improved.

Antidepressants
There is level 1a evidence that fluoxetine and nortriptyline may improve overall disability and upper extremity motor function.

There is level 1a that citalopram, reboxetine and lithium carbonate may enhance impaired arm and hand function however, level 1b evidence indicates that citalopram may not be effective at improving hand grip strength.

Steroids

There is level 1b evidence that intra-articular steroid injections may not improve pain or range of motion of the upper extremity; however, limited level 2 evidence provides conflicting findings.

Antibiotics
There is level 1b evidence that d-cycloserine delivered in combination with constraint-induced movement therapy may not improve upper extremity motor function.

Ozonated Autohemotherapy
There is limited level 2 evidence that ozonated autohemotherapy may improve general motor disability.

Acupuncture
There is level 1a evidence from high-quality, high-powered studies that acupuncture may not improve upper extremity motor function or performance of activities of daily living however, level 1a evidence from lower-powered studies and level 2 evidence indicating otherwise.

There is level 1a evidence from high-quality, high-powered studies that electroacupuncture may not improve upper limb motor function; however, lower-powered studies (level 1b and level 2) indicate otherwise.

There is conflicting level 1a evidence regarding the effect of acupuncture on spasticity.

There is level 2 evidence that electroacupuncture in combination with moxibustion therapy or strength training may reduce spasticity.

Meridian Acupressure
There is level 1a and limited level 2 evidence that meridian acupressure may improve spasticity, upper limb motor function, range of motion of the upper limb, and performance of activities of daily living.

Traditional Chinese Herbal Medicine
There is level 1b evidence that Astralagus Membranaceus may help to improve upper extremity following hemorrhagic stroke.

There is level 1b evidence that NeuroAid® may not improve upper extremity motor function or general functional recovery.

There is level 1b evidence that Tokishakuyakusan may improve functional independence in the chronic stage of stroke.

Massage Therapy
There is level 1b evidence that aromatherapy combined with acupressure may not improve motor function.

There is level 1b evidence that Thai massage may not be beneficial for improving spasticity, and quality of life.

There is limited level 2 evidence that Marma therapy may improve upper extremity strength but not dexterity.

Intermittent Pneumatic Compression for Hand Edema
There is level 1b evidence that intermittent pneumatic compression may not reduce hand edema or strength in the upper extremity following stroke.

11. Painful Hemiplegic Shoulder

Shoulder Subluxation
Shoulder subluxation may occur early on in the hemiplegic arm due to flaccid supporting shoulder musculature.

Shoulder subluxation may be a cause of shoulder pain; however, patients with shoulder subluxation do not necessarily experience pain and not all cases of hemiplegic shoulder pain suffer from subluxation.

Frozen or Contracted Shoulder
The incidence of contractures in hemiplegic shoulder pain range from 54.6% to 76.7%.

Functional Impact of Hemiplegic Shoulder Pain
The development of painful hemiplegic shoulder may be associated with poorer functional outcomes, reduced motor ability, and stroke severity.

Positioning of the Hemiplegic Shoulder
There is level 1a evidence that shoulder positioning may not reduce pain, motor function, range of motion, or spasticity.

Slings in Hemiplegic Shoulder
There are a wide variety of shoulder slings/treatment options available; however, there is no consensus regarding which is the most efficacious at reducing subluxation.

Strapping the Hemiplegic Shoulder
There is level 1a evidence that shoulder strapping/taping may reduce hemiplegic shoulder pain; however, it may not improve range of motion, spasticity, disability, or upper limb motor function.

Active Therapies in the Hemiplegic Shoulder
There is level 1b evidence that supplementing range of motion activities with ultrasound or positioning exercises may not be more effective than when performing range of motion exercises alone.

There is level 2 evidence that aggressive range of motion therapies, using overhead pullies may result in increased rates of shoulder pain.

There is level 1b evidence that continuous passive range of motion exercises are not superior over self-range of motion exercises at improving joint stability, spasticity, or pain.

There is limited level 2 evidence that stretching and joint stabilizing therapies are more effective at improving motor arm function compared to normal development therapies.

There is limited level 2 evidence that Bobath therapy for the hemiplegic shoulder may be associated with greater pain reduction than passive cryotherapy (application of local cold therapy).

Electrical Stimulation in the Hemiplegic Shoulder
There is level 1a and level 2 evidence that surface neuromuscular electrical stimulation (NMES) delivered prior to 6 months post-stroke may be more effective than conventional therapy at preventing/reducing shoulder subluxation but not shoulder pain. Treatment delivered after 6 months may not be more effective than conventional therapy at reducing shoulder subluxation. The evidence for the effect of NMES on hemiplegic shoulder pain after 6 months post-stroke is currently limited.

There is level 1a evidence that intramuscular NMES however, may be an effective treatment of hemiplegic shoulder pain that has lasting effects (up to 12 months post-treatment).

There is level 1b evidence that interferential electrical stimulation (IES) is beneficial at reducing pain during range of motion and at rest in patients suffering from shoulder hemiplegia.

There is limited level 2 evidence that high voltage pulsed galvanic stimulation (HVPGS) is superior to conventional therapy at reducing subluxation and improving shoulder joint displacement.

There is limited level 2 evidence that transcutaneous electrical nerve stimulation (TENS) may only improve passive range of motion when delivered at a high intensity.

Surgery as Treatment for Hemiplegic Shoulder Pain
There is limited level 4 evidence that surgically resecting the subscapularis and pectoralis muscle tendons improves range of motion in stroke patients with a painful hemiplegic shoulder. Further research is needed to confirm these findings.

Steroid Injections for Shoulder Pain
There is conflicting level 1a and level 2 evidence regarding the effect of intra-articular Triamcinolone acetonide injections on hemiplegic shoulder pain.

Aromatherapy Acupressure
There is level 1b evidence that aromatherapy combined with acupressure may reduce pain associated with painful hemiplegic shoulder.

Massage Therapy
There is level 1b and limited level 2 evidence that massage therapy by itself or in combination with acupuncture may reduce hemiplegic shoulder pain. Evidence also suggests improvements in anxiety, heart rate, blood pressure, and general motor function. Despite the positive findings regarding the use of massage therapy, further research is still warranted.

Suprascapular Nerve Block
There is level 1b and limited level 2 evidence that nerve block injections relative to saline injections or ultrasound therapy, may improve shoulder pain but not range of motion.

There is limited level 2 evidence that nerve block therapy may not be superior over intra-articular steroid injections at reducing shoulder pain.

Segmental Neuromyotherapy
There is level 1b evidence that segmental neuromyotherapy may improve hemiplegic upper limb motor function however it may not be more efficient than oral pain medication at reducing hemiplegic shoulder pain.

Complex Regional Pain Syndrome (CRPS)
The pathophysiology of complex regional pain syndrome is not fully understood. Most cases appear to improve with time.

Incidence of CRPS Post Stroke
The incidence of complex regional pain syndrome post stroke ranges from 12%-48% and may be influenced by the timing as well as the type of assessment.

Diagnostic Tests of CRPS
Several CRPS diagnostic tests exist however, none will identify all patients with CRPS. Most sensitive is the technetium diphosphonate bone scan.

Oral Corticosteroids in CRPS
There is level 1a evidence that oral corticosteroids may improve pain and potentially shoulder disability however, further investigations in the efficiency of corticosteroids for reducing complex regional pain syndrome are need.

Mirror Therapy Post Stroke
There is level 1b evidence that mirror therapy may be superior over placebo treatments at improving upper limb motor function.

There is level 1b evidence that mirror therapy may help reduce pain due to hemiplegic shoulder.

Physical Therapy to Prevent CRPS
There is limited level 2 evidence that passive range of motion exercises may prevent the development of complex regional pain syndrome.

Calcitonin to Prevent CRPS
There is limited level 2 evidence that intramuscular injections of calcitonin may prevent the development of complex regional pain syndrome.

12. Post-Stroke Cognitive Disorders

Depression and Cognitive Impairment
There is conflicting level 5 evidence regarding the link between post-stroke depression and cognitive and functional impairment.

Medications for Treatment of Hypertension and Prevention of Vascular Dementia and Cognitive Decline
There is level 1a evidence indicating no statistical association between lowering of blood pressure and a reduction in the risk for the development of dementia.

There is level 1a evidence that antihypertensive medication may prevent recurrence of stroke, but not reduce cognitive decline or dementia.

There is level 1b evidence that reducing risk factors detrimental to brain health such as cholesterol levels, blood pressure, and BMI may have no significant effect on cognitive performance.

Remediation of Attention Deficits Post Stroke
There is mixed level 1a and level 2 evidence regarding the effect of computerized training for attention tasks on the performance of specific attention tasks.

There is level 1a evidence that cognitive rehabilitation may improve divided attention but not global measures of attention and standardised attentional assessments.

There is level 1b evidence that Attention Process Training may improve aspects of visual and auditory attention.

There is level 1b evidence that an intensive, computerized training program may result in improvements in both working memory and attention.

There is level 1b evidence that visual attention retraining using the Useful Field of View may be more effective than conventional computerized visuoperceptual training at improving the on-road driving performance of individuals with right-sided lesions.

Remediation of Memory Deficits Post Stroke

There is level 1a evidence that compensatory strategies may be effective at improving memory outcomes, including imagery-based, process-oriented, and self-efficacy training.

There is level 1b evidence that home visits combined with mailed letters containing resources and information may result in an improvement of self-reported health status for both patients and caregivers after 6 months compared to mailed letters only.

There is level 1b and level 2 evidence that mental imagery may improve relearning of activities of daily living in patients with acute stroke and minimal cognitive deficits.

There is limited level 2 evidence that patients in group-based interventions may not improve memory abilities any better than patients who did not receive intervention while on a waiting list.

Rehabilitation of Executive Function and Problem Solving Post Stroke

There is level 1b evidence that an analogical problem solving skills approach may increase problem solving abilities and performance of extended activities of daily living.

There is level 1b evidence that self-regulation training may increase executive control over motor but not cognitive function, although these findings may be biased.

There is level 2 evidence that goal management training may be beneficial in the rehabilitation of executive function.

Multi-Modal Interventions Post Stroke

There is level 1b evidence that standard care combined with computerized training may improve cognitive performance more than standard care alone.

There is limited level 2 evidence that virtual reality training combined with computerized training may improve cognitive performance more than computerized cognitive training alone.

Electroacupuncture and TENS Post Stroke

There is level 1b evidence that electroacupuncture may improve attention, praxis, perception and orientation, but not thinking, organization memory and mental health.

There is level 1b evidence that high-intensity TENS may not be more effective than low-frequency TENS at improving cognitive function.

Music Listening Therapy Post Stroke

There is level 1b evidence that self-regulated music therapy may have a positive impact on verbal memory and focused attention in individuals with left hemisphere stroke.

Exercise Programs Post Stroke

There is conflicting level 1a evidence regarding the effect of exercise therapy on cognitive rehabilitation post stroke.

There is level 1b and level 2 evidence that exercise programs with a focus on resistance, balance and aerobics can result in significant cognitive gains.

Repetitive Transcranial Magnetic Stimulation Post Stroke

There is level 1b evidence that high-frequency, low-frequency and sham rTMS are not significantly different at improving cognitive performance.

There is level 4 evidence that rTMS to the left DPC may be associated with improvements in executive function following stroke.

Transcranial Direct Current Stimulation Post Stroke
There is level 2 evidence that anodal tDCS to the left dorsolateral prefrontal cortex may be associated with improvements in working memory and attention.

Aspirin for Vascular Dementia
There is level 1b evidence that aspirin is effective in stabilizing and/or improving cognitive outcomes in patients with multi-infarct dementia.

Donepezil for Vascular Dementia
There is level 1a evidence that donepezil taken for 24 weeks may improve cognitive function in patients with probable or possible vascular dementia.

There is level 1a evidence that treatment with donepezil is associated with improvement in global function for individuals with probable or possible vascular dementia.

Rivastigmine for Vascular Dementia
There is conflicting level 1a evidence regarding treatment with rivastigmine and its effect on vascular dementia and cognitive decline.

There is level 2 evidence that treatment with rivastigmine is associated with more stable cognitive performance and improved behavioural outcomes among patients with vascular dementia.

Galantamine for Vascular Dementia
There is level 1a evidence that treatment with galantamine is associated with improvements in cognitive and global function. However, the benefits associated with treatment are more clearly demonstrated among patients with mixed dementia than vascular dementia.

Nimodipine for Vascular Dementia
There is level 1a evidence that nimodipine may not be beneficial in the treatment of vascular dementia.

There is level 1b evidence that treatment with nimodipine may slow cognitive deterioration in patients with vascular dementia.

Conclusions Regarding Memantine for Vascular Dementia
There is level 1a evidence that treatment with memantine is associated with stabilization or improvement of cognitive function in patients with vascular dementia.

Pentoxifylline for Vascular Dementia
There is level 1a evidence that treatment with pentoxifylline is associated with cognitive benefits in patients with multi-infarct dementia.

Citicoline for Cognitive Function
There is conflicting level 1a evidence regarding the effect of citicoline in the long term management of cognitive function post stroke.

Antidepressants for Cognitive Function
There is level 1a and level 2 evidence that treatment with antidepressants may be associated with and improvement in cognitive functioning in patients without post-stroke depression.

Selegiline for Cognitive Function
There is level 1b evidence that selegiline may improve cognitive function post stroke, with benefits lasting as long as six weeks.

Prevention of Delirium
There is level 2 evidence that a multi-component approach to the management of known risk factors may be associated with reduced incidence and duration of delirium. However, this has not been demonstrated within the stroke population; further research is required.

Management of Delirium Post Stroke
There is limited level 4 evidence regarding the impact of short-term treatment with rivastigmine on post-stroke delirium. Further research is required.

13. Perceptual Disorders

Treatment of Perceptual Deficits
There is conflicting level 1a and level 2 regarding the evidence for perceptual training interventions on perceptual functioning.

There is level 1b evidence that a transfer of training approach may not produce different results on measures of neglect and functional ability when compared to a functional approach to perceptual training.

Family Participation
There is limited level 2 evidence that family participation in rehabilitation may not be associated with additional improvements in perceptual impairment and functional ability when compared to conventional rehabilitation.

Visual Scanning for Neglect
There is level 1a and level 2 evidence that treatment utilizing primarily visual scanning techniques may improve perceptual impairment post-stroke with associated improvements in function.

Computer-Based Rehabilitation in Neglect
There is level 1b and level 2 evidence that computer-based or virtual reality treatment for neglect may improve visual perception and alleviate right-hemisphere bias when compared to conventional rehabilitation or no treatment.

There is limited level 2 evidence that computerized visual perception training may be no more effective than occupational therapy for patients with hemianopia**.**

Limb Activation Treatment for Neglect
There is level 1a and level 2 evidence that limb activation may alleviate rightward bias and improve motricity when compared to conventional rehabilitation.

Sensory Stimulation Interventions

There is level 1b evidence that sensory cues for movement may have a positive effect on neglect, although evidence is inconclusive.

There is level 1b evidence that use of electrical somatosensory stimulation as a supplement to visual scanning training is associated with greater benefit than visual scanning training alone.

Feedback Strategies

There is level 1b and limited level 2 evidence that visuomotor feedback may be beneficial in the treatment of neglect. Further study is required to establish the degree to which treatment effects generalize to other behaviours and to determine the durability of effect.

There is limited level 2 evidence that the auditory feedback for left eye movement may not improve visual inattention or bias in eye movement.

Prisms for Neglect

There is level 1a and level 2 evidence that the use of rightward shifted prisms may be effective for neglect and hemianopia.

There is level 1a evidence that any improvements seen in visual-spatial tasks may not be sustained over time.

There is level 1b and limited level 2 evidence that improvements in visual-spatial tasks following prism treatment are not associated with improvement in functional ability.

There is limited level 2 evidence that terminal prismatic adaptation may alleviate rightward bias and improve visual perception to a greater degree than concurrent prismatic adaptation.

Eye-Patching and Hemispatial Glasses for Neglect

There is conflicting level 1b and level 2 evidence regarding the use of right half-field eye patches for left visual neglect.

There is limited level 2 evidence that monocular occlusion may not improve visual neglect or alleviate rightward bias.

There is conflicting level 1b and level 2 evidence with regards to the effect of bilateral half-field eye patches on functional ability.

Caloric Stimulation in Neglect

At present, there is little evidence regarding the effectiveness of caloric stimulation as a treatment intervention for visuospatial neglect post-stroke.

Vestibular Galvanic Stimulation

There is level 1a evidence that galvanic vestibular stimulation may improve unilateral spatial neglect.

There is conflicting level 1a evidence with regards to the effect of right cathodal versus left cathodal galvanic vestibular stimulation on unilateral spatial neglect.

Optokinetic Stimulation

There is level 1a evidence that optokinetic stimulation may have a positive impact on unilateral neglect when compared to scanning or alertness training; however, level 2 evidence suggests that optokinetic stimulation may not have additional benefit.

There is level 1a evidence that optokinetic stimulation may not have an effect on functional outcome.

There is level 2 evidence that optokinetic stimulation may not improve neglect when compared to standard rehabilitation.

Trunk Rotation
There is level 1b evidence that trunk rotation therapy may not have a positive effect on unilateral spatial neglect or performance of activities of daily living.

There is level 1b evidence that trunk rotation in combination with half-field eye-patching is similarly ineffective.

There is level 2 evidence that trunk rotation when combined with visual scanning is of benefit in the treatment of spatial neglect. Further study of trunk rotation therapy is indicated.

Neck Muscle Vibration Therapy
There is level 1b evidence that neck muscle vibration therapy in association with visual exploration training may be effective in improving both symptoms of neglect and performance of activities of daily living.

Music Therapy
Presently, there is little evidence to support the use of music as treatment for unilateral spatial neglect in right hemispheric patients. Further investigations are required.

TENS in Neglect
There is level 2 evidence that transcutaneous electrical nerve stimulation may result in improvements on tests of neglect, reading and writing post-stroke.

Repetitive Transcranial Magnetic Stimulation
There is level 1b and limited level 2 evidence that both the inhibition and excitation of the lesioned hemisphere through rTMS may improve neglect and functional ability.

There is level 1a evidence that theta burst stimulation may improve neglect with positive effects lasting up to four weeks post-intervention.

Transcranial Direct Current Stimulation
There is level 1b evidence that transcranial direct current stimulation is associated with improvement on tests of neglect; however, limited Level 2 and Level 4 evidence suggests that transcranial direct current stimulation may not be beneficial for neglect.

Dopaminergic Medications
There is level 1b evidence that the dopamine agonist rotigotine may not improve perceptual impairment or motor function.

Acetylcholinesterase Inhibitors for Neglect
There is level 1b evidence that the use of rivastigmine in conjunction with cognitive training may accelerate the rate of improvement of unilateral spatial neglect associated with therapy.

Nicotine Therapy for Neglect
There is level 1b evidence that nicotine may improve unilateral neglect and target information processing when compared to placebo treatment.

14. Aphasia and Apraxia

Language Therapy

There is level 1a and level 2 evidence that language therapy may not improve communicative ability, performance on comprehensive language assessments, comprehension or oral expression when compared to no treatment.

There is limited and conflicting level 1a and level 2 evidence for the effect of language therapy on communicative ability when compared to a non-aphasia therapy program.

There is level 2 and level 4 evidence that comparisons between similar types of aphasia therapy may not result in differences for the improvement of communicative ability, comprehension, language and cognitive impairment, non-verbal reasoning, verb acquisition and performance on comprehensive language assessments.

Intensity of Speech and Language Therapy

There is level 1a that intensive language therapy may not improve performance on comprehensive language assessments, cognitive and language tasks or communicative ability when compared to standard language therapy; however, level 2 evidence is conflicting.

There is level 1b evidence that 19.3hrs of speech therapy program may improve performance on comprehensive language assessments compared to standard therapy (6.9hrs).

Volunteer-Facilitated Speech and Language Therapy

There is level 1b and level 2 evidence that volunteers can provide speech and language therapy and achieve similar outcomes in terms of comprehension and communicative ability when compared to speech- language pathologists.

There is level 1b and level 2 evidence that immediate language therapy may not improve reading comprehension, auditory comprehension or non-verbal reasoning when compared to deferred therapy; however, the evidence for communicative ability is conflicting.

Group Language Therapy

There is level 1a evidence that group treatment may improve communicative ability but not conversational ability, non-verbal reasoning, verbal expression, auditory comprehension or fluency as compared to individual treatment.

There is level 1b evidence that group treatment, individual treatment and combined group and individual treatment may not produce different results in terms of word retrieval.

There is limited level 2 evidence that immediate group therapy may improve language impairment when compared to deferred group therapy; however, evidence for the effect on communicative ability is conflicting.

Community-Based Aphasia Programs

There is conflicting level 1b evidence in reference to the effectiveness of a community-based language program on communicative ability when compared to a recreational activities program; however, evidence suggests that the community-based program may not improve performance on comprehensive language assessments.

Training Conversation/Communication Partners

There is level 1b evidence that training conversation partners to acknowledge and reveal competence of individuals with aphasia may enhance the conversational skill of both parties when compared to delivering an informative video presentation to conversation partners.

Caregiver/Patient Education Programs

There is limited level 2 evidence that a caregiver and patient education program may improve knowledge of aphasia but not activity level, community integration or family functioning when compared to no treatment.

Computer-Based Treatments

There is level 1a evidence that computer-based aphasia therapy may improve word retrieval ability in the short-term but not language function or word retrieval ability in the long-term when compared to standard language therapy.

There is limited level 2 evidence that computer-based aphasia therapy may improve communicative ability and language function when compared to no treatment.

There is level 2 evidence that a reading comprehension focused computer-based treatment may improve communicative ability and language skills assessed at the impairment level when compared to a cognitive rehabilitation focused computer-based treatment.

There is conflicting and limited level 2 evidence in reference to the effect of audio-visual naming training on word retrieval ability when compared to audio only naming training.

Telehealth and Language Assessment Post Stroke

There is limited level 2 evidence for the use of remote assessment when compared to face-to-face assessment; however, preliminary findings suggest that the interventions are comparable.

There is limited level 2 evidence that the use of teleconferencing for remote speech and language treatment is comparable to face-to-face treatment in individuals with aphasia following stroke.

Filmed Language Instruction

There is level 1b evidence that supplementary-filmed programmed language instruction combined with speech therapy may be as effective as traditional speech therapy for aphasia recovery post-stroke.

There is limited level 5 evidence that speech rehabilitation involving biological feedback may be helpful for aphasia recovery; however, the use of video clips alone may not result an improvement. Further research regarding filmed language instruction is required.

Music Based Therapies

There is level 1b and limited level 2 evidence that melodic intonation therapy may be as effective as standard language therapy for the improvement of word retrieval ability or performance on comprehensive language assessments; however, evidence regarding its effect on repetition is conflicting.

There is limited level 2 evidence suggesting that melodic intonation therapy may improve responsive speech but not repetition when compared to no language treatment.

Constraint-Induced Therapy for Aphasia

There is conflicting and level 1a evidence for the effectiveness of constraint-induced aphasia therapy (CIAT) on language performance, as compared to conventional treatment or placebo.

There is limited level 2 evidence that CIAT administered by experienced therapists may be as effective as CIAT administered by trained lay persons for aphasia recovery.

There is limited level 2 evidence that CIAT may be as effective as the PACE treatment for the improvement of confrontational word retrieval in individuals with aphasia or other language disturbances caused by stroke.

Repetitive Transcranial Magnetic Stimulation (rTMS)
There is level 1a evidence that treatment with rTMS may improve performance on comprehensive language assessment as well as on tests of naming abilities. However, there is conflicting evidence for its effectiveness on test components such as comprehension and repetition.

There is limited level 2 evidence that theta burst stimulation may improve naming abilities among individuals with aphasia as compared to sham stimulation.

Transcranial Direct Current Stimulation (tDCS)
There is level 1a and limited level 2 evidence that anodal tDCS applied over the left frontal cortex is associated with improved naming performance in individuals with chronic post-stroke aphasia.

Unilateral Forced Nostril Breathing
There is limited Level 2 evidence that unilateral forced nostril breathing may improve anxiety and language but not attention level, spatial ability, auditory comprehension or depression.

Treatment for Word-Retrieval Deficits
There is level 1a and limited level 2 evidence that both semantic and phonological cues may aid in lexical retrieval abilities; however, it is unclear whether there is a difference between the uses of the two types of cues.

There is conflicting level 1b and limited level 2 evidence regarding the effect of picture-naming therapy when combined with gesture therapy on word retrieval abilities.

Treatment for Global Aphasia
There is limited level 2 evidence that speech and language therapy may be helpful for individuals with global aphasia post-stroke.

Treatment for Alexia
There is limited evidence that specific therapy for alexia in aphasic patients may improve language function and reading ability post-stroke.

Piracetam
There is level 1a evidence that piracetam may be no better than placebo for comprehensive language assessment, and specific language outcomes, including semantic and phonological outcomes.

There is level 1b evidence that piracetam may be helpful for arm and leg motor movement, and the rate of perfusion compared to placebo.

There is level 1b evidence that piracetam combined with language therapy may be no better than placebo for comprehensive language assessment and other language performance outcomes.

Bromocriptine
There is level 1a evidence that bromocriptine may be no better than placebo for treating aphasia post-stroke.

Levodopa
There is level 1a and level 2 evidence that the use of levodopa may not be an effective adjunct to speech and language therapy.

Amphetamines
There is level 1b evidence that dextroamphetamine may improve aphasia recovery when combined with speech and language therapy.

Bifemelane
There is level 1b evidence that Bifemelane may improve comprehension and naming; however more research is needed.

Dextran-40
There is level 1b evidence that Dextran-40 may result in better outcomes than the non-treatment control.

Moclobemide
There is level 1b evidence that the use of Moclobemide may not improve verbal communicative abilities of individuals with aphasia.

Donepezil
There is level 1b evidence that donepezil may produce some improvement on global language function, this improvement is reported only during active treatment and may not extend to everyday communication ability.

Memantine
There is level 1a evidence for the effectiveness of memantine therapy on the treatment of chronic aphasia. Combination therapy using constraint-induced language therapy and memantine may provide additional benefit than either therapy used independently.

Galantamine
There is level 1b evidence that galantamine may have a beneficial effect on post-stroke aphasia; however, Galantamine has not been studied sufficiently in aphasia recovery.

Treatment of Ideomotor Apraxias and Ataxia
There is level 1a evidence that strategy training is effective in the treatment of apraxias post-stroke. Training effects may include improvement in performance of activities of daily living that appear to be sustained over time.

Gesture Training
There is level 1b evidence that gesture training may be associated with improvements in ideomotor apraxia extending to activities of daily living. These effects may be sustained for at least 2 months following the end of treatment.

15. Dysphagia and Aspiration Following Stroke

Aspiration Associated with Dysphagia

There is limited level 4 evidence suggesting that the presence of post-swallow vallecular residue may result in a greater risk of penetration-aspiration.

Incidence of Aspiration and Silent Aspiration Post-Stroke
The incidence of aspiration in the acute phase of stroke varies from 16% to 52%. Silent aspiration occurs in 8% to 27% of acute stroke patients. Of identified aspirators, 20% to 67% developed silent aspiration.

Factors indicative of the development of aspiration include: a delayed swallow reflex, reduced peristalsis, respiratory tract infection, abnormal volitional coughing and cough with swallow, dysphonia, soft palate dysfunction, and facial hypesthesia.

Tested factors that may not be predictive of aspiration include: poor oral motility and bedside evaluations (which were associated with the identification of non-aspirators).

Incidence of Dysphagia in the Acute Phase of Stroke
The incidence of dysphagia appears to be quite variable following acute stroke with between 3.5% and 65% of patients affected, depending on the sample studied and the method of assessment used.

Age, diabetes, neurological status, and lesion location may be associated with an increase in the rate of dysphagia.

Prognostic Indicators of Dysphagia Post-Stroke

There is level 3 evidence that potential prognostic indicators of dysphagia include: the presence of dysarthria, dysphonia and aspiration, abnormal cough and cough after swallow, National Institute of

Health Stroke Scale scores ≥12, level of consciousness assessment, intubation and bi-hemispheric infarcts, cognitive dysfunction, disuse syndrome, fever and length of hospital stay (inversely related).

Relationship between Aspiration and Pneumonia
There is level 1a evidence that dysphagia and aspiration may both be associated with an increased risk of developing pneumonia. This association appears to be proportional to the severity of aspiration.

Dysphagia Screening Protocols
There is level 2 evidence that the introduction of swallow screening may reduce the incidence of pneumonia among patients with dysphagia when compared to no screening protocol or usual care.

Prevention of Pneumonia Post-Stroke
There is level 1a evidence from a meta-analysis that the use of angiotensin-converting enzyme inhibitors reduces the relative risk of developing pneumonia when compared to placebo or other antihypertensive agents.

There is level 1b evidence that metoclopramide may improve incidence of pneumonia and resultant days on antibiotic treatment, episodes of aspiration, and swallowing outcome in dysphasic patients following stroke compared to placebo. There was no observed effect on mortality.

There is level 4 evidence that cilostazol may improve the incidence of pneumonia when compared to patients not given the drug.

Flexible Endoscopic Evaluation of Swallowing
There is conflicting level 1b and level 2 evidence regarding the reported incidence of pneumonia after flexible endoscopic evaluation of swallowing (FEES) is used versus facial oral tract therapy or videofluoroscopy.

There is level 4 evidence from a large case series study indicating that the incidence of pneumonia may be reduced when dysphasic patients are assessed with FEES versus no assessment. Additionally, FEES may be responsible for a higher proportion of patients treated with instrumental assessment and on standard diet at discharge which may be related to longer periods of non-oral feeding and length of stay in hospital.

Ultrasonography

There is level 2 evidence that both ultrasonography and videofluoroscopy provide comparable results.

There is level 2 evidence that ultrasonography may be able to identify significant differences between factors involved in the diagnosis of dysphagia while approaching high levels of sensitivity (70-73.3%) and specificity (66.7-66.7%).

Dietary Modifications

There is level 1b and level 2 evidence supporting diets involving thickened liquids improving overall swallow safety and reducing incidence of aspiration pneumonia versus lower viscosity diets.

There is level 2 evidence suggesting that thin fluids may be associated with an increase of total fluid intake however, it is also associated with an increase in aspiration pneumonia.

Swallowing Treatment Programs

There is level 1b evidence supporting high intensity swallowing therapy with dietary prescription for better recovery of normal diet and swallowing ability in patients with dysphagia post-stroke compared to a lower intensity therapy or usual care.

Conflicting level 2 evidence suggests that formal dysphagia therapy may not be beneficial.

Non-Oral Feeding

It is unclear (conflicting level 2 evidence) whether oral feeding or nasogastric tube feeding increases the incidence of aspiration pneumonia among dysphasic patients.

There is level 2 evidence that a controlled infusion rate in enteral feeding based on the individual patient's gastric residual volume (GRV) may improve the incidence of regurgitation and aspiration versus no monitoring of the infusion rate.

Selection of Feeding Tubes

There is level 1b evidence from a large, multicentre RCT that nasogastric tube feeding may decrease the incidence of death and poor functional outcome. The same study suggests that the type of tube feeding may not affect incidence of pneumonia however, there is level 1b evidence from a lower powered RCT suggesting a positive effect of gastro-enteric tubes.

There is conflicting level 1b evidence regarding the effect of gastrostomy tubes on mortality, proportion of prescribed feed delivered, and weight gained.

It is unclear which method of tube feeding (gastrostomy tube vs. nasogastric tube) is associated with a greater increase in the incidence of pneumonia.

Mode of Nutritional Intake

There is level 3 evidence that oral intake versus tube feeding may be related to stroke severity.

There is level 4 evidence that oral intake versus tube feeding at discharge may be associated with lower age and improved functional independence during acute care.

Transcutaneous Electrical Stimulation
There is conflicting level 1a, level 1b and level 2 evidence that transcutaneous electrical stimulation may or may not improve swallowing function when compared to traditional swallowing therapy.

There is conflicting level 1b and level 2 evidence that electrical stimulation versus traditional therapy may or may not improve the incidence and severity of penetration-aspiration. However, similar evidence suggests no effect of electrical stimulation on the incidence of aspiration pneumonia or nutritional status.

There is level 2 evidence that electrical stimulation combined with traditional dysphagia therapy may decrease the incidence of swallowing restrictions when compared to traditional therapy alone.

There is level 2 evidence that electrical stimulation may improve swallowing function and the incidence and severity of penetration-aspiration when compared to thermal-tactile stimulation.

Thermal Application
There is conflicting level 1b and level 2 evidence regarding the effect of intensity and presence of thermal application on the incidence of aspiration and penetration.

There is level 1b evidence that swallowing efficiency is improved, specifically among patients with supranuclear lesions after dry swallow preceded by ice massage of the oral cavity.

Pharmacotherapy on Dysphagia Outcomes
There is level 1b evidence that nifedipine may be associated with improved swallowing function versus placebo. Level 2 evidence indicates that cilostazol prescribed with aspirin may not have an effect on swallowing function compared to aspirin alone.

There is level 2 and level 4 evidence that treatment of dysphagia with cabergoline, amantadine, imidapril or cilostazol may reduce the incidence of aspiration and subsequent pneumonia when compared to no treatment.

Transcranial Direct Current Stimulation as an Alternative Intervention
There is level 1a evidence suggesting that transcranial direct current stimulation (tDCS) may improve functional severity of dysphagia when compared to sham stimulation.

Repetitive Transcranial Magnetic Stimulation
There is level 1a evidence that repetitive transcranial magnetic stimulation (rTMS) may improve penetration and aspiration, swallowing function and functional disability compared to sham stimulation.

16. Nutritional Interventions Following Stroke

Incidence of Malnutrition
The prevalence of malnutrition varies from 6 - 62% post stroke, depending on timing of assessment and criteria used to define malnutrition.

There is currently no “gold standard” for the assessment of nutritional status, and various methods of detection may be used.

Factors Associated with the Development of Malnutrition
There is insufficient evidence regarding malnutrition during the acute phase of stroke.

There is insufficient evidence regarding the development of significant gastrointestinal impairments post stroke.

There is limited evidence suggesting that constipation can develop post stroke.

Patients consume 67% of their daily recommended intake during the first week post stroke, and up to 85% of their calorie requirements and 86% of their protein requirements during the first few weeks post stroke.

There is level 1b evidence that glucose-potassium insulin injections significantly reduce glucose levels and systolic blood pressure post stroke; no clinical benefits were observed.

There is level 1b evidence that administration of Metformin is ineffective in reducing glucose levels post stroke.

There is level 2 evidence that treadmill exercise significantly reduces insulin levels but not glucose levels post stroke.

There is level 3 evidence that patients with impaired glucose regulation post stroke are at significantly greater risk for mortality than those with normal glucose regulation; no differences in dependency or stroke recurrence were observed.

There is level 1b evidence that a single dose of Vitamin D2 (100,000 units) significantly increases 25-hydroxyvitamin D levels for up to 16 weeks; no effects on blood pressures, cholesterol levels, and albumin levels were observed.

There is level 1b evidence that Atorvastatin 80mg/d is effective in reducing total cholesterol and LDL levels and increasing HDL levels post stroke.

Nutritional Interventions Following Stroke

There is level 1a evidence that early enteral feeding does not differ significantly from late or delayed enteral feeding in its effects on poor outcome post stroke.

There is level 1b evidence that gastric tube feeding such as PEG is associated with fewer mechanical complications and greater consumed intake post stroke compared to NG feeding.

There is level 1b evidence that enteral protein supplementation post stroke does not differ significantly from standard enteral nutrition in its effect on malnutrition, based on biochemistry and/or body composition.

There is level 1a evidence that oral nutritional supplementation improves the calorie-protein intake of patients post stroke.

There is level 1a evidence that oral nutritional supplementation does not reduce the risk of death or dependency post stroke.

There is level 1a evidence that the ALAnerv nutritional supplement may significantly reduce total lipid levels and increase HDL levels compared to conventional treatment post stroke.

There is level 1b evidence that high-intensity dysphagia therapy results in improved swallowing function and less time to resuming a normal diet post stroke.

There is level 1b and level 2 evidence that dysphagia therapy does not reduce the risk of death or dependency post stroke, regardless of treatment intensity or diet type.

The one-year survival rate of patients with PEG feeding tubes post stroke varied from 16 - 67%, and functional recovery was reported in 2 - 28% of these patients.

There is level 2 evidence that long-term NG tube feeding post stroke results in greater levels of malnutrition than oral feeding.

There is currently no evidence regarding the efficacy of total parenteral nutrition in the treatment of patients post stroke.

17. Medical Complications Post Stroke

Management of Urinary Incontinence

There is level 1b evidence that prompted voiding may reduce the number of episodes of incontinence compared to usual care in patients with urge urinary incontinence.

There is level 1b evidence that biofeedback-assisted pelvic training may decrease the number of episodes of incontinence compared to standard rehabilitation.

There is level 1b evidence that pelvic floor muscle training does not reduce incontinence symptoms or outcomes compared to standard rehabilitation.

There is level 1b evidence that complete correspondence compared to incomplete correspondence of Chinese herbal medicines may be helpful for paruria and symptoms of abnormal defecation; however, the methodology is not adequately described to reproduce this intervention.

There is level 1b evidence that catheter clamping protocols offered at 0-days, 1-day and 3-days may be as effective on bladder reconditioning outcomes such as time to first void, volume on first void, voiding method, and residual urine volume following the first void.

There is conflicting level 2 evidence regarding the effectiveness of functionally-oriented rehabilitation programs alone at improving incontinence when compared to a conventional Bobath approach.

There are no RCTs of urinary incontinence in post-stroke patients to guide pharmacological agent selection in this population.

Use of Indwelling Urinary Catheters

The use of indwelling urinary catheters (IUC) in stroke patients is common.

There is level 3 evidence that IUCs are associated with worse outcomes, including urinary tract infections.

There is level 5 evidence that IUCs should be limited to those patients with intractable urinary retention, skin breakdown, continuous wetness and the need for urinary monitoring.

Treatment of Fecal Incontinence and Constipation Post Stroke

There is level 1b evidence that a traditional Japanese medicine, Diakenchuto, may be effective at reducing constipation.

There is level 1b evidence that a nursing evaluation program consisting of an assessment, provision of educational material for the patient, and a summary of the diagnostic results may be effective in reducing constipation long-term post stroke.

There is level 1b evidence that a morning bowel routine may be as effective as an evening bowel routine.

Prevention of Deep Venous Thromboembolism

There is level 1 evidence that the use of enoxaparin is effective for DVT prophylaxis after acute stroke and has lower risk of significant bleeding compared to unfractionated heparin.

There is level 1a evidence that low molecular weight heparin may reduce the incidence of DVT and PE. Its effectiveness may be comparable to that of aspirin for reducing the incidence of DVTs.

Prevention of Deep Vein Thrombosis with Mechanical Devices

There is level 1a evidence that the use of an intermittent pneumatic compression device may reduce the occurrence of DVT compared to no IPC.

There is level 1b evidence that compression stockings with intermittent pneumatic compression may reduce the occurrence of DVT as compared to compression stockings alone.

There is conflicting level 1a evidence regarding the use of graded compression stockings on the development of proximal DVT.

Incidence of Seizures Post Stroke

The incidence of post-stroke seizures is, on average, 10% but due to methodological variation and study population differences, the incidence reported in the literature has a wide range, from 1.2% to 27.8%.

Treatment of Seizures Post Stroke

There is level 1b and level 2 evidence that patients who have experienced seizures post stroke should receive monotherapy with an antiepileptic drug to prevent seizure reoccurrence.

There is level 1a evidence that prophylactic treatment with antiepileptic drugs may not be effective in preventing first seizures post stroke.

Treatment of Post- Stroke Osteoporosis

There is level 1a evidence that treatment with bisphosphonates (risedronate, etidronate, and zoledronate), may preserve bone mineral density post stroke compared to placebo.

There is level 1a evidence that treatment with vitamin D, including vitamin D2, vitamin D3, and sunlight therapy, may be helpful in preserving bone mass density.

There is limited level 2 evidence that treatment with estrogen-like products such as manaquinone, salmon calcitonin, or isoflavone derivatives compared to a placebo or vitamin D may not result in significant benefits in bone density outcomes.

There is conflicting level 1a evidence regarding the effect of vitamin D derivatives on osteoporotic fractures post stroke; further research is required.

Treatment of Central Pain Post Stroke

There is conflicting level 1a evidence for the effectiveness of anticonvulsants on pain post stroke: pregabalin, gabapentin, and lamotrigine have been shown to be variably effective at reducing pain compared to placebo.

There is level 1a evidence that there is no difference between amitriptyline and a placebo on improving central pain. There is level 1a evidence that there is no difference between duloxetine and placebo on improving central pain. However, further study is necessary.

There is level 1b evidence that intravenous injections of morphine may not provide pain relief compared to a saline treatment; however, this has not been sufficiently studied and further research is required.

There is level 1b evidence that intravenous injections of propofol may contribute to a significant difference in pain outcomes compared to a placebo.

There is conflicting level 1a evidence that rTMS may help to reduce symptoms of post-stroke pain in the short term, but this may not be different to sham rTMS.

There is level 1b evidence that high-strength μ-opioid agonist levorphanol may reduce pain in post-stroke patients.

Pharmacological and Non-Pharmacological Treatment of Post-Stroke Fatigue
Treatment with pharmacological agents has not been sufficiently studied to determine their efficacy for reducing post-stroke fatigue.

The effectiveness of fatigue management programs compared to a general stroke education program requires further study.

Acupuncture for Post-Stroke Insomnia
There is level 1a evidence that acupuncture may improve insomnia compared to a sham acupuncture session.

18. Post Stroke Depression

Prevalence and Natural History of PSD
At least one-third of stroke patients will experience depression. While the patterns of incidence and recovery change over time, for many individuals PSD may be persistent.

There is level 4 evidence that personality traits such as neuroticism and pessimism, and a passive coping style is significantly associated with the development of depression.

There is level 5 evidence that comorbidity of depression and anxiety occur in at least one-third of stroke patients and, despite recovery over time, are prevalent in one-fifth of patients after 5 years.

Risk Factors for Post-Stroke Depression
Commonly identified risk factors for depression include female gender, older age, a previous history of depression, functional limitations and cognitive impairment.

Prior treatment of depression and the need for assistance with activities of daily living may be the factors most predictive of risk of post stroke depression.

Younger age was found to be a commonly identified risk factor for developing multiple comorbid psychiatric concerns such as depression and anxiety, and psychological distress including anger, helplessness, emotional dyscontrol, and indifference.

Stroke Location and Depression
There is level 1a evidence from one meta-analysis that there may not be a definitive relationship between the site of the brain lesion and depression.

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 meta-analyses have failed to establish a definitive relationship between the site of the stroke and depression.

There is conflicting evidence regarding the hemispheric side of the lesion and rates of depression. Level 4 evidence from one study and level 5 evidence from three studies suggest left hemispheric strokes are more susceptible to developing depression. Level 5 evidence from one observational study suggests right hemispheric strokes are more susceptible.

There is level 5 evidence suggesting mixed results with only one outcome measure out of five revealing a significant difference in levels of depression. There is level 5 evidence of a lack of an association between the hemispheric side of the lesion and depression.

There is level 5 evidence that strokes involving the basal ganglia are associated with the development of PSD.

There is level 5 evidence suggesting that patients with stroke experience greater levels of depression and mood disturbance than traumatic brain injury patients.

Detection and Diagnosis of Post-Stroke Depression

There is level 1a evidence from one meta-analysis that the PHQ-9 is an effective diagnostic tool for post-stroke depression as well as favourable findings for use of the CES-D and the HAM-D.

There is level 5 evidence that PSD is significantly different from a diagnosis of major depression and that a new tool for PSD, the Post-Stroke Depression Predict Scale (DePres), may be of use when detecting post-stroke depression.

There is level 5 evidence that the Hospital Anxiety and Depression Scale (HADS) demonstrates low sensitivity but mixed conclusions were drawn regarding specificity with one study reporting a low specificity score whilst the other reported a higher score.

Functional Impairment and Depression Post-Stroke

There is level 3 evidence that depression may have a significant and negative impact on functional ability following stroke.

There is level 3 evidence that functional dependence is associated with greater levels of depression, illness comorbidity and cognitive deficits when compared to functional independence.

There is level 5 evidence that patients admitted to an inpatient stroke unit demonstrate significantly greater levels of apathy compared to patients living in the community.

Depression and Social Activities Post-Stroke

There is level 3 evidence that decreased socialization outside of the home, inside the home, and in hobbies and interests lead to significant increases in depressive symptoms among stroke patients compared to age and gender-matched controls.

There is level 5 evidence that patients who socialise with friends, spend time with relatives and/or a partner, and participate in passive activities such as listening to music exhibit lower levels of depression while returning to work and/or playing sports was associated with higher levels of depression.

Cognitive Impairment and Depression Post-Stroke

There is level 1a evidence that cognitive impairments can be improved with cognitive training interventions but these do not result in improvements for depression.

There is level 5 evidence that executive dysfunction and depression-executive dysfunction syndrome are both associated with older age.

Mortality and Depression Post-Stroke

There is level 3 evidence that the presence of mental health disorders post stroke, including depressive symptomatology, has been associated with an increased risk for mortality. Further study to clarify the association between psychological distress and mortality is required.

There is level 4 and level 5 evidence that presence of depression, presence of apathy, male gender, younger age, and use of anti-depressants are significant risk factors for suicide and suicidal ideation.

Prevention of Post-Stroke Depression

There is level 1a evidence that early initiation of antidepressant therapy, in non-depressed stroke patients is associated with reduced risk for the development of post-stroke depression. Further study is required to assess both duration of treatment and optimal timing for the initiation of therapy.

There is level 1a evidence that Fluoxetine is an effective pharmaceutical treatment for preventing PSD with level 1b evidence from one RCT that Fluoxetine can also improve functional disabilities.

There is level 1a evidence that Escitalopram can assist with improving mood among stroke patients with one RCT revealing a successful prevention of depression compared to problem-solving therapy and a placebo group, and another RCT revealing a prevention of apathy compared to a placebo.

There is mixed evidence regarding the efficacy of Sertraline with level 1b evidence it does not prevent depression any better than a placebo while other level 1b evidence reporting successful prevention of depression compared to placebo.

There is level 1b evidence that Milnacipran may be effective in preventing depression compared to a placebo.

There is level 2 evidence that Mirtazapine may be effective in preventing depression compared to not receiving pharmacological treatment.

Care Provision and the Prevention of Post-Stroke Depression

There is level 1a evidence that ongoing individualized contact and support provided via various care provision models is associated with less deterioration of mood and/or mental health state following stroke.

There is level 1a evidence that outreach communication initiatives such as mailed postcards and letters to patients are ineffective in reducing depression however mixed evidence in regards to direct telephone calls with level 1b evidence that it is ineffective and level 2 evidence that weekly telephone appointments reduced depression scores.

There is level 1a evidence that motivational interviewing resulted in significant improvements in reducing depression compared to usual care.

There is level 1b evidence that outreach initiatives in the form of follow-up home visits from nurses resulted in significant improvements in depression and functioning compared to no contact or home visits.

There is level 2 evidence that assistance from a stroke family support service did not result in a significant improvement in depression compared to usual care.

There is level 2 evidence that goals and recommendations for general practitioners to manage risk factors and provide frequent appointments with patients did not reduce rates of depression significantly compared to usual care.

Omega-3 Fish Oil Supplementation and Mood Post-Stroke

There is level 1b evidence that fish oil supplementation following stroke has no impact on mood.

B-Vitamin Therapy

There is level 1b evidence that B-vitamin therapy, administered over a long period, may be associated with reduction in long-term risk for depression. Further study is required.

Heterocyclic Antidepressants
There is level 1a evidence that heterocyclic antidepressants may improve depression post stroke. Side effects in elderly patients mean that these medications should be used with caution in that population.

Selective Serotonin Reuptake Inhibitors
Based on the results of meta-analysis, there is level 1a evidence that selective serotonin reuptake inhibitors are effective in the treatment of post-stroke depression. Further placebo studies should be conducted using a blinded administrator and optimal treatment duration in order to address methodological differences across current studies.

Adjunctive Light Therapy
Based on the results of a recent meta-analysis, there is level 1a evidence that the use of bright light therapy in conjunction with SSRI antidepressants is an effective treatment for non-seasonal depression, in general.

There is level 1b evidence that adjunctive bright light therapy may be more effective than moderate intensity light therapy in the treatment of post-stroke depression. Further research is required to examine timing, duration and optimal intensity.

Selective Noradrenaline Reuptake Inhibitors
There is level 1b evidence that Reboxetine, a noradrenaline reuptake inhibitor, is effective in reducing retarded post-stroke depression.

Venlafaxin and Duloxetine
There is level 1b evidence that duloxetine may improve depression symptoms post-stroke.

There is level 4 evidence that venlafaxine may be an effective treatment for post-stroke depression.

Nefiracetam
There is level 1b evidence that the GABA compound nefiracetam may not be more effective than placebo in the treatment of post-stroke depression.

Psychostimulants
There is level 1b evidence that methylphenidate is more effective than placebo in improving both symptoms of depression and functional recovery. Methylphenidate (a psychostimulant) has an earlier onset of action than traditional antidepressants.

Melatonin Agonist
There is limited level 4 evidence that valdoxan, a melatonin agonist, may be effective in management of PSD.

Statins
There is limited level 2 evidence that statins may improve post-stroke depression and anxiety.

Herbal Medicine
There is level 1b evidence that treatment with the herbal preparation, Free and Easy Wanderer Plus (FEWP), may be as effective as fluoxetine in the treatment of post-stroke depression.

Care Management
There is level 1b evidence that an active care management program including patient education and ongoing monitoring may enhance effectiveness of pharmacologic treatment for post stroke depression.

Stroke Recovery After Treatment With Antidepressant Medications
There is level 1a evidence that treatment with Nortriptyline may improve post-stroke depression. There is also limited evidence to suggest that an improvement in post-stroke anxiety and functional recovery but not cognitive functioning may follow after treatment with Nortriptyline.

There is level 1a evidence that treatment with Fluoxetine may improve depression symptoms and independent functioning but not cognitive functioning. Findings for the effect of Fluoxetine on functional recovery are conflicting.

There is level 1a evidence that Trazodone treatment may not improve post-stroke depression.

There is level 1b evidence that Maprotiline may improve depressive symptoms, motor and independence functioning.

There is level 1b evidence that Desipramine may not improve depression or motor recovery post-stroke.

There is limited level 2 evidence that Citalopram may improve depression symptomology and functional recovery.

Mortality and Pharmacologic Treatment of Post-Stroke Depression
There is level 1b evidence that early treatment with antidepressants (Nortriptyline or Fluoxetine) post stroke is associated with improved long-term survival. Further research is required.

Electroconvulsive Therapy
There is limited level 3 evidence that electroconvulsive therapy may be an effective treatment for short term depressive symptoms without worsening existing neurological deficits. Further studies are required.

Repetitive Transcranial Magnetic Stimulation (rTMS)
There is level 1a evidence that rTMS may improve depressive symptomatology.

Cognitive Behavioural Therapy
There is level 1a evidence that cognitive behavioral therapy (CBT) may not be effective at improving post-stroke depression symptomology.

There is level 1b evidence that mood-based CBT may improve depression and self-esteem in post-stroke patients with aphasia.

There is level 1b evidence that mindfulness may help improve mental fatigue after a stroke.

Combined Therapy
There is level 1b evidence that delivery of a brief psychosocial intervention in addition to antidepressant therapy may be more effective than antidepressant therapy alone in terms of depressive symptomatology, functional ability and social participation.

There is level 1a evidence that hyperbaric oxygen therapy with dexamethasone or fluoxetine may improve depressive symptoms post-stroke.

There is level 1b evidence that combination therapy of high-intensity light therapy and citalopram is superior over low-intensity light therapy with citalopram at improving post-stroke depression.

Music Therapy
There is conflicting level 1b and level 2 evidence regarding the effect of music therapy on post-stroke depression.

There is level 1b evidence that music-movement therapy may not improve depression however, it may improve upper limb range of motion.

Speech Therapy and Emotional Outcomes
There is level 1b evidence that speech therapy may not improve depression scores or overall psychological wellbeing.

Physical Activity
There is level 1a and limited level 2 evidence (one study) that various forms of exercise therapy may not improve depressive symptoms. However, level 2 evidence suggest otherwise.

Ecosystem Focused Therapy
There is level 1b evidence that ecosystem focused therapy may not be more effective than education in reducing depressive symptoms post-stroke.

Acupuncture
There is level 1b evidence that acupuncture may not improve post-stroke depression however, it may improve neurological status.

There is level 1b evidence that dense cranial acupuncture with SSRI body electro-acupuncture may improve post-stroke depression however, the effects are not maintained.

There is limited level 2 evidence that electro-acupuncture may help improve post-stroke depression.

Reiki Treatment
There is level 1b evidence that Reiki treatment may not improve functional recovery or depression symptomology post-stroke.

Meridian Acupressure
There is limited level 2 evidence that meridian acupressure may improve depression and independent functioning.

Massage Therapy
There is limited level 2 evidence that anxiety may be improved following massage therapy.

Relaxation Therapy
There is limited level 2 evidence that relaxing unilateral nostril breathing may not improve anxiety or depressive symptoms in aphasic compared to non-aphasic individuals.

Art Therapy

There is limited level 4 evidence that art therapy may improve anxiety or depressive symptoms post-stoke.

Treatment of Post-Stroke Emotionalism
There is level 1a evidence that antidepressants and SSRIs in particular may be an effective treatment for post-stroke emotionalism.

19. Community Reintegration

Social Support and Functional Status
High levels of social support may facilitate improved functional gains, mood, and social interactions.

Moderate amounts of instrumental support and high amounts of emotional support may appear to be most beneficial to stroke patients.

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, psychological distress 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.

Having a pet was found to facilitate physical, psychological and social recovery after a stroke.

Social Work Interventions
There is level 1a evidence that social work interventions providing counselling along with information and education for stroke patients and their families may not be associated with improvements on measures of independence or social activity.

Specialized Social Support Network Interventions
There is level 1b and limited level 2 evidence that a specialized social support intervention that includes the stroke patient's social support network may not be effective in improving perceived social support or functional recovery. Subgroup analyses suggest that there may be some benefit in terms of physical performance and instrumental activities of daily living for healthier, non-frail stroke survivors.

Day Services
There is level 1b evidence that early attendance (within 6 months of stroke) at a day service is associated with improved participation in leisure activities.

Home-Based Support and Care Management
There is level 1a evidence that home-based support and care management interventions are not associated with improved social activity, mood, quality of life or physical independence. However, there is level 1b evidence that participation in a social worker led program of care coordination featuring frequent, regularly-scheduled contact may result in improved mental health.

There is level 1a evidence that involvement with a stroke liaison worker or case manager is associated with increased knowledge about stroke and satisfaction with services.

There is level 1a evidence that social support interventions may be associated with a reduction in caregiver burden or strain.

There is inconclusive level 1b evidence regarding the efficacy of occupational therapist led home-visits on mental health and hospital readmission.

Active Case Management
There is level 1a evidence that active case management may result in improved social activity and mood however, it may not be more effective than the comparator control treatment. Further study is required.

Discharge Planning Programs
There is limited level 2 evidence that individualised, caregiver-oriented discharge planning may improve both preparedness and quality of care.

Education Programs
There is limited and inconclusive level 2 evidence regarding the effect of caregiver training programs on the patients' and caregivers' well-being.

There is limited level 2 evidence that community-based nurse-led education programs for patients may improve stroke knowledge.

There is limited and inconclusive level 2 evidence regarding the effect of providing re-integration guidelines to patients.

Community Based Rehabilitation Programs
There is limited level 1b evidence that community walking programs are more efficient than usual care at improving walking performance and the impact of stroke on the patient.

Self-Management Education Programs
There is level 1b evidence that self-management programs are not superior to usual care for improving quality of life of patients with stroke.

Effects of Caregiving Post stroke
Commonly identified effects of caregiving on the caregiver include increasing psychological distress, increased financial burden, 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 in itself may contribute to increased carer strain, increased risk of depression and decreased life satisfaction.

Reports concerning the influence of patient characteristics vary with the effect in question. However, age, severity of stroke and stroke-related impairments, functional status and cognitive status have been reported as influencing caregiver outcomes.

Positive consequences of caregiving include improved appreciation of life, feeling needed or appreciated and development of a more positive outlook. Maintaining a positive attitude has been identified as an important coping strategy.

Social Support Interventions for the Caregiver
Support provided by caregiving peers may have a positive effect on the caregiver.

There is level 1b evidence that participation in an online program providing information and support through contact with both a nurse and other caregivers has no impact on depression or life satisfaction. However, access to web-based information may be associated with reductions in healthcare utilization.

There is level 1a evidence that group-based programs and support may improve stroke-related knowledge and family structure however, it may not have an impact on psychological health.

There is level 1b evidence that interactive educational resources and professional support accessed via online chat sessions, message boards and educational videos may reduce depression in caregivers but has no impact on mastery or self-esteem.

There is level 1b evidence that a caregiver-mediated home-based program may improve the physical impairments of stroke patients.

Family Interactions and Stroke:

Perceived family dysfunction is common post stroke. However, family function affects treatment adherence, performance of ADLs and social activity. Stroke patients do better with well-functioning families. Effective communication, good problem solving or adaptive coping, and strong emotional interest in each other characterize well-functioning families.

Information Provision and Education Interventions:

There is level 1a evidence from a meta-analysis that psychoeducational interventions have no significant effect on the burden or health of caregivers but may benefit family functioning.

There is level 1a 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 level 1a evidence that skills training is associated with a reduction in depression.

There is level 1b evidence that a problem-solving intervention for caregivers is associated with a reduction in depression, life changes, and health. These benefits may not be maintained beyond 6 months.

Perceived Need for Information, Education and Training

Although the receipt of information is of great importance to stroke patients and their families/caregivers, relatively few receive adequate information about topics they perceive to be important. Caregivers rarely receive adequate training in skills they require to care for the stroke survivor.

Healthcare professionals involved in stroke care may acknowledge the importance of education for patients and carers; however, relatively few provide adequate information based upon the information needs of the recipients. In addition, written materials should be suited to the educational/reading level of the intended recipient.

Leisure Activities Post-Stroke

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 Intervention Post-Stroke

When considered individually, there appears to be conflicting evidence as to the benefit of leisure therapy post-stroke and following discharge. However, based on the information from a meta-analysis using pooled data from the same RCTs, there is level 1a evidence that leisure therapy is associated with modest improvement in leisure activity.

There is level 1b evidence that participation in a leisure education program focused on awareness and competency development is associated with improvement in number and duration of activities and reduction in depressive symptoms.

There is level 1a evidence that participation in group education and exercise programs result in improved physical outcomes, but not social/leisure participation outcomes.

Sexual Activity Post-Stroke

A decrease in sexual activity is very common post-stroke. There is general agreement that sexual drive is still present and the main barriers to sexual activity are physical impairments and psychological factors, in particular a changed body image and lack of communication.

Inappropriate sexual behaviour following stroke is not well studied. There may be an association between inappropriate sexual behaviour and the presence of right frontal lobe stroke and cognitive impairment.

There is level 3 evidence 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.

Assessment of Driving Ability

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. In addition, provision of contextual driving therapy may be associated successful on-road evaluation.

Driving Ability Treatment Interventions Post-Stroke

There is level 1b evidence that a visual attention-retraining program is no more effective than traditional visuoperception retraining in improving the driving performance of patients with stroke.

There is level 1b evidence that a simulator training program involving use of appropriate adaptations and driving through complex scenarios similar to real life is associated with improvement in driving fitness and successful on road evaluation.

There is level 1b evidence that Dynavision training is not effective in improving the results of on-road assessments in individuals with stroke.

Return to Work Post-Stroke

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 severity of functional limitations, age and type of pre-stroke employment.

There is level 3 evidence that stroke survivors who worked prior to their stroke should, if their condition permits, be encouraged to be evaluated for their potential to return to work.

Factors Influencing Community Reintegration

The physical limitations of stroke have a direct impact on the patient's ability to reintegrated back into the community. Accepting and adapting to a post-stroke status can mitigate the negative effects that come as a result of stroke.

The individual characteristics of stroke patients such as optimism, determination, competitiveness, resilience and initiative can facilitate community reintegration.

Emotional and social support from family, friends and professionals plays a crucial role in reintegration success.

Physical barriers and the lack of environmental accessibility limit one's ability to return in the community.

21. The Rehabilitation of Younger Stroke Patients

Incidence of Stroke for Younger Individuals
The incidence of stroke in young patients is notably lower than in older patients. Variable incident rates have been reported, ranging from 3/100,000 to 44.3/100,000 and 3/1,000 to 25/1,000 for younger versus older individuals, respectively.

The incidence of stroke in young patients has increased over time.

The incidence of ischemic stroke tends to be greater than the incidence of hemorrhagic stroke.

Unknown Etiology
Up to one third of strokes in young people are of unknown etiology. However, as diagnostic methods improve this proportion is decreasing.

Hemorrhagic Etiology
The most common causes for hemorrhagic stroke in young patients include hypertension, arteriovenous malformation, ruptured aneurysm, or a combination of these factors.

Hypertension remains an important and more common cause of ICH in the younger population, with varying rates among different races.

Ischemic Stroke
The majority of strokes in young patients are ischemic. Cardiac embolism is a frequent cause for patients younger than 40, while advanced atherosclerosis is a common etiology in patients aged 40-49.

Uncommon Etiologies
Uncommon etiologies are likely in stroke patients under 30.

There are many uncommon etiologies that have been recognized as risk factors for stroke in young patients, including but not limited to, migraines, non-atherocleroticvasculopathy, plasma homocysteine level, drug abuse, alcohol abuse, mitral valve prolapse, oral contraceptives, stroke, multifocal intracranial stenosis, monoarterial intracranial stenosis, extracranial dissection, cardioembolism, cardiac disease, polymorphis, and BMI associated with postpartum state.

Modifiable Risk Factors
Smoking is the most significant risk factor for stroke in the young population.

Hypertension is a significant risk factor for young stroke.

Hyperlipidemia, diabetes mellitus, and elevated plasma homocysteine level are stroke risk factors, particularly for those aged >35.

Alcohol-related stroke events in young patients are relative to the amount consumed. One to two alcoholic beverages daily may reduce the risk of stroke while alcohol abuse can be a significant risk factor for stroke.

Drug use is an uncommon risk factor for stroke in general but is more common in the younger population. Drug abuse and cocaine use can cause both ischemic stroke and hemorrhage in young people.

Oral contraceptives play a minor role in stroke risk when paired with other factors. High-dose oral contraceptives appear to be a more important risk factor for stroke in young people compared to low-dose oral contraceptives.

Adherence to specific dietary patterns, particularly a Mediterranean type diet, can reduce the risk of stroke in a young population. High intake of salt can increase risk of stroke, whereas high intake of potassium can reduce the risk of stroke.

Migraine with aura is a risk factor for young stroke. Young women in particular are at an elevated risk.

Further study is required to determine the validity of Chlamydia pneumonia as a risk factor for young stroke.

Non-Modifiable Risk Factors

The significance of family history of stroke and patent foramen ovale as risk factors for stroke in young populations is unclear.

There is a gender preponderance related to age of onset of stroke. Young stroke patients under the age of 35 are more likely to be females and above 35 years of age are more likely to be males.

Race appears to be an important risk factor for stroke in young populations. Risk appears to be elevated particularly for young Black patients.

Previous stroke in young patients is less common than in older patients.

Mitral valve prolapse appears to be a minimal risk factor and an infrequent sole etiology in young stroke events.

Atrial fibrillation is an uncommon and understudied risk factor for stroke in young populations.

Pregnancy and postpartum state are unique periods of elevated stroke risk in young females. The postpartum period is associated with a higher risk of stroke.

Recovery and Prognosis for Young Stroke Patients

Young stroke patients make better neurological recoveries with less disability.

Young stroke patients have a better long-term survival rate.

Impaired cognitive performance, recurrent stroke and epilepsy may be associated with post-stroke recovery in young adults.

Rehabilitation of Young Stroke Patients

Rehabilitation of young stroke patients is similar to the rehabilitation of older stroke patients with the main differences being the nature of neurological recovery and associated social issues.

Stroke rehabilitation programs with an emphasis on socialization and community integration could be effective for young stroke patients.

Family Stress
Young stroke patients tend to achieve higher levels of functional recovery and independence than elderly stroke patients. This improved outcome commonly puts less stress on caregivers and close relations.

Young stroke patients tend to experience different social and adjustment issues compared to elderly stroke patients.

Caregivers reported more emotional distress when caring for patients exhibiting more depressive symptoms and more cognitive impairment.

Institutionalization
Institutionalization is required infrequently in young stroke patients as a result of better prognosis and greater availability of caregivers.

Functional improvement was found to be more significant when young stroke patients were discharged home compared to when they were institutionalized.

Return to Work for Young Stroke Patients
Vocational issues are important for young stroke patients.

An inability to return to full employment is associated with cognitive impairments, poor functional recovery, working in a blue color position and more severe stroke.

Reported rates of return to work one year post-stroke range from 7% to 75%.

Future Needs of Younger Stroke Patients
Young patients need to be aware of possible long-term health consequences including recurrent stroke, epilepsy and sexual impairment.

Post-stroke depression and post-stroke fatigue can occur in young patients.

Young stroke patients need to be connected with support organizations and those who share similar experiences.

22. The Rehabilitation of Severe Stroke

Stroke Severity and Recovery
Animal studies, combined with human neuroimaging, demonstrate that recovery post-stroke is largely dependent on peri-lesional intact cortical areas which subsume a similar function and can take over the lost function. Larger strokes have reduced potential for this to occur.

Neuroimaging studies suggest that although increased bilateral activity may occur following a stroke, this does not necessarily translate into functional recovery. A combination of residual activity, compensatory actions by surrounding regions, and cortical reorganization may play a role in the activity observed.

Although anatomical integrity of the brain may explain part of the recovery, recent studies suggest that cortical connectivity may better predict clinical change in the first three months after a stroke. More studies are needed to investigate the cortical connectivity patterns in patients post-stroke.

Issues in Severe Stroke Rehabilitation
Despite having the greatest number of impairments and the most severe disabilities, patients often have limited access to rehabilitation.

Limited access to rehabilitation may be a result of many factors but in particular concerns about reduced potential for functional gains comparable to those individuals with moderate sized strokes.

Rehabilitation of individuals with severe stroke is associated with a greater use of rehabilitation resources.

Definition of Severe Stroke
Stroke severity has been defined in a variety of ways. Common definitions are unconsciousness with severe unilateral or bilateral paresis at onset; early FIM® score <40 or motor FIM® score <37; high risk for failure to return home due to physical, cognitive, perceptual, and communication difficulties, or a combination of the above.

Funding Models and Severe Strokes
Severe strokes may be the most negatively affected by the type of funding models employed.

Severe Stroke Admission to ICUs
Severe strokes are seldom admitted to intensive care units as compared with other types of critically ill or injured patients.

Severe stroke patients with critical health issues appear to have lower mortality rates when admitted to intensive care. Further research is needed to establish other specific outcome gains.

It is currently unclear whether stroke type influences the extent of the benefits that the ICUs may offer.

Stroke Severity and Rehabilitation Outcomes.
More severe strokes, as determined upon admission, are associated with poorer outcomes after rehabilitation when compared with less severe strokes.

Benefits of Rehabilitation for Severe Strokes
There is level 1a evidence that specialized interdisciplinary stroke rehabilitation reduces mortality in severe stroke patients when compared to general rehabilitation programs.

There is level 1b and limited level 2 evidence suggesting that severe stroke patients who are admitted to specialized interdisciplinary stroke rehabilitation programs are more likely to be discharged home.

There is conflicting level 1a and level 2 evidence regarding the effect of specialized interdisciplinary stroke rehabilitation programs on hospital length of stay.

There is conflicting level 4 evidence regarding functional gains of persons with severe stroke following specialised interdisciplinary inpatient stroke rehabilitation.

Functional outcomes suggest that rehabilitation of severe stroke patients should emphasize discharge planning and reduction of post-stroke complications.

Slow-Stream Rehabilitation
Some data suggest that slow-stream stroke rehabilitation may result in less favourable outcomes when compared to the more intensive stroke rehabilitation program.

The utilization of slow stream rehabilitation should be dictated by the tolerance of the individual patient for therapy and not by preconceived notions about the amount of therapy that patients can successfully tolerate.

Severe Stroke Rehabilitation Ethics
More research needs to be conducted in the area of severe stroke prognosis.

Trial treatments may assist in creating a more accurate basis for ethical decision-making.

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