strokefoundation

Stop stroke. Save lives. End suffering.

Clinical Guidelines for Stroke Management 2010

National Stroke Foundation

About the National Stroke Foundation

The National Stroke Foundation is a not-for-profit organisation that works with the public, government, health professionals, patients, carers, families and stroke survivors to reduce the impact of stroke on the Australian community.

Our challenge is to save 110 000 Australians from death and disability due to stroke over 10 years.

We will achieve this by:

- educating the public about the risk factors and signs of stroke and promoting healthy lifestyles
- working with all stakeholders to develop and implement policy on the prevention and management of stroke
- encouraging the development of comprehensive and coordinated services for all stroke survivors and their families
- encouraging and facilitating stroke research.

Visit **www.strokefoundation.com.au** for more information.

Navigation

Click to view table of contents

Click to return to previous view

Click to go to previous page

Click to go to next page

Clinical Guidelines for Stroke Management 2010

The following organisations have provided valuable input into the development of this document and the National Stroke Foundation gratefully acknowledges their endorsement of the Clinical Guidelines for Stroke Management 2010:

Australian and New Zealand Society for Geriatric Medicine
Australian College of Emergency Medicine
Australian College of Rural and Remote Medicine
Australian Physiotherapy Association
Beyond Blue
Continence Foundation of Australia
Carers Australia
Dietitians Association of Australia
Internal Medicine Society of Australia and New Zealand
Occupational Therapy Australia
Royal Australian and New Zealand College of Psychiatrists
Royal College of Nursing, Australia
Speech Pathology Australia
Stroke Society of Australasia
The Council of Ambulance Authorities
The Pharmacy Guild of Australia
The Royal Australian College of General Practitioners

Supported by the Royal Australasian College of Physicians and its Australasian Faculty of Rehabilitation Medicine.

Disclaimer

This document is a general guide to appropriate practice, to be followed subject to the clinician's judgment and the patient's preference in each individual case. The guidelines are designed to provide information to assist decision-making and are based on the best evidence available at the time of development. Copies of the document can be downloaded through the National Stroke Foundation website: www.strokefoundation.com.au.

Funding

The National Stroke Foundation gratefully acknowledges the financial assistance provided by the Australian Government Department of Health and Ageing. The development of the final recommendations has not been influenced by the views or interests of the funding body.

Suggested citation

National Stroke Foundation. Clinical Guidelines for Stroke Management 2010. Melbourne Australia.

ISSBN0-978-0-9805933-3-4

© No part of this publication can be reproduced by any process without permission from the National Stroke Foundation. September 2010.

Publication Approval

Australian Government
National Health and Medical Research Council

These guidelines were approved by the Chief Executive Officer of the National Health and Medical Research Council (NHMRC) on 3rd August 2010, under Section 14A of the *National Health and Medical Research Council Act 1992*. In approving these guidelines the NHMRC considers that they meet the NHMRC standard for clinical practice guidelines.

NHMRC is satisfied that they are based on the systematic identification and synthesis of the best available scientific evidence and make clear recommendations for health professionals practising in an Australian health care setting. The NHMRC expects that all guidelines will be reviewed no less than once every five years.

This publication reflects the views of the authors and not necessarily the views of the Australian Government.

Contents

Preface 3

Recommendations 4

Introduction 30

Purpose 30
Scope 30
Target audience 30
Continuum of stroke care 30
Development 30
Consumer versions of the guidelines 30
Revision of the guidelines 31
Using the guidelines 31
Multidisciplinary team approach 31

CHAPTER ONE
Organisation of services 33

1.1 Hyper-acute care 33
1.2 Hospital care 35
1.2.1 Stroke unit care 35
1.2.2 Ongoing inpatient rehabilitation 36
1.2.3 Care pathways 37
1.2.4 Inpatient stroke care coordinator 38
1.2.5 Telemedicine and networks 38
1.3 Discharge planning and transfer of care 39
1.3.1 Safe transfer of care from hospital to community 39
1.3.2 Carer training 41
1.4 Care after hospital discharge 41
1.4.1 Community rehabilitation and follow-up services 41
1.4.2 Long-term rehabilitation 43
1.5 Transient ischaemic attack 44
1.6 Standardised assessment 45
1.7 Goal setting 45
1.8 Team meetings 46
1.9 Patient and carer/family support 46
1.9.1 Information and education 46
1.9.2 Family meetings 47
1.9.3 Counselling 47
1.9.4 Respite care 48
1.10 Palliative care 48
1.11 Stroke service improvement 49

CHAPTER TWO
Stroke recognition and pre-hospital care 51

CHAPTER THREE
Early assessment and diagnosis 53

3.1 Transient ischaemic attack 53
3.2 Rapid assessment in the emergency department 54
3.3 Imaging 55
3.4 Investigations 56

CHAPTER FOUR
Acute medical and surgical management 59

4.1 Thrombolysis 59
4.2 Neurointervention 61
4.3 Antithrombotic therapy 61
4.4 Acute phase blood pressure lowering therapy 62
4.5 Surgery for ischaemic stroke and management of cerebral oedema 63
4.6 Intracerebral haemorrhage management 63
4.7 Physiological monitoring 64
4.8 Oxygen therapy 65
4.9 Glycaemic control 65
4.10 Neuroprotection 66
4.11 Pyrexia management 66
4.12 Seizure management 67
4.13 Complementary and alternative therapy 67

CHAPTER FIVE
Secondary prevention 69

5.1 Lifestyle modifications 69
5.1.1 Smoking 69
5.1.2 Diet 69
5.1.3 Physical activity 69
5.1.4 Obesity 69
5.1.5 Alcohol 69
5.2 Adherence to pharmacotherapy 70
5.3 Blood pressure lowering 71
5.4 Antiplatelet therapy 71
5.5 Anticoagulation therapy 72
5.6 Cholesterol lowering 73
5.7 Carotid surgery 73
5.8 Diabetes management 75
5.9 Patent foramen ovale management 75
5.10 Hormone replacement therapy 75
5.11 Oral contraception 76

CHAPTER SIX
Rehabilitation 79

6.1 Amount, intensity and timing of rehabilitation 79
6.1.1 Amount and intensity of rehabilitation 79
6.1.2 Timing of rehabilitation 80
6.2 Sensorimotor impairment 81
6.2.1 Dysphagia 81
6.2.2 Weakness 83
6.2.3 Loss of sensation 83
6.2.4 Visual field loss 84
6.3 Physical activity 84
6.3.1 Sitting 84
6.3.2 Standing up 84
6.3.3 Standing 85
6.3.4 Walking 85
6.3.5 Upper limb activity 86
6.4 Activities of daily living 87
6.5 Communication 89
6.5.1 Aphasia 89
6.5.2 Dyspraxia of speech 91
6.5.3 Dysarthria 91
6.5.4 Cognitive communication deficits 92
6.6 Cognition 92
6.6.1 Assessment of cognition 92
6.6.2 Attention and concentration 93
6.6.3 Memory 93
6.6.4 Executive functions 94
6.6.5 Limb apraxia 94
6.6.6 Agnosia 95
6.6.7 Neglect 95

CHAPTER SEVEN
Managing complications 97

7.1 Nutrition and hydration 97
7.2 Poor oral hygiene 98
7.3 Spasticity 99
7.4 Contracture 100
7.5 Subluxation 101
7.6 Pain 101
7.6.1 Shoulder pain 101
7.6.2 Central post-stroke pain 102
7.7 Swelling of the extremities 103
7.8 Loss of cardiorespiratory fitness 103
7.9 Fatigue 104
7.10 Incontinence 104
7.10.1 Urinary incontinence 104
7.10.2 Faecal incontinence 106
7.11 Mood disturbance 106
7.12 Behavioural change 108
7.13 Deep venous thrombosis or pulmonary embolism 108
7.14 Pressure care 109
7.15 Falls 110
7.16 Sleep apnoea 111

CHAPTER EIGHT
Community participation and long-term recovery 113

8.1 Self-management 113
8.2 Driving 113
8.3 Leisure 115
8.4 Return to work 115
8.5 Sexuality 115
8.6 Support 116
8.6.1 Peer support 116
8.6.2 Carer support 117

CHAPTER NINE
Cost and socioeconomic implications 119

9.1 Organisation of care 119
9.2 Specific interventions for the management of stroke 122

Appendix 1: Membership and terms of reference of working and advisory groups 127
Appendix 2: Guideline development process report 129
Appendix 3: Priorities for research 134
Appendix 4: National stroke audit 136
Appendix 5: Thrombolysis inclusion/exclusion criteria 137
Glossary and abbreviations 138
References 141
Index 166

Preface

These revised national guidelines for stroke, encompassing both acute and post-acute stroke care are the culmination of the work of hundreds of individuals, including stroke survivors and their families, who gave their time and expertise voluntarily, and we thank everyone for their efforts, particularly our peers on the expert working group.

We hope health professionals, administrators and policy makers find these guidelines a useful resource, remembering, of course, that guidelines are not a textbook; rather, they are a distillation of primary evidence which has been critically appraised and then summarised for the Australian context. If a treatment, intervention strategy or process of care is likely to be effective, we have recommended it, with a grading to reflect the reliability of the evidence and the importance of the intervention. Unfortunately, the process of guideline development does not always allow detailed comment on how best to adopt the recommended interventions in every clinical practice setting or the factors that may influence successful adoption. Where possible, the text accompanying each recommendation raises some of these issues. Clinical expertise is still an essential part of using any such guidelines.

This edition of the guidelines importantly includes new information on fatigue, goal setting, secondary prevention measures for those on hormone replacement therapy or who are using oral contraception, oral hygiene, cognitive communication deficits, behavioural change and the amount and timing of rehabilitation. Many existing topics have been significantly revised including management of transient ischaemic attack (TIA), contracture, swelling of extremities and driving.

Finally, as Co-Chairs, we would like to express our thanks to the NSF project team, Leah Wright and Kelvin Hill, for ensuring this immensely complex task was completed and to all those who have provided input to these guidelines.





Richard Lindley — Julie Bernhardt

Co-chairs Stroke Guidelines Expert Working Group

Recommendations

This section lists the recommendations presented in the guidelines along with the relevant section where the supporting evidence is discussed. Each recommendation is given an overall grading based on National Health and Medical Research Council (NHMRC) levels of evidence and grades of recommendation.[1] Where no robust Level I, II III or IV evidence was available but there was sufficient consensus within the EWG, good practice points have been provided.

In general, where the evidence is clear and trusted, or where there is consensus on the basis of clinical experience and expert opinion (Good practice point), the word "should" has been used to indicate that the intervention should be routinely carried out.

Where the evidence is less clear or where there was significant variation in opinion, the word "can" has been used. Individual patient factors should always be taken into account when considering different intervention options.

GRADE	DESCRIPTION
A	Body of evidence can be trusted to guide practice
B	Body of evidence can be trusted to guide practice in most situations
C	Body of evidence provides some support for recommendation(s) but care should be taken in its application
D	Body of evidence is weak and recommendation must be applied with caution
Good practice point (GPP)	Recommended best practice based on clinical experience and expert opinion

CHAPTER ONE **Organisation of services**

1.1 Hyper-acute care	**Grade**
Local protocols developed jointly by staff from pre-hospital emergency service, the hospital emergency department and the acute stroke team should be used fotr all people with suspected stroke. Such protocols should include systems to receive early notification by paramedic staff, high priority transportation and triage, rapid referrals from ED staff to stroke specialists and rapid access to imaging.	C [15–19, 21, 31]

1.2 Hospital care	**Grade**
1.2.1 Stroke unit care	
a) All people with stroke should be admitted to hospital and be treated in a stroke unit with a multidisciplinary team.	A [5]
b) All people with stroke should be admitted directly to a stroke unit (preferably within three hours of stroke onset).	C [37]
c) Smaller hospitals should consider stroke services that adhere as closely as possible to the criteria for stroke unit care. Where possible, patients should receive care on geographically discrete units.	B [5, 41]
d) If people with suspected stroke present to non-stroke unit hospitals, transfer protocols should be developed and used to guide urgent transfers to the nearest stroke unit hospital.	C [35, 36]

1.2.2 Ongoing inpatient rehabilitation		
a)	To ensure all stroke patients receive early, active rehabilitation by a dedicated stroke team, health systems should have comprehensive services which include and link the fundamentals of acute and rehabilitation care.	B [5, 38]
b)	Patients should be transferred to a stroke rehabilitation unit if ongoing inpatient rehabilitation is required.	B [5, 38]
c)	If a stroke rehabilitation unit is not available, patients who require ongoing inpatient rehabilitation should be transferred to a conventional rehabilitation unit where staff have stroke-specific expertise.	B [38]
d)	All patients, including those with severe stroke, who are not receiving palliative care should be assessed by the specialist rehabilitation team prior to discharge from hospital regarding their suitability for ongoing rehabilitation.	GPP
1.2.3 Care pathways		
	All stroke patients admitted to hospital should be managed using an acute care pathway.	C [46]
1.2.4 Inpatient stroke care coordinator		
	An inpatient stroke care coordinator should be used to coordinate services and assist in discharge planning.	GPP
1.2.5 Telemedicine and networks		
a)	All health services which include regional or rural centres caring for stroke patients should use networks which link large stroke specialist centres with smaller regional and rural centres.	C [48, 49]
b)	These networks should be used to help establish appropriate stroke services along with protocols governing rapid assessment, telestroke services and rapid transfers.	C [48, 49, 51]
c)	Where no on-site stroke medical specialists are available, telestroke consultation should be used to assess eligibility for acute stroke therapies and/or transfer to stroke specialist centres.	B [48–50]
d)	Telestroke can be used to improve assessment and management of rehabilitation where there is limited access to on-site stroke rehabilitation expertise.	C [48, 49]

1.3 Discharge planning and transfer of care		Grade
1.3.1 Safe transfer of care from hospital to community		
a)	Prior to hospital discharge, all patients should be assessed to determine the need for a home visit, which may be carried out to ensure safety and provision of appropriate aids, support and community services.	C [59]
b)	To ensure a safe discharge occurs, hospital services should ensure the following are completed prior to discharge:	
	• patients and families/carers have the opportunity to identify and discuss their post-discharge needs (e.g. physical, emotional, social, recreational, financial and community support) with relevant members of the multidisciplinary team	GPP
	• general practitioners, primary healthcare teams and community services are informed before or at the time of discharge	GPP
	• all medications, equipment and support services necessary for a safe discharge are organised	GPP
	• any continuing specialist treatment required is organised	GPP
	• a documented post-discharge care plan is developed in collaboration with the patient and family and a copy provided to them. This may include relevant community services, self-management strategies (e.g. information on medications and compliance advice, goals and therapy to continue at home), stroke support services, any further rehabilitation or outpatient appointments, and an appropriate contact number for any queries.	GPP
c)	A locally developed protocol may assist in implementation of a safe discharge process.	GPP
d)	A discharge planner may be used to coordinate a comprehensive discharge program for stroke survivors.	D [65]
1.3.2 Carer training		
	Relevant members of the multidisciplinary team should provide specific and tailored training for carers/family before the stroke survivor is discharged home. This should include training, as necessary, in personal care techniques, communication strategies, physical handling techniques, ongoing prevention and other specific stroke-related problems, safe swallowing and appropriate dietary modifications, and management of behaviours and psychosocial issues.	B [67]

1.4 Care after hospital discharge		Grade
1.4.1 Community rehabilitation and follow-up services		
a)	Health services with a stroke unit should provide comprehensive, experienced multidisciplinary community rehabilitation and adequately resourced support services for stroke survivors and their families/carers. If services such as the multidisciplinary community rehabilitation services and carer support services are available, then early supported discharge should be offered for all stroke patients with mild to moderate disability.	A [68, 69]
b)	Rehabilitation delivered in the home setting should be offered to all stroke survivors as needed. Where home rehabilitation is unavailable, patients requiring rehabilitation should receive centre-based care.	B [72, 73]
c)	Contact with and education by trained staff should be offered to all stroke survivors and families/carers after discharge.	C [77, 81]
d)	Stroke survivors can be managed using a case management model after discharge. If used, case managers should be able to recognise and manage depression and help to coordinate appropriate interventions via a medical practitioner.	C [89, 92]
e)	Stroke survivors should have regular and ongoing review by a member of a stroke team, including at least one specialist medical review. The first review should occur within 3 months, then again at 6 and 12 months post-discharge.	GPP
f)	Stroke survivors and their carers/families should be provided with contact information for the specialist stroke service and a contact person (in the hospital or community) for any post-discharge queries for at least the first year following discharge.	GPP

1.4.2 Long-term rehabilitation		
a)	Stroke survivors who have residual impairment at the end of the formal rehabilitation phase of care should be reviewed annually, usually by the general practitioner or rehabilitation provider to consider whether access to further interventions is needed. A referral for further assessment should be offered for relevant allied health professionals or general rehabilitation services if there are new problems not present when undertaking initial rehabilitation, or if the person's physical or social environment has changed.	GPP
b)	Stroke survivors with residual impairment identified as having further rehabilitation needs should receive therapy services to set new goals and improve task-orientated activity.	B [104, 105]
c)	Stroke survivors with confirmed difficulties in performance of personal tasks, instrumental activities, vocational activities or leisure activities should have a documented management plan updated and initiated to address these issues.	GPP
d)	Stroke survivors should be encouraged to participate long-term in appropriate community exercise programs.	C [103]

1.5 Transient ischaemic attack	Grade
All patients with suspected TIA presenting to a general practitioner or emergency department should be rapidly assessed.	
• Those identified as high risk (e.g. ABCD^2 score >3 and/or those with any one of the following: AF, carotid territory symptoms or crescendo TIA, should be admitted to a stroke unit (or where available referred to a specialist TIA clinic if the person can be assessed within 24 hours) to facilitate rapid specialist assessment and management.	C [107–110, 120, 121]
• Those identified as low risk (e.g. ABCD^2 score <4 and without AF or carotid territory symptoms or crescendo TIA should commence initial therapy (e.g. aspirin) and then be managed in the community by a general practitioner or private specialist or, where possible, be referred to a specialist TIA clinic and seen within seven days.	GPP

1.6 Standardised assessment	Grade
Clinicians should use validated and reliable assessment tools or measures that meet the needs of the patient to guide clinical decision-making.	GPP

1.7 Goal setting		Grade
a)	Stroke survivors and their families/carers who are involved in the recovery process should have their wishes and expectations established and acknowledged.	GPP
b)	Stroke survivors and their families/carers should be given the opportunity to participate in the process of setting goals unless they choose not to or are unable to participate.	B [5]
c)	Health professionals should collaboratively set goals for patient care. Goals should be prescribed, specific and challenging. They should be recorded, reviewed and updated regularly.	C [122]
d)	Stroke survivors should be offered training in self-management skills that include active problem-solving and individual goal setting.	GPP

1.8 Team meetings		Grade
	The multidisciplinary stroke team should meet regularly (at least weekly) to discuss assessment of new patients, review patient management and goals, and plan for discharge.	C [41]

1.9 Patient and carer/family support		Grade
1.9.1 Information and education		
a)	All stroke survivors and their families/carers should be offered information tailored to meet their needs using relevant language and communication formats.	A [125]
b)	Information should be provided at different stages in the recovery process.	B [125]
c)	Stroke survivors and their families/carers should be provided with routine, follow-up opportunities for clarification or reinforcement of the information provided.	B [125]
1.9.2 Family meetings		
	The stroke team should meet regularly with the patient and their family/carer to involve them in management, goal setting and planning for discharge.	C [41]
1.9.3 Counselling		
	Counselling services should be available to all stroke survivors and their families/carers and can take the form of:	
	• an active educational counselling approach	B [126]
	• information supplemented by family counselling	C [129]
	• a problem-solving counselling approach.	C [130]
1.9.4 Respite care		
	Stroke survivors and their carers/families should have access to respite care options. The respite care may be provided in their own home or in an institution.	GPP

1.10 Palliative care		Grade
a)	An accurate assessment of prognosis or imminent death should be made for patients with severe stroke or those who are deteriorating.	GPP
b)	Stroke patients and their families/carers should have access to specialist palliative care teams as needed and receive care consistent with the principles and philosophies of palliative care.	B [137]
c)	A pathway for stroke palliative care can be used to support stroke patients and their families/carers and improve care for people dying after stroke.	D [134]

1.11 Stroke service improvement		Grade
a)	All stroke services should be involved in quality improvement activities that include regular audit and feedback ('regular' is considered at least every two years).	B [141]
b)	Indicators based on nationally agreed standards of care should be used when undertaking any audit.	GPP
c)	General practitioners should keep a register (or be able to extract this from current practice datasets) which enables audit and review of relevant stroke and TIA management.	B [145]

CHAPTER TWO **Stroke recognition and pre-hospital care**

Stroke recognition and pre-hospital care		Grade
a)	The general public should receive ongoing education on how to recognise the symptoms of stroke and the importance of early medical assistance.	B [149, 151]
b)	Stroke patients should be assigned a high priority by ambulance services.	C [14–16, 26, 162]
c)	Ambulance services should use a validated rapid pre-hospital stroke-screening tool and incorporate such tools into pre-hospital assessment of people with suspected stroke.	B [31, 163–165]
d)	Health and ambulance services should develop and use prenotification systems for stroke.	C [17, 26, 162]
e)	Ambulance services should preferentially transfer suspected stroke patients to a hospital with stroke unit care.	C [13, 17, 26, 166, 167]

CHAPTER THREE **Early assessment and diagnosis**

3.1 Transient ischaemic attack		Grade
a)	All patients with suspected TIA should have a full assessment that includes a detailed history and clinical, prognostic (e.g. ABCD^2 score) and investigative tests (e.g. blood tests, brain and carotid imaging and ECG) at the initial point of healthcare contact, whether first seen in primary or secondary care.	B [109, 110, 121]
b)	Patients identified as high risk (e.g. ABCD^2 score >3 and/or any one of AF, carotid territory symptoms or crescendo TIA should undergo: • urgent brain imaging (preferably MRI with DWI), 'urgent' being immediately where available, but within 24 hours) • carotid imaging should also be undertaken urgently in patients with anterior circulation symptoms who are candidates for carotid re-vascularisation. In settings with limited access to these investigations, referral within 24 hours should be made to the nearest centre where such tests can be quickly conducted.	B [121, 184, 186, 193, 194]
c)	Patients classified as low-risk (e.g. ABCD^2 score <4 without AF or carotid territory symptoms or who present more than one week after last symptoms should have brain and carotid imaging (where indicated) as soon as possible (i.e. within 48 hours).	B [121, 185, 193, 194]
d)	The following investigations should be undertaken routinely for all patients with suspected TIA: full blood count, electrolytes, erythrocyte sedimentation rate (ESR), renal function, lipid profile, glucose level, and ECG.	GPP

3.2 Rapid assessment in the emergency department		Grade
a)	Initial diagnosis should be reviewed by a clinician experienced in the evaluation of stroke.	C [195, 199, 200]
b)	Emergency department staff should use a validated stroke screening tool to assist in rapid accurate assessment for all people with stroke.	C [204, 205]
c)	Stroke severity should be assessed and recorded on admission by a trained clinician using a validated tool (e.g. NIHSS or SSS).	C [201, 203, 206]

3.3 Imaging		Grade
a)	All patients with suspected stroke should have an urgent brain CT or MRI ('urgent' being immediately where facilities are available but within 24 hours). Patients who are candidates for thrombolysis should undergo brain imaging immediately.	A [185, 207]
b)	A repeat brain CT or MRI and acute medical review should be considered urgently when a patient's condition deteriorates.	GPP
c)	All patients with carotid territory symptoms who would potentially be candidates for carotid re-vascularisation should have urgent carotid imaging.	B [193, 209, 213]
d)	Further brain, cardiac or carotid imaging should be undertaken in selected patients: • where initial assessment has not identified the likely source of the ischaemic event • with a history of more than one TIA • likely to undergo carotid surgery.	B [193, 194]

3.4 Investigations		Grade
a)	The following investigations should be routinely carried out in all patients with suspected stroke: full blood count, electrocardiogram, electrolytes, renal function, fasting lipids, erythrocyte sedimentation rate and/or C-reactive protein and glucose.	GPP
b)	Selected patients may require the following additional investigations: catheter angiography, chest X-ray, syphilis serology, vasculitis screen and prothrombotic screen. These tests should be performed as soon as possible after stroke onset. Some of these tests may need to be performed as an emergency procedure in certain patients.	GPP

CHAPTER FOUR **Acute medical and surgical management**

4.1 Thrombolysis		Grade
a)	Intravenous rt-PA in acute ischaemic stroke should only be undertaken in patients satisfying specific inclusion and exclusion criteria.	A [12]
b)	Intravenous rt-PA should be given as early as possible in carefully selected patients with acute ischaemic stroke as the effect size of thrombolysis is time-dependent. Where possible, therapy should commence in the first few hours but may be used up to 4.5 hours after stroke onset.	A [12, 223]
c)	Intravenous rt-PA should only be given under the authority of a physician trained and experienced in acute stroke management.	B [12]
d)	Thrombolysis should only be undertaken in a hospital setting with appropriate infrastructure, facilities and network support including:	
	• access to an multidisciplinary acute care team with expert knowledge of stroke management who are trained in delivery and monitoring of patients receiving thrombolytic therapy	GPP
	• pathways and protocols available to guide medical, nursing and allied health acute phase management, in particular acute blood pressure management	C [224, 227 234]
	• immediate access to imaging facilities and staff trained to interpret images.	GPP
e)	A minimum set of de-identified data from all patients treated with thrombolysis should be recorded in a central register to allow monitoring, review, comparison and benchmarking of key outcomes measures over time.	C [225]
f)	The commencement of aspirin for patients who have received thrombolysis should be delayed for 24 hours (usually after a follow-up scan has excluded significant bleeding).	GPP

4.2 Neurointervention		Grade
a)	Intra-arterial (IA) thrombolysis within six hours can be used in carefully selected patients.	B [12]
b)	Each large tertiary centre should consider establishing facilities and systems for IA thrombolysis.	GPP
c)	There is insufficient evidence to recommend the use of mechanical clot removal in routine clinical practice. Consideration should be given to enrolling patients in a suitable clinical trial evaluating this intervention.	GPP

4.3 Antithrombotic therapy		Grade
a)	Aspirin orally or via a nasogastric tube or suppository (for those with dysphagia) should be given as soon as possible after the onset of stroke symptoms (i.e. within 48 hours) if CT/MRI scans exclude haemorrhage. The first dose should be at least 150 to 300 mg. Dosage thereafter can be reduced (e.g. 100 mg daily).	A [246]
b)	The routine use of early anticoagulation in unselected patients following ischaemic stroke/TIA is NOT recommended.	A [247]

4.4 Acute phase blood pressure lowering therapy		Grade
a)	In ischaemic stroke, if blood pressure is more than 220/120 mmHg, antihypertensive therapy can be started or increased, but blood pressure should be cautiously reduced (e.g. by no more than 10–20%) and the patient monitored for signs of neurological deterioration.	GPP
b)	In acute primary intracerebral haemorrhage where severe hypertension is observed on several occasions within the first 24 to 48 hours of stroke onset, antihypertensive therapy (that could include intravenous treatment) can be used to maintain a blood pressure below 180 mmHg systolic (mean arterial pressure of 130 mmHg).	GPP
c)	Pre-existing antihypertensive therapy can be continued (orally or via nasogastric tube) provided there is no symptomatic hypotension or other reason to withhold treatment.	GPP

4.5 Surgery for ischaemic stroke and management of cerebral oedema		Grade
a)	Selected patients (18–60 years, where surgery can occur within 48 hours of symptom onset) and with large middle cerebral artery infarction should be urgently referred to a neurosurgeon for consideration of decompressive hemicraniectomy.	A [256]
b)	Corticosteroids are NOT recommended for management of patients with brain oedema and raised intracranial pressure.	A [258]
c)	Osmotherapy and hyperventilation can be trialled while a neurosurgical consultation is undertaken, or in patients whose condition is deteriorating due to raised intracranial pressure.	C [259, 261]

4.6 Intracerebral haemorrhage management		Grade
a)	The use of haemostatic drug treatment with rFVIIa is currently considered experimental and is NOT recommended for use outside a clinical trial.	B [264]
b)	In patients with ICH who were receiving anticoagulation therapy prior to the stroke and who have elevated INR, therapy to reverse anticoagulation should be initiated rapidly e.g. using a combination of prothrombin complex concentrate and vitamin K.	D [268, 269]
c)	Patients with supratentorial ICH should be referred for neurosurgical review if they have hydrocephalus.	GPP
d)	Surgery for supratentorial haemorrhage can be considered in carefully selected patients. If undertaken, surgery should be performed within 72 hours. The strongest evidence for benefit with surgery is for patients aged <85, a Glasgow Coma Score of 5–15 having altered consciousness or severe neurological deficit and presenting within 24 hours.	C [272]
e)	Surgical evacuation may be undertaken for cerebellar hemisphere haematomas >3 cm diameter in selected patients.	GPP

4.7 Physiological monitoring		Grade
	Patients should have their neurological status (e.g. Glasgow Coma Scale), vital signs (including pulse, blood pressure, temperature, oxygen saturation, and glucose levels) and respiratory pattern monitored and documented regularly during the acute phase, the frequency of such observations being determined by the patient's status.	C [277–280]

4.8 Oxygen therapy		Grade
a)	Patients who are hypoxic (i.e. <95% oxygen saturation) should be given supplemental oxygen.	GPP
b)	The routine use of supplemental oxygen is NOT recommended in acute stroke patients who are not hypoxic.	C [282]

4.9 Glycaemic control		Grade
a)	On admission, all patients should have their blood glucose level monitored and appropriate glycaemic therapy instituted to ensure euglycaemia, especially if the patient is diabetic.	GPP
b)	An early intensive approach to the maintenance of euglycaemia is currently NOT recommended.	B [296]

4.10 Neuroprotection		Grade
a)	Putative neuroprotectors (including hypothermic cooling) should only be used in a randomised controlled trial.	A [302, 305, 315, 320, 321]
b)	Patients with acute ischaemic stroke who were receiving statins prior to admission can continue statin treatment.	B [317]

4.11 Pyrexia		Grade
	Antipyretic therapy, comprising regular paracetamol and/or physical cooling measures, should be used routinely where fever occurs.	C [316, 324]

4.12 Seizure management		Grade
	Anti-convulsant medication should be used for people with recurrent seizures after stroke.	GPP

4.13 Complementary and alternative therapy		Grade
a)	The routine use of the following complementary and alternative therapies is NOT recommended:	
	• acupuncture	B [334]
	• traditional Chinese herbal medicines.	B [335, 337–339, 341–344]
b)	Health professionals should be aware of different forms of complementary and alternative therapies and be prepared to discuss these with stroke survivors and their families/carers.	GPP

CHAPTER FIVE **Secondary prevention**

5.1 Lifestyle modification		Grade
a)	Every stroke patient should be assessed and informed of their risk factors for a further stroke and possible strategies to modify identified risk factors. The risk factors and interventions include:	
	• stopping smoking: nicotine replacement therapy, bupropion or nortriptyline therapy, nicotine receptor partial agonist therapy and/or behavioural therapy	A [354–359]
	• improving diet: a diet low in fat (especially saturated fat) and sodium but high in fruit and vegetables	A [361, 363, 364, 366–369]
	• increasing regular exercise	C [377, 378]
	• avoiding excessive alcohol (i.e. no more than two standard drinks per day).	C [387, 388]
b)	Interventions should be individualised and delivered using behavioural techniques such as educational or motivational counselling.	A [356, 357, 359, 391]

5.2 Adherence to pharmacotherapy		Grade
	Interventions to promote adherence with medication regimes are often complex and should include combinations of the following:	
	• reminders, self-monitoring, reinforcement, counselling, family therapy, telephone follow-up, supportive care and dose administration aids	B [395, 396]
	• information and education in hospital and in the community.	B [395, 397]

5.3 Blood pressure lowering		Grade
a)	All stroke and TIA patients, whether normotensive or hypertensive, should receive blood pressure lowering therapy, unless contraindicated by symptomatic hypotension.	A [399]
b)	New blood pressure lowering therapy should commence before discharge for those with stroke or TIA, or soon after TIA if the patient is not admitted.	B [402, 403]

5.4 Antiplatelet therapy		Grade
a)	Long-term antiplatelet therapy should be prescribed to all people with ischaemic stroke or TIA who are not prescribed anticoagulation therapy.	A [404]
b)	Low-dose aspirin and modified release dipyridamole or clopidogrel alone should be prescribed to all people with ischaemic stroke or TIA, taking into consideration patient co-morbidities.	A [411]
c)	Aspirin alone can be used, particularly in people who do not tolerate aspirin plus dipyridamole or clopidogrel.	A [404]
d)	The combination of aspirin plus clopidogrel is NOT recommended for the secondary prevention of cerebrovascular disease in people who do not have acute coronary disease or recent coronary stent.	A [412, 413]

5.5 Anticoagulation therapy		Grade
a)	Anticoagulation therapy for secondary prevention for people with ischaemic stroke or TIA from presumed arterial origin should NOT be routinely used.	A [415]
b)	Anticoagulation therapy for long-term secondary prevention should be used in people with ischaemic stroke or TIA who have atrial fibrillation or cardioembolic stroke.	A [416, 417]
c)	In stroke patients, the decision to begin anticoagulation therapy can be delayed for up to two weeks but should be made prior to discharge.	C [389]
d)	In patients with TIA, anticoagulation therapy should begin once CT or MRI has excluded intracranial haemorrhage as the cause of the current event.	GPP

5.6 Cholesterol lowering		Grade
a)	Therapy with a statin should be used for all patients with ischaemic stroke or TIA.	A [430, 431]
b)	Statins should NOT be used routinely for haemorrhagic stroke.	B [430, 431]

5.7 Carotid surgery		Grade
a)	Carotid endarterectomy should be undertaken in patients with non-disabling carotid artery territory ischaemic stroke or TIA with ipsilateral carotid stenosis measured at 70–99% (NASCET criteria) only if it can be performed by a specialist surgeon with low rates (<6%) of peri-operative mortality/morbidity.	A [433, 435, 438]
b)	Carotid endarterectomy can be undertaken in highly selected ischaemic stroke or TIA patients (considering age, gender and co-morbidities) with symptomatic carotid stenosis of 50–69% (NASCET criteria) or asymptomatic carotid stenosis >60% (NASCET criteria) only if it can be performed by a specialist surgeon with very low rates (<3%) of peri-operative mortality/morbidity.	A [435, 438, 440]
c)	Eligible stable patients should undergo carotid endarterectomy as soon as possible after the stroke event (ideally within two weeks).	A [437]
d)	Carotid endarterectomy should only be performed by a specialist surgeon in centres where outcomes of carotid surgery are routinely audited.	B [438, 443]
e)	Carotid endarterectomy is NOT recommended for those with symptomatic stenosis <50% (NASCET criteria) or asymptomatic stenosis < 60% (NASCET criteria).	A [438, 440]
f)	Carotid stenting should NOT routinely be undertaken for patients with carotid stenosis.	A [435, 436]

5.8 Diabetes management		Grade
	Patients with glucose intolerance or diabetes should be managed in line with national guidelines for diabetes.	GPP

5.9 Patent foramen ovale		Grade
a)	All patients with ischaemic stroke or TIA, and a PFO should receive antiplatelet therapy as first choice.	C [453]
b)	Anticoagulation therapy can also be considered taking into account other risk factors and the increased risk of harm.	C [453]
c)	There is insufficient evidence to recommend PFO closure.	GPP

5.10 Hormone replacement therapy	Grade
Following a stroke event, HRT should be stopped. The decision whether to start or continue HRT in patients with a history of previous stroke or TIA should be discussed with the individual patient and based on an overall assessment of risk and benefit.	B [458–461]

5.11 Oral contraception	Grade
The decision whether to start or continue oral contraception in women of child-bearing age with a history of stroke should be discussed with the individual patient and based on an overall assessment of risk and benefit. Non-hormonal methods of contraception should be considered.	C [462, 463, 465]

CHAPTER SIX **Rehabilitation**

6.1 Amount, intensity and timing of rehabilitation		Grade
6.1.1 Amount and intensity of rehabilitation		
a)	Rehabilitation should be structured to provide as much practice as possible within the first six months after stroke.	A [470]
b)	For patients undergoing active rehabilitation, as much physical therapy (physiotherapy and occupational therapy) should be provided as possible with a minimum of one hour active practice per day at least five days a week.	GPP
c)	Task-specific circuit class training or video self-modelling should be used to increase the amount of practice in rehabilitation.	B [471, 472]
d)	For patients undergoing active rehabilitation, as much therapy for dysphagia or communication difficulties should be provided as they can tolerate.	C [475, 477–479]
e)	Patients should be encouraged by staff members, with the help of their family and/or friends if appropriate, to continue to practice skills they learn in therapy sessions throughout the remainder of the day.	GPP
6.1.2 Timing of rehabilitation		
a)	Patients should be mobilised as early and as frequently as possible.	B [482]
b)	Treatment for aphasia should be offered as early as tolerated.	B [478]
c)	Upper limb training should commence early. CIMT is one approach that may be useful in the first week after stroke.	C [474]

6.2 Sensorimotor impairment		Grade
6.2.1 Dysphagia		
a)	Patients should be screened for swallowing deficits before being given food, drink or oral medications. Personnel specifically trained in swallowing screening using a validated tool should undertake screening.	B [494, 495]
b)	Swallowing should be screened for as soon as possible but at least within 24 hours of admission.	GPP
c)	The gag reflex is not a valid screen for dysphagia and should NOT be used as a screening tool.	B [496, 497]
d)	Patients who fail the swallowing screening should be referred to a speech pathologist for a comprehensive assessment. This may include instrumental examination e.g. VMBS &/or FEES. Special consideration should be given to assessing and managing appropriate hydration. These assessments can also be used for monitoring during rehabilitation.	GPP
e)	Compensatory strategies such as positioning, therapeutic manoeuvres or modification of food and fluids to facilitate safe swallowing should be provided for people with dysphagia based on specific impairments identified during comprehensive swallow assessment.	B [479]
f)	One or more of the following methods can be provided to facilitate resolution of dysphagia:	
	• therapy targeting specific muscle groups (e.g. 'Shaker' therapy)	C [516, 517]
	• thermo-tactile stimulation	C [511, 513, 515]
	• electrical stimulation if it is delivered by clinicians experienced with this intervention, applied according to published parameters and employing a research or quality framework.	C [512]
g)	Dysphagic patients on modified diets should have their intake and tolerance to diet monitored. The need for continued modified diet should be regularly reviewed.	GPP
h)	Patients with persistent weight loss and recurrent chest infections should be urgently reviewed.	GPP
i)	All staff and carers involved in feeding patients should receive appropriate training in feeding and swallowing techniques.	GPP
6.2.2 Weakness		
	One or more of the following interventions should be used for people with reduced strength:	
	• progressive resistance exercises	B [519, 520, 522]
	• electrical stimulation	B [519, 521]
	• electromyographic biofeedback in conjunction with conventional therapy.	C [519]
6.2.3 Loss of sensation		
a)	Sensory-specific training can be provided to stroke survivors who have sensory loss.	C [524–527]
b)	Sensory training designed to facilitate transfer can also be provided to stroke survivors who have sensory loss.	C [530]

6.2.4 Visual field loss		
a)	Stroke survivors who appear to have difficulty with recognising objects or people should be screened using specific assessment tools, and if a visual deficit is found, referred for comprehensive assessment by relevant health professionals.	GPP
b)	Fresnel Prism glasses (15-diopter) can be used to improve visual function in people with homonymous hemianopia.	C [537]
c)	Computer-based visual restitution training can be used to improve visual function in people with visual field deficits.	C [538]

6.3 Physical activity		**Grade**
6.3.1 Sitting		
	Practising reaching beyond arm's length while sitting with supervision/assistance should be undertaken by people who have difficulty sitting.	B [542, 543]
6.3.2 Standing up		
	Practising standing up should be undertaken by people who have difficulty in standing up from a chair.	A [487, 548]
6.3.3 Standing		
	Task-specific standing practice with feedback can be provided for people who have difficulty standing.	B [487, 549, 550]
6.3.4 Walking		
a)	People with difficulty walking should be given the opportunity to undertake tailored, repetitive practice of walking (or components of walking) as much as possible.	A [487)]
b)	One or more of the following interventions can be used in addition to conventional walking training outlined in (a):	
	• cueing of cadence	B [548]
	• mechanically-assisted gait (via treadmill or automated mechanical or robotic device)	B [553]
	• joint position biofeedback	C [548]
	• virtual reality training.	C [569–573]
c)	Ankle-foot orthoses, which should be individually fitted, can be used for people with persistent drop foot.	C [560–568]

6.3.5 Upper limb activity		
a)	People with difficulty using their upper limb(s) should be given the opportunity to undertake as much tailored practice of upper limb activity (or components of such tasks) as possible. Interventions which can be used routinely include:	
	• constraint-induced movement therapy in selected people	A [548]
	• repetitive task-specific training	B [487]
	• mechanical assisted training.	B [586]
b)	One or more of the following interventions can be used in addition to those listed above:	
	• mental practice	B [548]
	• EMG biofeedback in conjunction with conventional therapy	C [548, 584]
	• electrical stimulation	C [548]
	• mirror therapy	C [587–589]
	• bilateral training.	C [578]

6.4 Activities of daily living (ADL)		Grade
a)	Patients with difficulties in performance of daily activities should be assessed by a trained clinician.	A [98, 602]
b)	Patients with confirmed difficulties in personal or extended ADL should have specific therapy (e.g. task-specific practice and trained use of appropriate aids) to address these issues.	B [98, 603]
c)	Staff members and the stroke survivor and their carer/family should be advised regarding techniques and equipment to maximise outcomes relating to performance of daily activities and sensorimotor, perceptual and cognitive capacities.	GPP
d)	People faced with difficulties in community transport and mobility should set individualised goals and undertake tailored strategies such as multiple (i.e. up to seven) escorted outdoor journeys (which may include practice crossing roads, visits to local shops, bus or train travel), help to resume driving, aids and equipment, and written information about local transport options/alternatives.	B [604]
e)	Administration of amphetamines to improve ADL is NOT recommended.	B [605, 606]
f)	The routine use of acupuncture alone or in combination with traditional herbal medicines is NOT recommended in stroke rehabilitation.	B [334, 340, 607]

6.5 Communication		Grade
6.5.1 Aphasia		
a)	All patients should be screened for communication deficits using a screening tool that is valid and reliable.	C [608]
b)	Those patients with suspected communication difficulties should receive formal, comprehensive assessment by a specialist clinician.	GPP
c)	Where a patient is found to have aphasia, the clinician should:	
	• document the provisional diagnosis	GPP
	• explain and discuss the nature of the impairment with the patient, family/carers and treating team, and discuss and teach strategies or techniques which may enhance communication	GPP
	• in collaboration with the patient and family/carer, identify goals for therapy and develop and initiate a tailored intervention plan. The goals and plans should be reassessed at appropriate intervals over time.	GPP
d)	All written information on health, aphasia, social and community supports (such as that available from the Australian Aphasia Association or local agencies) should be available in an aphasia-friendly format.	D [615, 616]
e)	Alternative means of communication (such as gesture, drawing, writing, use of augmentative and alternative communication devices) should be used as appropriate.	GPP
f)	Interventions should be individually tailored but can include:	
	• treatment of aspects of language (including phonological and semantic deficits, sentence-level processing, reading and writing) following models derived from cognitive neuropsychology	C [320]
	• constraint-induced language therapy	B [476]
	• the use of gesture	D [321]
	• supported conversation techniques	C [617, 618]
	• delivery of therapy programs via computer.	C [612]
g)	The routine use of piracetam is NOT recommended.	B [621]
h)	Group therapy and conversation groups can be used for people with aphasia and should be available in the longer term for those with chronic and persisting aphasia.	C [619]
i)	People with chronic and persisting aphasia should have their mood monitored.	GPP
j)	Environmental barriers facing people with aphasia should be addressed through training communication partners, raising awareness of and educating about aphasia in order to reduce negative attitudes, and promoting access and inclusion by providing aphasia-friendly formats or other environmental adaptations. People with aphasia from culturally and linguistically diverse backgrounds may need special attention, for example, from trained healthcare interpreters.	GPP
k)	The impact of aphasia on functional activities, participation and quality of life, including the impact upon relationships, vocation and leisure, should be assessed and addressed as appropriate from early post-onset and over time for those chronically affected.	GPP

6.5.2 Dyspraxia of speech		
a)	Patients with suspected dyspraxia of speech should receive comprehensive assessment.	GPP
b)	Interventions for speech motor skills should be individually tailored and can target articulatory placement and transitioning, speech rate and rhythm, increasing length and complexity of words and sentences, and prosody including lexical, phrasal, and contrastive stress production. In addition, therapy can incorporate:	
	• integral stimulation approach with modelling, visual cueing, and articulatory placement cueing	D [623]
	• principles of motor learning to structure practice sessions (e.g. order in which motor skills are practised during a session, degree of variation and complexity of behaviours practised, intensity of practice sessions) and delivery of feedback on performance and accuracy	D [624–626]
	• PROMPT therapy.	D [623]
c)	The use of augmentative and alternative communication modalities such as gesture or speech-generating devices is recommended for functional activities.	D [623]
6.5.3 Dysarthria		
a)	Patients with unclear or unintelligible speech should be assessed to determine the nature and cause of the speech impairment.	GPP
b)	Interventions for the treatment of dysarthria can include:	
	• biofeedback or a voice amplifier to change intensity and increase loudness	D [628, 629]
	• intensive therapy aiming to increase loudness (e.g. Lee Silverman Voice Treatment)	D [630]
	• the use of strategies such as decreased rate, over-articulation or gesture	GPP
	• oral musculature exercises.	GPP
c)	People with severe dysarthria can benefit from using augmentative and alternative communication devices in everyday activities.	GPP
6.5.4 Cognitive communication deficits		
	Stroke patients with cognitive involvement who have difficulties in communication should have a comprehensive assessment, a management plan developed and family education, support and counselling as required.	GPP

6.6 Cognition		**Grade**
6.6.1 Assessment of cognition		
a)	All patients should be screened for cognitive and perceptual deficits using validated and reliable screening tools.	GPP
b)	Patients identified during screening as having cognitive deficits should be referred for comprehensive clinical neuropsychological investigations.	GPP

6.6.2 Attention and concentration		
	Cognitive rehabilitation can be used in stroke survivors with attention and concentration deficits.	C [648, 650, 651]
6.6.3 Memory		
	Any patient found to have memory impairment causing difficulties in rehabilitation or adaptive functioning should:	
	• be referred for a more comprehensive assessment of their memory abilities	GPP
	• have their nursing and therapy sessions tailored to use techniques which capitalise on preserved memory abilities	GPP
	• be assessed to see if compensatory techniques to reduce their disabilities, such as notebooks, diaries, audiotapes, electronic organisers and audio alarms, are useful	D [653]
	• be taught approaches aimed at directly improving their memory	GPP
	• have therapy delivered in an environment as like the patient's usual environment as possible to encourage generalisation.	GPP
6.6.4 Executive functions		
a)	Patients considered to have problems associated with executive functioning deficits should be formally assessed using reliable and valid tools that include measures of behavioural symptoms.	GPP
b)	External cues, such as a pager, can be used to initiate everyday activities in stroke survivors with impaired executive functioning.	C [653]
c)	In stroke survivors with impaired executive functioning, the way in which information is provided should be considered.	C [655]
6.6.5 Limb apraxia		
a)	People with suspected difficulties executing tasks but who have adequate limb movement should be screened for apraxia and, if indicated, complete a comprehensive assessment.	GPP
b)	For people with confirmed apraxia, tailored interventions (e.g. strategy training) can be used to improve ADL.	C [657, 658]
6.6.6 Agnosia		
	The presence of agnosia should be assessed by appropriately trained personnel and communicated to the stroke team.	GPP
6.6.7 Neglect		
a)	Any patient with suspected or actual neglect or impairment of spatial awareness should have a full assessment using validated assessment tools.	C [660, 661]
b)	Patients with unilateral neglect can be trialled with one or more of the following interventions:	
	• simple cues to draw attention to the affected side	GPP
	• visual scanning training in addition to sensory stimulation	C [662, 663]
	• prism adaptation	C [665]
	• eye patching	C [662, 664]
	• mental imagery training or structured feedback.	D [662]

CHAPTER SEVEN **Managing complications**

7.1 Nutrition and hydration		Grade
a)	All stroke patients should have their hydration status assessed, monitored and managed. Appropriate fluid supplementation should be used to treat or prevent dehydration.	B [666, 667, 669, 679, 681]
b)	All patients with stroke should be screened for malnutrition.	B [670, 686]
c)	Patients who are at risk of malnutrition, including those with dysphagia, should be referred to a dietitian for assessment and ongoing management.	GPP
d)	Screening and assessment of nutritional status should include the use of validated nutritional assessment tools or measures.	B [675]
e)	Nutritional supplementation should be offered to people whose nutritional status is poor or deteriorating.	A [682]
f)	Nasogastric tube feeding is the preferred method during the first month post-stroke for people who do not recover a functional swallow.	B [687]
g)	Food intake should be monitored for all people with acute stroke.	GPP

7.2 Poor oral hygiene		Grade
a)	All patients, particularly those with swallowing difficulties, should have assistance and/or education to maintain good oral and dental (including dentures) hygiene.	GPP
b)	Staff or carers responsible for the care of patients disabled by stroke (in hospital, in residential care and in home care settings) can be trained in assessment and management of oral hygiene.	C [691]

7.3 Spasticity		Grade
a)	Interventions to decrease spasticity other than an early comprehensive therapy program should NOT be routinely provided for people who have mild to moderate spasticity (i.e. spasticity that does not interfere with a stroke survivor's activity or personal care).	GPP
b)	In stroke survivors who have persistent moderate to severe spasticity (i.e. spasticity that interferes with activity or personal care):	
	• botulinum toxin A should be trialled in conjunction with rehabilitation therapy which includes setting clear goals	B [696–698]
	• electrical stimulation and/or EMG biofeedback can be used.	C [344, 712–714]

7.4 Contracture		Grade
a)	Conventional therapy (i.e. early tailored interventions) should be provided for stroke survivors at risk of or who have developed contracture.	GPP
b)	For stroke survivors at risk of or who have developed contractures and are undergoing comprehensive rehabilitation, the routine use of splints or prolonged positioning of muscles in a lengthened position is NOT recommended.	B [724, 725, 727, 730, 733–735, 740]
c)	Overhead pulley exercise should NOT be used routinely to maintain range of motion of the shoulder.	C [736]
d)	Serial casting can be used to reduce severe, persistent contracture when conventional therapy has failed.	GPP

7.5 Subluxation		Grade
a)	For people with severe weakness who are at risk of developing a subluxed shoulder, management should include one or more of the following interventions:	
	• electrical stimulation	B [741]
	• firm support devices	GPP
	• education and training for the patient, family/carer and clinical staff on how to correctly handle and position the affected upper limb.	GPP
b)	For people who have developed a subluxed shoulder, management may include firm support devices to prevent further subluxation.	C [729]

7.6 Pain		Grade
7.6.1 Shoulder pain		
a)	For people with severe weakness who are at risk of developing shoulder pain, management may include:	
	• shoulder strapping	B [729, 752]
	• interventions to educate staff, carers and people with stroke about preventing trauma.	GPP
b)	For people who develop shoulder pain, management should be based on evidence-based interventions for acute musculoskeletal pain.	GPP
c)	The routine use of the following interventions is NOT recommended for people who have already developed shoulder pain:	
	• corticosteroid injections	C [753]
	• ultrasound.	C [758]
7.6.2 Central post-stroke pain		
a)	People with stroke found to have unresolved CPSP should receive a trial of:	
	• tricyclic antidepressants e.g. amitriptyline first, followed by other tricyclic agents or venlafaxine	B [761]
	• anticonvulsants e.g. carbamazepine.	C [771]
b)	Any patient whose CPSP is not controlled within a few weeks should be referred to a specialist pain management team.	GPP

7.7 Swelling of the extremities		Grade
a)	For people who are immobile, management can include the following interventions to prevent swelling in the hand and foot:	
	• dynamic pressure garments	C [715]
	• electrical stimulation	C [772]
	• elevation of the limb when resting.	GPP
b)	For people who have swollen extremities, management can include the following interventions to reduce swelling in the hand and foot:	
	• dynamic pressure garments	C [715]
	• electrical stimulation	C [772]
	• continuous passive motion with elevation	D [774]
	• elevation of the limb when resting.	GPP

7.8 Loss of cardiorespiratory fitness		Grade
a)	Rehabilitation should include interventions aimed at increasing cardiorespiratory fitness once patients have sufficient strength in the large lower limb muscle groups.	A [379, 776]
b)	Patients should be encouraged to undertake regular, ongoing fitness training.	GPP

7.9 Fatigue		Grade
a)	Therapy for stroke survivors with fatigue should be organised for periods of the day when they are most alert.	GPP
b)	Stroke survivors and their families/carers should be provided with information and education about fatigue including potential management strategies such as exercise, establishing good sleep patterns, and avoidance of sedating drugs and excessive alcohol.	GPP

7.10 Incontinence		Grade
7.10.1 Urinary incontinence		
a)	All stroke survivors with suspected urinary continence difficulties should be assessed by trained personnel using a structured functional assessment.	B [780, 781]
b)	A portable bladder ultrasound scan should be used to assist in diagnosis and management of urinary incontinence.	B [780]
c)	Stroke survivors with confirmed continence difficulties should have a continence management plan formulated, documented, implemented and monitored.	C [781]
d)	The use of indwelling catheters should be avoided as an initial management strategy except in acute urinary retention.	GPP
e)	A community continence management plan should be developed with the stroke survivor and family/carer prior to discharge and should include information on accessing continence resources and appropriate review in the community.	GPP
f)	If incontinence persists the stroke survivor should be re-assessed and referred for specialist review.	GPP
g)	For people with urge incontinence:	
	• anticholinergic drugs can be trialled	B [783, 784]
	• a prompted or scheduled voiding regime program/ bladder retraining should be trialled	GPP
	• if continence is unachievable, containment aids can assist with social continence.	GPP
h)	For people with urinary retention:	
	• The routine use of indwelling catheters is NOT recommended. However if urinary retention is severe, intermittent catheterisation should be used to assist bladder emptying during hospitalisation. If retention continues, intermittent catheterisation is preferable to indwelling catheterisation.	GPP
	• If using intermittent catheterisation, a closed sterile catheterisation technique should be used in hospital.	C [791]
	• Where management of chronic retention requires catheterisation, consideration should be given to the choice of appropriate route, urethral or suprapubic.	GPP
	• If a stroke survivor is discharged with either intermittent or in-dwelling catheterisation, they and their family/carer will require education about management, where to access supplies and who to contact in case of problems.	GPP
i)	For people with functional incontinence, a whole-team approach is recommended.	GPP
7.10.2 Faecal incontinence		
a)	All stroke survivors with suspected faecal continence difficulties should be assessed by trained personnel using a structured functional assessment.	B [793]
b)	For those with constipation or faecal incontinence, a full assessment (including a rectal examination) should be carried out and appropriate management of constipation, faecal overflow or bowel incontinence established and targeted education provided.	B [793]
c)	Bowel habit retraining using type and timing of diet and exploiting the gastro-colic reflex should be used for people who have bowel dysfunction.	C [794]
d)	If continence is unachievable, containment aids can assist with social continence.	GPP
e)	Education and careful discharge planning and preparation are required for any patient discharged with bowel incontinence.	GPP

7.11 Mood disturbance		Grade
Identification		
a)	All patients should be screened for depression using a validated tool.	GPP
b)	Patients with suspected altered mood (e.g. depression, anxiety, emotional lability) should be assessed by trained personnel using a standardised and validated scale.	B [800, 801, 805]
c)	Diagnosis should only be made following clinical interview.	GPP
Prevention		
d)	Psychological strategies (e.g. problem solving, motivational interviewing) can be used to prevent depression after stroke.	B [806]
e)	Routine use of antidepressants to prevent post-stroke depression is NOT recommended.	B [806]
Intervention		
f)	Antidepressants can be used for stroke patients who are depressed (following due consideration of the benefit and risk profile for the individual) and for those with emotional lability.	B [807]
g)	Psychological (cognitive-behavioural) intervention can be used for stroke patients who are depressed.	B [807]

7.12 Behavioural change		Grade
a)	The impact of chronic behavioural changes (irritability, aggression, perseveration, adynamia/ apathy, emotional lability, disinhibition and impulsivity) on functional activities, participation and quality of life, including the impact on relationships, employment and leisure, should be assessed and addressed as appropriate over time.	GPP
b)	Stroke survivors and their families/carers should be given access to individually tailored interventions for personality and behavioural changes e.g. participation in anger-management therapy and rehabilitation training and support in management of complex and challenging behaviour.	GPP

7.13 Deep venous thrombosis or pulmonary embolism		Grade
a)	Early mobilisation and adequate hydration should be encouraged in all acute stroke patients to help prevent DVT and PE.	GPP
b)	Antiplatelet therapy should be used for people with ischaemic stroke to help prevent DVT/PE.	A [240]
c)	Low molecular weight heparin or heparin in prophylactic doses can be used with caution for selected patients with acute ischaemic stroke at high risk of DVT/PE. If low molecular weight heparin is contraindicated or not available, unfractionated heparin should be used.	B [247, 829]
d)	Antithrombotic therapy is NOT recommended for the prevention of DVT/PE in haemorrhagic stroke patients.	GPP
e)	Thigh-length antithrombotic stockings are NOT recommended for the prevention of DVT/PE post-stroke.	B [831]

7.14 Pressure care		Grade
a)	All stroke survivors at risk (e.g. stroke severity, reduced mobility, diabetes, incontinence and nutritional status) should have a pressure care risk assessment and regular evaluation completed by trained personnel.	GPP
b)	All stroke survivors assessed as high risk should be provided with appropriate pressure-relieving aids and strategies, including a pressure-relieving mattress as an alternative to a standard hospital mattress.	B [832]

7.15 Falls		Grade
a)	Falls risk assessment should be undertaken using a valid tool on admission to hospital. A management plan should be initiated for all those identified as at risk of falls.	GPP
b)	Multifactorial interventions in the community, including an individually prescribed exercise program, should be provided for people who are at risk of falling.	B [61]

7.16 Sleep apnoea		Grade
	CPAP or oral devices should be used for stroke survivors with sleep apnoea.	B [854, 858]

CHAPTER EIGHT **Community participation and long-term recovery**

8.1 Self-management		Grade
a)	Stroke survivors who are cognitively able should be made aware of the availability of generic self-management programs before discharge from hospital and be supported to access such programs once they have returned to the community.	C [863, 867]
b)	Stroke-specific programs for self-management should be provided for those who require more specialised programs.	GPP
c)	A collaboratively developed self-management care plan can be used to harness and optimise self-management skills.	GPP

8.2 Driving		Grade
a)	All patients admitted to hospital should be asked if they intend to drive again.	GPP
b)	Any patient who does wish to drive should be given information about driving after stroke and be assessed for fitness to return to driving using the national guidelines (*Assessing Fitness To Drive)* and relevant state guidelines. Patients should be informed that they are required to report their condition to the relevant driver licence authority and notify their car insurance company before returning to driving.	GPP
c)	Stroke survivors should not return to driving for at least one month post event. A follow-up assessment (normally undertaken by a GP or specialist) should be conducted prior to driving to assess suitability. Patients with TIA should be instructed not to drive for two weeks.	GPP
d)	If a person is deemed medically fit but is required to undertake further testing, they should be referred for an occupational therapy driving assessment. Relevant health professionals should discuss the results of the test and provide a written record of the decision to the patient as well as informing the GP.	GPP

8.3 Leisure	Grade
Targeted occupational therapy programs can be used to increase participation in leisure activities.	A [603]

8.4 Return to work	Grade
Stroke survivors who wish to work should be offered assessment (i.e. to establish their cognitive, language and physical abilities relative to their work demands), assistance to resume or take up work, or referral to a supported employment service.	GPP

8.5 Sexuality		Grade
a)	Stroke survivors and their partners should be offered:	
	• the opportunity to discuss issues relating to sexuality with an appropriate health professional	GPP
	• written information addressing issues relating to sexuality post stroke.	GPP
b)	Any interventions should address psychosocial aspects as well as physical function.	GPP

8.6 Support		Grade
8.6.1 Peer support		
	Stroke survivors and family/carers should be given information about the availability and potential benefits of a local stroke support group and/or other sources of peer support before leaving hospital and when back in the community.	GPP
8.6.2 Carer support		
a)	Carers should be provided with tailored information and support during all stages of the recovery process. This includes (but is not limited to) information provision and opportunities to talk with relevant health professionals about the stroke, stroke team members and their roles, test or assessment results, intervention plans, discharge planning, community services and appropriate contact details.	C [125, 903]
b)	Where it is the wish of the person with stroke, carers should be actively involved in the recovery process by assisting with goal setting, therapy sessions, discharge planning, and long-term activities.	GPP
c)	Carers should be provided with information about the availability and potential benefits of local stroke support groups and services, at or before the person's return to the community.	C [903–905, 907]
d)	Carers should be offered support services after the person's return to the community. Such services can use a problem-solving or educational-counselling approach.	C [126, 904, 906]
e)	Assistance should be provided for families/carers to manage stroke survivors who have behavioural problems.	GPP

Introduction

In Australia, there are approximately 60 000 new or recurrent strokes per year. Around half of these occur in people over the age of 75 and as the population ages the number of strokes occurring each year is expected to increase. The burden of stroke goes beyond the estimated cost in Australia of $2.14 billion per annum. The impact on individuals, families and the workforce is substantial. Approximately one in five of those who have a first-ever stroke will die within a month and one in three will die within the first 12 months.[2] About 88 per cent of those who survive live at home, most with a disability.[2] Effective intervention aims to promote maximum recovery and prevent costly complications and subsequent strokes.

The first-hand experiences of people with stroke and their families/carers suggest that the availability and quality of stroke care in Australia varies.[3, 4] It is important that such experiences help inform stroke service improvements including these guidelines. Patient engagement, information provision, comprehensive discharge planning and ongoing health professional education are suggested as important components to improving stroke services.[3, 4]

These guidelines have been developed in response to the burden of stroke on individuals and the community as a whole and to incorporate new evidence related to care of people with stroke or TIA.

Purpose

This edition of the *Clinical Guidelines for Stroke Management,* referred to through this document as 'the guidelines', provides a series of evidence-based recommendations related to recovery from stroke and TIA to assist decision-making and is based on the best evidence available at the time of development. The guidelines should not be seen as an inflexible recipe for stroke care, sometimes rather disparagingly called 'cookbook medicine'; rather, they provide a general guide to appropriate practice to be followed subject to the clinician's judgment and the patient's preference.

Scope

These updated guidelines cover the most critical topics in effective stroke care relevant to the Australian context and include aspects of stroke care across the continuum of care including pre-hospital, acute, post-acute and community care, secondary prevention of stroke and management of TIA. Some issues are dealt with in more detail, particularly where current management is at variance with best management or where the evidence needs translation into practice.

These guidelines do not cover:

- subarachnoid haemorrhage
- stroke in infants, children and youth (i.e. <18 years old)
- primary prevention of stroke (refer to *Guidelines for the assessment of absolute cardiovascular disease risk 2009* (www.strokefoundation.com.au/prevention-guidelines). Guidelines for the management of absolute cardiovascular disease risk are currently being developed.

Target audience

These guidelines are intended for use by administrators, funders, policy makers and health professionals who plan, organise and deliver care for people with stroke during all phases of recovery from stroke or TIA.

Continuum of stroke care

There is a growing body of evidence (see 6.1 Amount and timing of rehabilitation) that shows that the earlier that rehabilitation is commenced the better the outcome for the stroke survivor. It is with this in mind that the guidelines have been written and presented to reflect this continuum of care. Acute care is characterised by a focus on rapid thorough assessment and early management. The principles of rehabilitation should also be applied in the acute and post-acute settings.[5] Rehabilitation is a proactive, person-centred and goal-oriented process that should begin the first day after stroke. Its aim is to improve function and/or prevent deterioration of function, and to bring about the highest possible level of independence — physically, psychologically, socially and financially. Rehabilitation is concerned not only with physical recovery but also with reintegration of the person into the community and therefore the transition between hospital and community care (including primary care) and supporting services is vitally important.

Development

The guidelines have previously been published as two documents: *Clinical Guidelines for Acute Stroke Management 2007* and *Clinical Guidelines for Stroke Rehabilitation and Recovery 2005*. This document updates and amalgamates these two guidelines.

The guidelines have been developed according to processes prescribed by the NHMRC[6] under the direction of a multidisciplinary working group (see Appendix 1). Details of the development methodology and consultation process are outlined in Appendix 2.

Consumer versions of the guidelines

Consumer versions of the guidelines have been developed and are available from the National Stroke Foundation (NSF).

Revision of the guidelines

The NSF aims to review and update the guidelines every three to five years.

Using the guidelines

The primary goal of these guidelines is to help healthcare workers improve the quality and effectiveness of the care they provide.

Guidelines differ from clinical or care pathways (also referred to as critical pathways, care paths, integrated care pathways, case management plans, clinical care pathways or care maps). Guidelines are an overview of the current best evidence translated into clinically relevant statements. Care pathways are based on best practice guidelines but provide a local link between the guidelines and their use.[7]

In considering implementation of these guidelines at a local level, health professionals are encouraged to identify the barriers and facilitators to evidence-based care within their environment to determine the best strategy for local needs.[8] Where change is required, initial and ongoing education is essential and is relevant to all recommendations in these guidelines. Further information regarding implementation is discussed in Appendix 2.

Multidisciplinary team approach

The central aspect of stroke recovery is the provision of a coordinated program by a specialised, multidisciplinary team of health professionals. This team involves integrated use of medical, nursing and allied health skills, along with social, educational and vocational services, to provide individual assessment, treatment, regular review, discharge planning and follow-up.

While the multidisciplinary team recognises the specialist contribution of each discipline, it was the decision of the expert development group that the focus of the guidelines be on what care is recommended rather than who provides that care. However, the following is provided as a summary of the main roles of members of the team:

- Dietitians work with stroke survivors (and their families/carers) who need medical nutrition therapy including texture-modified diets and enteral (tube) feeding as well as those at risk of or suffering from malnutrition. They also provide education and counselling for risk factor modification and management of co-morbidities.
- Doctors coordinate comprehensive medical care (including consulting other medical specialists as needed), assist stroke survivors and their families in making informed choices and re-adjustments, and aim to prevent complications and recurrent stroke. The doctor is often responsible for making sure the best available resources and services are offered to those affected by stroke. An in-patient medical team (commonly a specialist [e.g. in neurology, rehabilitation or geriatrics], a registrar and junior medical officers) should work in conjunction with a general practitioner to provide care in hospital and subsequently in the community.
- Nurses perform comprehensive nursing assessments and help manage aspects of patient care including observations, swallowing, mobility, continence, skin integrity, pain control and prevention of complications. Nurses also provide 24-hour in-patient-centred care and assist coordination of care, discharge planning, support and education. Nurses can provide specialist stroke care in the acute, rehabilitation and community context as well as deliver palliative and terminal care.
- Occupational Therapists work with stroke survivors and their families/carers to optimise participation and independence for all daily activities (including self-care, leisure and productivity). This is achieved by either working directly to address recovery of function (including motor, cognitive or perceptual function), or by adapting the task or the environment.
- Pharmacists help with guidance and advice on the optimal use of pharmacotherapy and liaise with other health professionals to discuss treatment options, provide therapeutic drug monitoring and assist in therapeutic decision-making. They also educate and counsel patients and their families/carers.
- Physiotherapists address recovery of sensorimotor function in the upper and lower limbs, and work with stroke survivors and their families/carers to aid recovery of functional mobility (e.g. walking) in both hospital and community environments. They also assist in the treatment of musculoskeletal problems or complications (e.g. shoulder pain) and respiratory problems.
- Psychologists work with stroke survivors who have intellectual/cognitive impairment, difficulties with behaviour, daily functioning and interpersonal relationships, and emotional problems. They also work with families/carers on adjusting and understanding the cognitive deficits experienced by their relatives.
- Social Workers provide support, counselling and information to stroke survivors and their families/carers regarding options for optimising physical, emotional, social and spiritual wellbeing. They also assist in organising community resources and appropriate moves to low or high-level care (e.g. nursing homes).
- Speech Pathologists work with stroke survivors who have difficulties with communication, cognition, and swallowing, and also train carers to facilitate activity and participation.

The team may be expanded to include psychiatrists, ophthalmologists, orthoptists, podiatrists, orthotists, recreation therapists and therapy assistants as well as general ward staff.

The person with stroke and their family/carer should be acknowledged as important team members.

CHAPTER

ONE

Organisation of services

Organisation of services

Access is one of the major barriers to equitable services and is influenced by geography, culture and spiritual beliefs. Particular challenges are therefore noted for rural and remote services where resources, particularly human resources, may be limited. Whilst it is recognised that residents in rural and remote areas may have difficulty accessing health care as readily as their urban counterparts, the aim in all settings must be to develop local solutions that ensure optimal practice and quality outcomes that are based on the best available evidence using the available resources.

Careful consideration is also required for the differing needs of people with stroke. Appropriate resources may be required in a variety of languages and formats for people with stroke and their families/carers. Other groups of people (e.g. younger people with stroke) may also have specific needs that require particular resources or application of these guidelines.

A national framework for acute stroke services organisation has been developed to improve the equity of organised stroke services depending on factors such as geography, stroke numbers and infrastructure. This can be found at www.strokefoundation.com.au.

Aboriginal and Torres Strait Islander people

The particular needs of Aboriginal and Torres Strait Islanders (ATSI) demand special attention and resources.[9] In March 2010, the NSF surveyed a number of ATSI and non-ATSI health professionals and researchers concerning stroke care for ATSI people. The survey results reinforced the issues previously identified and outlined in the Aboriginal Stroke Project report.[10] These issues fall into two broad categories: a) whole health system; and b) stroke-service specific.

The issues identified as relevant to the whole health system are consistent with current national policy and program initiatives including the National Strategic Framework for Aboriginal and Torres Strait Islander Health. Whole health system issues include access to and equity of appropriate services (including transportation needs), cultural safety, workforce development (Aboriginal health workers and training for non-Aboriginal health workers) and improving communication and knowledge.

Regarding stroke-specific services, survey respondents confirmed the need for increased availability of stroke unit care in larger regional centres, which might increase access by ATSI people and reduce the need for transfer, often over large distances, away from family and community. There was overwhelming belief that ATSI people are less likely to want to participate in rehabilitation away from family and community. Thus it was suggested that networks and processes be improved so that stroke specialist centres support non-specialist staff at smaller regional and rural centres.

1.1 Hyper-acute care

Hyper-acute care is care that is provided in the first twenty-four hours after stroke or TIA symptoms. While 80% of patients arrived in the emergency department (ED) by ambulance, only 39% of patients reached hospital within 4.5 hours of onset of symptoms.[11] Furthermore, although 91% of patients received brain imaging within 24 hours, only 47% of patients who arrived at hospital within three hours underwent imaging within that time.[11] Thrombolytic therapy with intravenous (IV) recombinant tissue plasminogen activator (rt-PA) is the most effective hyper-acute intervention proven to reduce the combined end-point of death and disability for ischaemic stroke.[12] However, in 2008, only 3% of all ischaemic stroke patients received intravenous rt-PA in Australia.[11] Organisation of systems that incorporate the ambulance service, emergency department, radiology department and stroke teams is therefore paramount to improving thrombolytic therapy.

Several studies have shown that rapid assessment as part of a coordinated system of hyper-acute stroke care, including pre-hospital or very early notification to the stroke service, improves processes of care (e.g. door to computerised tomography [CT] times) and can improve access to thrombolysis and stroke unit care.[13–19] Such services have also been shown to reduce length of acute stay and potentially reduce in-hospital mortality.[19] The creation of stroke services with pre-hospital notification and diversion of selected patients may centralise stroke care to particular institutions. A rapid response stroke team and associated protocols for early notification appears critical to such services.

A cluster RCT in Italy reported that training in and use of a pathway increased referrals to stroke unit care and rt-PA from ambulance services and reduced time in ED but did not increase the numbers who were referred from ED to stroke unit care or who received rt-PA; however, significant drop-outs occurred in this study (37% in the intervention arm).[17]

There are different models of care aimed at facilitating improved hyper-acute care. A systematic review of 54 observational studies (describing 59 services) found rates of thrombolysis varied with different models of care but regional collaborations resulted in higher rates than centres that worked in isolation (Table 1).[20] The decision as to which model to use will be determined by factors such as local resources and distance to the nearest hospital with a stroke unit.

TABLE 1
Stroke thrombolysis (rt-PA) use by different service type[20]

SERVICE DESCRIPTION	TREATMENT RATE (SD) PER 100 ISCHAEMIC STROKES	TREATMENT RATE (SD) PER 100 ACTIVATIONS	SYMPTOMATIC HAEMORRHAGES (%) #	PROTOCOL VIOLATIONS (%)
Local service	3.1 (2.1) n=31, 411	NA	4.6 n=619	24.7 n=417
EMS redirection of thrombolysis-eligible patients	9.9 (0.9) n=491	NA	4.4 n=480	0.7 n=450
EMS redirection of all possible acute stroke patients	5.7 (2.1) n=3976	NA	5.1 n=273	13.0 n=69
Telemedicine – no redirection	5.8 (0.02) n=3995	15.3 (3.7) n=268	3.9 n=563	Not reported
Telemedicine – drip and ship	7.1 (0.3) n=4082	23.5 (NA) n=255	4.4 n=273	20.7 n=117

n = pooled number of patients in contributing service descriptions. # As reported in study (no standard definition applied) Weighted SD is only displayed when there is > 1 contributing services description. EMS: Emergency medical services; NA: Not available; SD: Standard deviation

The use of pathways or protocols has been found to reduce hospital delays for acute care in several, mostly non-randomised studies.[19, 21–27] Such pathways ensure that patients receive appropriate and timely medical and nursing assessments and crucial investigations (see 1.2.3 Care pathways).

One non-randomised study reported benefits from a reorganisation of services that included establishing a nurse-led triage team specifically for neurological patients, improving pre-notification by ambulance staff of patients eligible for rt-PA, and introducing a small CT unit within the ED for priority imaging.[16] While the proximity of the CT unit was seen as a key component, it is unrealistic to consider this a feasible strategy for most departments.

Education of ED staff has also been undertaken as part of a multidimensional strategy with improvements noted in processes of care, for example, reduced delays in CT and increased numbers receiving thrombolysis.[13, 19, 26–29]

The main barriers to early delivery of thrombolytic therapy include:[30]

- lack of patient or family recognition of stroke symptoms
- delay in seeking appropriate emergency help
- calling the general practitioner first rather than an ambulance
- triaging of stroke as non-urgent by paramedics and emergency department staff
- delays in obtaining urgent brain imaging
- delays in in-hospital evaluation and treatment
- difficulties in obtaining consent for thrombolysis
- physicians' uncertainty about administering thrombolysis.

A systematic approach to resolving the barriers that delay early stroke care and the implementation of geographically appropriate models of hyper-acute care should help achieve higher thrombolysis rates and improved access to stroke unit care across Australia.

Recommendations for elements considered important to deliver effective hyper-acute stroke care are found throughout these guidelines and include:

- effective public education systems for stroke recognition (see 2 Stroke recognition and pre-hospital care)
- well-organised pre-hospital care systems (see 2 Stroke recognition and pre-hospital care)
- services for rural and regional centres (see 1.2.5 Telemedicine and networks, 1.2.1 Stroke unit care)
- rapid assessment in the ED (see 3.2 Rapid assessment in the emergency department)
- early imaging (see 3.3 Imaging)
- thrombolysis (see 4.1 Thrombolysis)
- early use of aspirin (see 4.3 Antithrombotic therapy)
- early stroke unit care (see 1.2.1 Stroke unit care)
- early rehabilitation (see 6.1 Amount and timing of rehabilitation).

1.1 Hyper-acute care	Grade
Local protocols developed jointly by staff from pre-hospital emergency service, the hospital emergency department and the acute stroke team should be used fotr all people with suspected stroke. Such protocols should include systems to receive early notification by paramedic staff, high priority transportation and triage, rapid referrals from ED staff to stroke specialists and rapid access to imaging.	C [15–19, 21, 31]

1.2 Hospital care

1.2.1 Stroke unit care

The organisation of hospital services to provide stroke unit care is the single most important recommendation for improving stroke management. While numbers of stroke units and stroke unit beds have increased between 2007 and 2009, the percentage of patients receiving stroke unit care has not increased.[32] Hence stroke unit care should be the highest priority for clinicians and administrators to consider.

There is overwhelming evidence (31 RCTs) that stroke unit care significantly reduces death and disability after stroke compared with conventional care in general wards for all people with stroke (odds ratio [OR] 0.82, 95% CI 0.73–0.92).[5] There is also evidence that stroke unit care has reduced mortality through prevention and treatment of complications, especially infections and immobility-related complications.[33] A systematic review of 18 observational studies found similar outcomes for stroke units to those described in the trials making a strong case for the generalisability of stroke unit care.[34]

In situations where the nearest hospital does not have a stroke unit the situation is more complex. Several non-randomised studies found significantly improved outcomes when patients were admitted directly to a stroke unit rather than assessed at a non-stroke unit centre and subsequently transferred.[35, 36] One cohort study found that, excluding the effects of rt-PA treatment, early (less than three hours after symptom onset compared to over six hours) admission to a stroke unit resulted in significantly better recovery at three months (National Institutes of Health Stroke Scale [NIHSS] 34.6% vs 15.2%; modified Rankin Score [mRS] 32.9% vs 16.8%) without any significant difference in mortality.37 Evidence derived from other studies for pre-hospital and thrombolysis services also show improved processes of care (door-to-brain imaging) and access to proven interventions (rt-PA, stroke unit care) with direct access to stroke unit hospitals (see 2 Pre-hospital care and 4.1 Thrombolysis).

Models of stroke unit care described in the literature include:

- acute stroke ward: acute unit in a discrete ward (usually discharged within seven days)
- comprehensive stroke unit care: combined acute and rehabilitation unit in a discrete ward
- stroke rehabilitation unit: a discrete rehabilitation unit for stroke patients who are transferred from acute care 1–2 weeks post-stroke
- mixed rehabilitation ward: rehabilitation provided on a ward managing a general caseload.

The evidence for the benefits of stroke unit care is clearest for units that can provide several weeks of rehabilitation on a comprehensive stroke unit or stroke rehabilitation unit.[5, 38] Different models of rehabilitation produce slightly different results (Table 2). Services that can provide combined or highly integrated acute and rehabilitation care appear to deliver the best outcomes.

TABLE 2
Mortality and dependency rates for different models of stroke care [38]

MODEL OF STROKE CARE	MORTALITY OR (95% CI)	DEATH/DEPENDENCY OR (95% CI)
Local service	3.1 (2.1) n=31, 411	0.70 (0.56–86)
Acute stroke care	0.80 (0.61–1.03)	0.50 (0.39–0.65)
Combined acute and rehabilitation	0.71 (0.54–0.94)	0.63 (0.48–0.83)
Post-acute rehabilitation	0.60 (0.44–0.81)	0.62 (0.53–0.71)
	Overall 0.71 (0.60–0.83)	

In Australia, most stroke units have a primary focus on acute care and early aspects of rehabilitation, with varying degrees of intensity and follow-up. There are 68 stroke units managing acute stroke patients but only eight stroke rehabilitation units as reported in the National Stroke Audits in 2008 and 2009.[39, 40]

The stroke units that have been shown to deliver highly effective stroke care share a number of characteristics including:

- location in a geographically discrete unit
- comprehensive assessments
- a coordinated multidisciplinary team
- early mobilisation and avoidance of bed-rest
- staff with a special interest in the management of stroke, and access to ongoing professional education and training
- clear communication, with regular team meetings to discuss management (including discharge planning) and other meetings as needed (e.g. family conferences)
- active encouragement of stroke survivors and their carers/families to be involved in the rehabilitation process.[41]

A mobile stroke team has been suggested as one strategy to improve processes of care for hospitals that do not currently have a dedicated stroke unit.[42] One systematic review (six RCTs) found only one significant benefit related to a process outcome (documented occupational therapy [OT] assessment) with non-significant trends reported for improved patient outcomes.[43] Mobile stroke teams are generally not more effective than care on a general ward and are inferior to care on a stroke unit.[43] Mobile stroke teams are therefore not the solution for regional hospitals or metropolitan hospitals which see sufficient numbers of patients to warrant care by a specialised team on a dedicated stroke unit. In such situations it is recommended that a small (2–4 bed) geographically-based stroke unit be established as part of a larger general ward, and linked to larger stroke specialist centres as part of a formal network (see 1.2.5 Telemedicine and networks). In larger hospitals, a comprehensive stroke unit is considered the best model for acute stroke patients.[38] Mobile stroke teams should only be used if part of a formal randomised controlled trial to establish an Australian evidence base.

There is also evidence that all patients should be admitted to a stroke unit in a hospital rather than being treated at home ('hospital at home'). Evidence from one systematic review (22 RCTs) found that hospital at home services had similar outcomes to general ward care but noted that general ward care is inferior to stroke unit care.[44] A subsequent RCT confirmed that stroke unit care is indeed superior to general hospital ward care and hospital at home services provided by a specialist stroke team.[45] Hospital at home services are not widely used in Australia and efforts should be focused on providing organised inpatient stroke unit care.

All hospital services should clearly review the existing stroke services in light of the recommendations below. For hospitals without existing stroke units the *NSF Acute Stroke Services Framework* provides details of the minimum standards for acute stroke unit care: the recommended infrastructure, processes, workforce and monitoring which can be used to plan for stroke service improvement. For hospitals with existing stroke units, consideration should be given to reviewing the percentage of stroke patients actually admitted to the stroke unit to determine if there is adequate capacity (i.e. bed numbers). Clear protocols for bed allocation are needed for all stroke unit hospitals.

1.2.1 Stroke unit care		Grade
a)	All people with stroke should be admitted to hospital and be treated in a stroke unit with a multidisciplinary team.	A [5]
b)	All people with stroke should be admitted directly to a stroke unit (preferably within three hours of stroke onset).	C [37]
c)	Smaller hospitals should consider stroke services that adhere as closely as possible to the criteria for stroke unit care. Where possible, patients should receive care on geographically discrete units.	B [5, 41]
d)	If people with suspected stroke present to non-stroke unit hospitals, transfer protocols should be developed and used to guide urgent transfers to the nearest stroke unit hospital.	C [35, 36]

1.2.2 Ongoing inpatient rehabilitation

Organised stroke unit care is most effective when a number of weeks of rehabilitation are offered.[5] While stroke unit care or mixed rehabilitation units reduce death and disability compared to general ward care, specialist stroke rehabilitation units were found to reduce odds of death or dependency compared to mixed rehabilitation units even though there was no difference in length of stay.[5, 38] Furthermore, all patient types benefit from rehabilitation, particularly those who are severely affected by stroke.[5] If the acute stroke services are unable to provide the necessary ongoing rehabilitation by a specialised multidisciplinary team then alternative rehabilitation services, ideally on a stroke rehabilitation unit, need to be considered and organised.

While prognostic studies have described different patient attributes that impact on rehabilitation, and recent imaging can predict the amount of damage and areas where recovery may be possible, there are no generic criteria for selecting those who will most benefit from ongoing active rehabilitation. Hence, the decision as to who should be provided with continued in-patient or out-patient rehabilitation is a complex one that requires input from the whole stroke team and takes into consideration the needs and wishes of the stroke survivor and their family/carer.

Hospitals and healthcare services should ensure there are clear referral protocols and processes to effectively link acute and rehabilitation services so that rehabilitation is commenced as soon as possible and continues in an appropriate setting and intensity (see 6.1 Amount and timing of rehabilitation).

Early support discharge models substitute inpatient rehabilitation for rehabilitation in the home but require similar levels of therapy to inpatient care. There are few such models currently in Australia (see 1.4.1 Community rehabilitation and follow-up services).

1.2.2 Ongoing inpatient rehabilitation		Grade
a)	To ensure all stroke patients receive early, active rehabilitation by a dedicated stroke team, health systems should have comprehensive services which include and link the fundamentals of acute and rehabilitation care.	B [5, 38]
b)	Patients should be transferred to a stroke rehabilitation unit if ongoing inpatient rehabilitation is required.	B [5, 38]
c)	If a stroke rehabilitation unit is not available, patients who require ongoing inpatient rehabilitation should be transferred to a conventional rehabilitation unit where staff have stroke-specific expertise.	B [38]
d)	All patients, including those with severe stroke, who are not receiving palliative care should be assessed by the specialist rehabilitation team prior to discharge from hospital regarding their suitability for ongoing rehabilitation.	GPP

1.2.3 Care pathways

A clinical pathway (also known as a care pathway or a critical pathway) is defined as a plan of care that aims to promote organised and efficient multidisciplinary stroke care based on the best available evidence and guidelines.[46] Care pathways are one way of promoting organised and efficient patient care and improving outcomes. The definition, structure and detail contained within the pathway may vary from setting to setting.[46]

A systematic review found both positive and negative effects and concluded that there was insufficient evidence to justify routine use of care pathways.[46] Of the three RCTs and twelve non-RCTs included, only one RCT and seven non-RCTs were initiated in the acute phase (three of the non-RCTs were initiated in the hyper-acute phase in the ED). When the acute trials were considered separately no negative effects were found while benefits for some patient outcomes, including reduced LOS, fewer readmissions and fewer urinary tract infections as well as improved process outcomes such as access to neuroimaging, were found.[5] Of the other outcomes reported, a large proportion demonstrated non-significant trends in favour of care pathway intervention.[46] Further, a large cluster RCT found a pre-hospital care pathway using validated tools, criteria and education led to more patients transferred by pre-hospital services to a stroke unit (24.2% vs 13.1%), although this was not statistically significant.[17] Overall there is a small body of consistent evidence that suggests care pathways can improve the process of care in acute stroke management where a number of investigations are needed in a short period of time, particularly when thrombolysis is considered. In the clinical setting, care pathways can provide a useful resource to optimise early stroke care, especially in settings without organised stroke care or where hospital staff are frequently changing.

In contrast, the current evidence reveals little or no benefit for the routine use of care pathways in rehabilitation; patient satisfaction with hospital care is in fact reduced.[46] The routine implementation of care pathways is not recommended where there is a dedicated multidisciplinary team in an established stroke unit or in situations where the patient has been undergoing rehabilitation for more than seven days. If used, care pathways should be flexible enough to meet the varying needs of stroke survivors.

1.2.3 Care pathways	Grade
All stroke patients admitted to hospital should be managed using an acute care pathway.	C [46]

1.2.4 Inpatient stroke care coordinator

The use of an inpatient stroke care coordinator is one of a number of strategies to facilitate a coordinated approach to care. The coordinator is generally a member of the stroke team and the role is often performed in addition to other clinical or management responsibilities. Exponents of this model suggest that a stroke care coordinator is particularly useful for coordinating services and facilitating the involvement of the person with stroke and the family/carer in care planning, including planning for discharge or transfer of care. A Cochrane review (one RCT and two non-RCTs) of case-managed care intervention in which one person coordinates in-patient acute stroke care reported a reduction in LOS (11 vs 14 days) and therefore lower costs as well as a reduction in returns to ED.[46] Although a care coordinator is only one component of care (usually in combination with protocols), it is logical to expect that such a position aids the organisation of services in stroke unit settings.

1.2.4 Inpatient stroke care coordinator	Grade
An inpatient stroke care coordinator should be used to coordinate services and assist in discharge planning.	GPP

1.2.5 Telemedicine and networks

In some areas, the number of people with stroke requiring care is not high enough to support a dedicated stroke unit and maintain staff expertise. Support for non-specialist sites may be facilitated via formal or informal networks. Access to more specialised medical or allied health, but not nursing, expertise may also be facilitated through the use of telemedicine.

Telemedicine is broadly defined as the use of telecommunications technologies to provide medical information and services.[47] The application of telemedicine in stroke care is known as 'telestroke'. Telestroke usually takes the form of video-teleconferencing (VTC) to support acute stroke intervention (i.e. rt-PA); however, telephone and diagnosis through remote imaging are also included. VTC is characterised by the use of dedicated, high-quality, interactive, bidirectional audiovisual systems, coupled with the use of teleradiology for remote review of brain images. Telestroke via VTC has also been shown to be a feasible, reliable and valid method of assessing acute stroke patients.[48, 49] One RCT demonstrated that the accuracy of decision making by a stroke neurologist via telestroke assisted by the local referring physician is superior to that by telephone alone when assessing suitability for treatment with thrombolytics (OR for correct intervention decision 10.9, 95% CI 2.7–44.6).[50]

The application of telestroke for thrombolysis, when used as part of an organised system of care (i.e. linked with stroke experts/units), has been found to be feasible and reliable and to improve thrombolysis rates without increasing complication rates.[48, 49] One systematic review (54 observational studies) found services that use telemedicine increased thrombolysis rates by 4.4% when initiated by remote hospitals and subsequently transferred to a specialist stroke centre, i.e. 'drip and ship' approach and 1.9% when initiated but with no redirection.[51] The TEMPiS project, a notable example, established high-quality VTC telestroke services in a 'hub and spoke' network that linked twelve regional hospitals that had no stroke units to two comprehensive stroke centres. A high rate (38%) of telestroke consultations[52] led to a significantly greater number of patients treated by thrombolysis as well as improved outcomes.[53, 54] Patients in telestroke network hospitals had a 38% lower probability of a poor outcome, defined as severe disability, institutional care or death at 3, 12 and 30 months.[49, 53] In addition to improved access to thrombolysis and the subsequent improved patient outcomes, the application of telemedicine for stroke care and the networked stroke services may reduce length of stay, improve decisions regarding patient transfers for other urgent investigations or interventions (e.g. surgery) and lead to general improvement of stroke care in non-specialist hospitals.[55]

Telerehabilitation is defined as the ability to provide distance support, evaluation and intervention via telecommunication.[56] The use of telemedicine for allied health assessments has been reported to be feasible and valid in several trials and is also feasible and useful for providing therapy.[48, 49, 57]

Telemedicine services are available in 60% of Australian acute hospitals. Such services are used in 77% of acute hospitals to facilitate staff education.[32] But the actual use of these services to assist with clinical support is unknown. Along with the availability of acute and rehabilitation stroke specialists, infrastructure and training need to be available to effectively use telestroke in Australia.

1.2.5 Telemedicine and networks		Grade
a)	All health services which include regional or rural centres caring for stroke patients should use networks which link large stroke specialist centres with smaller regional and rural centres.	C [48, 49]
b)	These networks should be used to help establish appropriate stroke services along with protocols governing rapid assessment, telestroke services and rapid transfers.	C [48, 49, 51]
c)	Where no on-site stroke medical specialists are available, telestroke consultation should be used to assess eligibility for acute stroke therapies and/or transfer to stroke specialist centres.	B [48–50]
d)	Telestroke can be used to improve assessment and management of rehabilitation where there is limited access to on-site stroke rehabilitation expertise.	C [48, 49]

1.3 Discharge planning and transfer of care

Good discharge planning is crucial for successful reintegration into the community and effective and efficient use of limited hospital resources. Stroke survivors and carers/family report that this phase of the recovery process is a critical step and that often insufficient attention and resources are provided.[4] One group that is of particular concern is younger stroke survivors (i.e. <65 years) who may require residential care post-discharge. While the ideal discharge outcome may be to an in-patient rehabilitation facility, this is not always feasible in all geographical locations. Careful consideration needs to be given to discharge destinations (other than a rehabilitation facility) to ensure the stroke survivor is in appropriate accommodation and is able to receive the necessary services.[58]

Discharge planning relies on effective communication between team members, stroke survivors, families/carers, and community service providers including general practitioners. Important aspects of care during this phase including team meetings (see 1.8), family meetings (see 1.9.2), information and education (see 1.9.1) and care after hospital discharge (see 1.4) have been discussed under organisation of care and should also be considered when planning discharge or transfer of care.

1.3.1 Safe transfer of care from hospital to community

The safe transfer of a stroke survivor from the hospital to the community is often a complex process and requires early planning, assessment of the stroke survivor's needs and effective communication.

Assessment of discharge needs should start as soon as possible after admission. A pre- and/or post-discharge needs assessment examines, for example, the social, emotional, physical and financial needs of the stroke survivor and their family/carer. Any cognitive or behavioural issues identified should be discussed and management incorporated into any discharge plan (e.g. monitoring of mood).

The needs assessment should identify who requires a home visit. Factors to consider include the reported environmental barriers at home, specific physical, communication and/or cognitive impairments, risk of falls and the needs and desires of the stroke survivor and their family/carer. The need for home modifications or assistive equipment may also be determined, and the appropriate modifications and/or equipment recommended. There is no stroke-specific evidence regarding the effectiveness of home visits, and very little evidence in other populations. One systematic review (four RCTs) found no clear evidence on the effectiveness of a pre-discharge OT home visit.[59] A subsequent RCT[60] considered an intervention of therapeutic weekend care, bedside teaching and structured information for relatives during rehabilitation. This study reported long-term benefits (reduced institutionalisation and mortality) but numbers were small and a larger study is required. Home assessment and modification have not been found to affect the number of falls in elderly people in the community[61] but it is unclear if this is the same for stroke survivors discharged from acute care in hospital. Further studies are required to determine which sub-groups benefit from home visits, since this is a time-consuming and costly intervention.

A post-discharge care plan is normally completed prior to discharge and identifies appropriate management strategies to guide care after the stroke survivor returns to the community. Care plans are based on the needs and goals identified in the pre-discharge assessment, and may be useful in building self-management strategies for the stroke survivor. Ideally all team members, including the stroke survivor, the family/carer, the general practitioner, and community-based service providers are involved in developing and documenting an agreed plan that takes into account the complex adjustments needed, especially when changing settings or care. A formal family meeting or conference is often used to develop such a plan.

A systematic review of 18 qualitative and quantitative studies found it is uncertain whether multidisciplinary care involving GPs improves outcomes for stroke survivors.[62]

Interpretation of the results is difficult as results of the two largest studies appear contradictory and analysis is complicated by the diversity of outcome measures.

Discharge planning may be coordinated by one member of the team (e.g. in-patient care coordinator) or it may be undertaken by someone who coordinates discharges for multiple teams or the whole hospital. Two relevant Cochrane reviews were identified related to discharge planning; however, neither review provided clear conclusions.[46, 63] One subsequent systematic review (21 RCTs and 4 non-randomised trials) for interventions to improve discharge planning for elderly people (>65 years) reported improved patient satisfaction and quality of life early after discharge along with possible reduced length of stay and lower readmission rates.[64] One lower-level trial involving a comprehensive discharge planning program coordinated by a discharge planner for people with craniotomy or stroke reduced LOS and readmissions, but did not change function or patient satisfaction.[65] Any person coordinating discharge should provide the stroke survivor and their family/carer with appropriate information regarding the details of any community services, possible waiting times, costs and contact details prior to discharge.

1.3.1 Safe transfer of care from hospital to community		Grade
a)	Prior to hospital discharge, all patients should be assessed to determine the need for a home visit, which may be carried out to ensure safety and provision of appropriate aids, support and community services.	C [59]
b)	To ensure a safe discharge occurs, hospital services should ensure the following are completed prior to discharge:	
	• patients and families/carers have the opportunity to identify and discuss their post-discharge needs (e.g. physical, emotional, social, recreational, financial and community support) with relevant members of the multidisciplinary team	GPP
	• general practitioners, primary healthcare teams and community services are informed before or at the time of discharge	GPP
	• all medications, equipment and support services necessary for a safe discharge are organised	GPP
	• any continuing specialist treatment required is organised	GPP
	• a documented post-discharge care plan is developed in collaboration with the patient and family and a copy provided to them. This may include relevant community services, self-management strategies (e.g. information on medications and compliance advice, goals and therapy to continue at home), stroke support services, any further rehabilitation or outpatient appointments, and an appropriate contact number for any queries.	GPP
c)	A locally developed protocol may assist in implementation of a safe discharge process.	GPP
d)	A discharge planner may be used to coordinate a comprehensive discharge program for stroke survivors.	D [65]

1.3.2 Carer training

Carers often report feeling inadequately trained, poorly informed, and dissatisfied with the extent of support available after discharge.[66] Evidence from a high-quality RCT (n=300) suggests that carers benefit from training in a range of activities related to care prior to the patient's discharge from hospital. These include personal care techniques, communication, physical handling and transfers, ongoing prevention of functional decline and other specific stroke-related problems.[67] Another RCT (n=70) of an intervention of therapeutic weekend care, bedside teaching and structured information for relatives during rehabilitation reported long-term benefits (reduced institutionalisation and mortality).[60] Ideally training should occur in both hospital and home environments.

1.3.2 Carer training	Grade
Relevant members of the multidisciplinary team should provide specific and tailored training for carers/family before the stroke survivor is discharged home. This should include training, as necessary, in personal care techniques, communication strategies, physical handling techniques, ongoing prevention and other specific stroke-related problems, safe swallowing and appropriate dietary modifications, and management of behaviours and psychosocial issues.	B [67]

1.4 Care after hospital discharge

1.4.1 Community rehabilitation and follow-up services

As the early post-discharge period is consistently reported by stroke survivors and their families/carers to be a difficult time, the provision of simple and relevant services appears important.[4] The needs identified by the stroke team and the stroke survivor and family/carer via the pre-discharge needs assessment, and availability of local community services, will determine which services are preferred.

Rehabilitation will often need to continue after discharge either as part of an early supported discharge (ESD) program or as general community rehabilitation and can be undertaken in various settings depending on availability of transport, wishes of the stroke survivor and family/carer, and local resources. Generally there are two models for rehabilitation in the community:

- centre-based therapy, provided in the hospital or in a community facility, and including rehabilitation for those attending on a full-day basis or as an out-patient
- home-based or domiciliary rehabilitation.

ESD is a model that links in-patient care with community services with the aim of reducing LOS. ESD services should be considered an extension of stroke unit care rather than an alternative. A key argument for ESD is that the home provides an optimum rehabilitation environment, since the goal of rehabilitation is to establish skills that are appropriate to the home setting. One Cochrane review (11 RCTs) and another systematic review (seven RCTs) found that ESD services reduce in-patient LOS and adverse events (e.g. readmission rates) while increasing the likelihood of being independent and living at home.[68, 69] Risks relating to carer strain might be expected with ESD, but there is too little evidence to demonstrate whether or not this is the case.[68, 69] ESD trials included people with mild to moderate disability and thus ESD services should target this group of stroke survivors.[68, 69] Stroke survivors have reported greater satisfaction following ESD than conventional care. To work effectively, ESD services must have similar elements to those of organised stroke teams (see 1.2.1 Stroke unit care). The level of services available following discharge from hospital can be poor, and stroke survivors and their families/carers often report being dissatisfied with the information, support services and therapy available.[70] Therefore, while there is great pressure to ensure early discharge from acute services, the evidence is based on early supported discharge, and it is vital to ensure that adequate community services for rehabilitation and carer support services, mirroring those used in the trials, are developed and utilised.

One Cochrane review (14 RCTs) found rehabilitation therapy services in the community (home or centre-based) within the first year after stroke reduced the odds of a poor outcome (OR 0.72, 95% CI 0.57–0.92) and improved personal ADL scores (SMD 0.14, 95% CI 0.02–0.25).[71] One systematic review (six RCTs and one non-randomised trial) found that home-based rehabilitation may be cheaper than centre-based therapy, but no difference in effectiveness was found.[72] A subsequent systematic review (11 RCTs) found home-based rehabilitation compared with centre-based rehabilitation significantly improved scores on functional measures within six months (MWD 3–6 months 4.07, 95% CI 0.81–7.34) although differences between settings were no longer significant at six months (MWD 0.65, 95% CI –0.50–1.81).[73] Home-based therapy may also increase satisfaction of carers. A subsequent Australian RCT of mixed populations (36% of whom were stroke survivors) found home-based rehabilitation had a lower risk of readmission (RR 2.1, 95% CI 1.2–3.9) and lower carer strain than centre-based rehabilitation.[74] Home-based rehabilitation is not a common model of care in Australia and access to such services is variable.

A number of other follow-up services after hospital discharge have been evaluated including:

- social work[75, 76]
- specialist nurse support[77–82]
- the Stroke Transition After Inpatient Care (STAIR) program[83]
- stroke family care worker[84]
- mental health worker[85]
- workbook-based intervention[86]
- structured exercise and education program[87]
- home visits by physician or physiotherapist[88]
- case management[89–92]
- stroke family support organisers.[93–95]

Such services are usually multidimensional and can include emotional and social support, assistance with referral to other services, development of tailored care plans, coordination between stroke specialists and general practitioners and the provision of information to people with stroke and their families/carers. The evidence is difficult to interpret and no one service has been shown to be clearly beneficial. Studies suggest a modest advantage when providing tailored education although no clear functional benefits have been found and further studies are needed.

A simple approach often incorporated into other multidimensional interventions is the use of telephone contact after discharge. One Cochrane review (33 RCTs) failed to demonstrate consistent benefits in a range of non-stroke populations.[96] Several stroke studies involving telephone calls as part of complex intervention have also reported conflicting findings.[77, 81, 86, 90, 91]

Usually stroke survivors will have a specialist medical review in the first few months following discharge from hospital to assess progress and need for additional support or therapy. However, many issues or difficulties may not become evident for a considerable time following a stroke. Access to rehabilitation later in recovery may be needed to prevent deterioration or to realise potential for improvement, especially for those in residential facilities who have made little progress due to co-existing illness. One RCT compared a structured re-assessment system for patients and their carers at six months post stroke with existing care from their GP.[97] No difference was found on any outcome.

A systematic review (three RCTs and several observational studies) was unable to make clear conclusions about coordinated care planning involving primary care.[62] Coordinated care by the general practitioner may be facilitated by care planning/management items as part of the Medicare funded Enhanced Primary Care program, which provides incentive payments in an effort to improve the care of complex chronic conditions, including stroke.

1.4.1 Community rehabilitation and follow-up services		Grade
a)	Health services with a stroke unit should provide comprehensive, experienced multidisciplinary community rehabilitation and adequately resourced support services for stroke survivors and their families/carers. If services such as the multidisciplinary community rehabilitation services and carer support services are available, then early supported discharge should be offered for all stroke patients with mild to moderate disability.	A [68, 69]
b)	Rehabilitation delivered in the home setting should be offered to all stroke survivors as needed. Where home rehabilitation is unavailable, patients requiring rehabilitation should receive centre-based care.	B [72, 73]
c)	Contact with and education by trained staff should be offered to all stroke survivors and families/carers after discharge.	C [77, 81]
d)	Stroke survivors can be managed using a case management model after discharge. If used, case managers should be able to recognise and manage depression and help to coordinate appropriate interventions via a medical practitioner.	C [89, 92]
e)	Stroke survivors should have regular and ongoing review by a member of a stroke team, including at least one specialist medical review. The first review should occur within 3 months, then again at 6 and 12 months post-discharge.	GPP
f)	Stroke survivors and their carers/families should be provided with contact information for the specialist stroke service and a contact person (in the hospital or community) for any post-discharge queries for at least the first year following discharge.	GPP

1.4.2 Long-term rehabilitation

Access to 'top-up services' where some long-term rehabilitation is provided is often raised by stroke survivors and their families/carers. Limited health resources need to be managed in the most equitable way and ongoing rehabilitation is not feasible unless the stroke survivor has clear and realistic goals. However, current rehabilitation services after the first six months are rarely available although evidence demonstrates further improvements can be made after this time. Often stroke survivors have to pay for ongoing services or try to access generic community exercise programs, for example 'Heartmoves', but many other programs exclude people after stroke.

The major part of physical recovery following stroke occurs within the first six months but further input can prevent the decline that frequently occurs after stroke. One Cochrane review (14 RCTs) found rehabilitation therapy services in the community (home or centre-based) within the first year after stroke reduces the odds of a poor outcome (OR 0.72, 95% CI 0.57–0.92) and improves personal ADL scores (SMD 0.14, 95% CI 0.02–0.25).[71] Another Cochrane review (nine RCTs) that focused on practice of personal activities of daily living (ADL) found that OT targeted at personal ADL increased performance scores (SMD 0.18, 95% CI 0.04–0.32) and reduced the odds of deterioration or dependency in personal ADL (OR 0.67, 95% CI 0.51–0.87).[98] A subsequent cluster RCT 99 carried out in 12 nursing and residential homes found that those in the intervention group receiving OT interventions targeted at improving independence in personal ADLs such as feeding, dressing, toileting, bathing, transferring and mobilising were less likely to deteriorate or die and showed improvements in functional measures compared to controls.

The potential benefits of rehabilitation services more than one year after stroke are less clear. One Cochrane review (five RCTs) compared therapy-based rehabilitation with conventional care in chronic stroke patients (a study inclusion criterion was that at least 75% of the participants were recruited one year post stroke).[100] Overall the evidence was inconclusive as to whether therapy-based rehabilitation intervention one year after stroke was able to influence any relevant patient or carer outcome. Trials varied in design, type of interventions provided, quality and outcomes assessed.

Another Cochrane review (nine RCTs) specifically looking at walking practice in chronic stroke patients found some benefits (improved walking speed, timed up-and-go, endurance) but no change in gait function as measured by the Rivermead Mobility Index or the Stroke Rehabilitation Assessment of Movement.[101]

Motivation and practical assistance to facilitate regular exercise following stroke should be considered. Strategies such as regular check-ups can be used but the optimum frequency of contact is unclear.[102, 103]

Community-based allied health practitioners can play a crucial role in monitoring the need for, and encouraging actual participation in, community and exercise activities. A range of factors can substantially limit community participation in appropriate programs, such as access to and costs of appropriate transport, fears related to limited communication ability and awareness of appropriate services and their location. These factors need to be considered when planning or referring to such programs. The GP also plays an important role in appropriately referring people in the months and years after formal rehabilitation has ended, where clear further needs are identified. Younger stroke survivors wishing to return to work often require ongoing support and specific services should be available (see 8.4 Return to work).

1.4.2 Long-term rehabilitation		Grade
a)	Stroke survivors who have residual impairment at the end of the formal rehabilitation phase of care should be reviewed annually, usually by the general practitioner or rehabilitation provider to consider whether access to further interventions is needed. A referral for further assessment should be offered for relevant allied health professionals or general rehabilitation services if there are new problems not present when undertaking initial rehabilitation, or if the person's physical or social environment has changed.	GPP
b)	Stroke survivors with residual impairment identified as having further rehabilitation needs should receive therapy services to set new goals and improve task-orientated activity.	B [104, 105]
c)	Stroke survivors with confirmed difficulties in performance of personal tasks, instrumental activities, vocational activities or leisure activities should have a documented management plan updated and initiated to address these issues.	GPP
d)	Stroke survivors should be encouraged to participate long-term in appropriate community exercise programs.	C[103]

1.5 Transient ischaemic attack

There are three main models suggested for organising services for those with TIA.

Admission to hospital

While there is very strong evidence for the benefits of admission to hospital and care on a stroke unit for all levels of stroke severity, it is unclear if there are benefits for those with TIA.[5] Hospital admission to a stroke unit increased the likelihood of having the necessary diagnostic tests (e.g. carotid imaging, MRI) and was associated with higher adherence to protocols and processes of care consistent with best practice stroke care than a conventional hospital ward.[106] Another Australian cohort study[107] found that patients assessed in the ED and then admitted to hospital (mostly to specialist stroke care) rather than discharged back to the community had a significantly lower rate of recurrent events (TIA or stroke) at 28 days (2.3% vs 5.3%). A Canadian cohort study found admission to a 'rapid evaluation unit' for those deemed at high risk significantly reduced subsequent stroke by about half (4.7% vs 9.7%) compared to usual care as an inpatient or outpatient.[108] Two studies of rapid TIA services (clinics) both admitted approximately 25% of the TIA patients (generally those deemed to be higher risk) for specialist management.[109, 110]

A RCT of a diagnostic protocol in ED found shorter hospital stays compared to normal admission for TIAs (25.6 hours vs 61.2 hours) and greater access to diagnostic tests with similar 90-day event rates.[111] The authors suggested the protocol was also associated with reduced costs.

While mild or recovering symptoms are one reason for not administering rt-PA initially, there is some indication of a correlation between TIA and a subsequent deterioration in symptoms in a significant minority of cases.[112–114] Hence a short hospital admission may provide the opportunity to administer rt-PA should the patient deteriorate. One study found a policy of admission to hospital for 24 hours after TIA is cost-neutral if considering rt-PA alone.[115]

Rapid access TIA clinic

One UK study of a rapid access TIA clinic reported significant reductions in event rates (80%) after introduction of the new service with 90-day stroke rates of 2.1%.[109] The same study noted that three-quarters of the patients returned home on the same day, potentially reducing health costs. Another French study of a 24/7 rapid TIA clinic attached to a large urban stroke unit hospital found much lower rates of subsequent events than those predicted by the ABCD^2 tool (1.24% actual vs 5.96 expected risk).[110] In both studies, approximately 25% of the 'high risk' TIA patients were admitted with an average LOS for the French study of four days. One retrospective study in the UK found that a TIA-clinic was cost-effective if all relevant investigations had been completed prior to the visit allowing informed decisions to be made at a 'one stop' service.[116] Another case series reported a rapid assessment clinic was useful to screen for patients eligible for carotid surgery but found only a small number of patients (4.8%) underwent carotid surgery.[117]

There are currently no national data on TIA care provided in EDs or outpatient clinics. Only 19% of hospitals surveyed in 2009 have a rapid assessment outpatient clinic for TIAs or mild stroke.[32] The availability of such services was significantly more common where there was a stroke care unit. There are no Australian data on average waiting times from referral to being seen in a clinic. Data from the UK indicate that while 78% of hospitals have a neurovascular clinic only 34% of patients are seen within seven days with the average waiting time being 12 days.[118] Australian services have begun to provide earlier access to special clinics for people with TIA or minor stroke, especially for those assessed as having a lower risk of stroke. It is vital that any such service should provide timely access to routine investigations.

Management by primary care

There are few published data on the role of the GP in initial assessment and management of TIA and stroke in Australia. Information collected in one ongoing Australian study found that TIA represents only 0.1% of GP consultations.[119]

Overall, cohort studies report the lowest risk of subsequent stroke in services that provide emergency intervention in specialised stroke centres.[120] Due to limited resources, access to services may need to be determined on the basis of predicted risk of stroke. The ABCD^2 score has modest but clinically useful predictive ability[121] but may miss 20–30% of cases and other important indications of risk, particularly the presence of atrial fibrillation (AF) or carotid disease, should be considered to determine high and low-risk (see 3.1 Transient ischaemic attack). Further studies, particularly of Australian cohorts where more aggressive preventative interventions are used, are needed to understand the usefulness of the ABCD^2 score. Whichever model is used should focus on rapid assessment and early initiation of proven therapies (e.g. antiplatelet therapy, blood pressure lowering and cholesterol lowering) and be based on local resources and needs.

1.5 Transient ischaemic attack	Grade
All patients with suspected TIA presenting to a general practitioner or emergency department should be rapidly assessed.	
• Those identified as high risk (e.g. ABCD^2 score >3 and/or those with any one of the following: AF, carotid territory symptoms or crescendo TIA, should be admitted to a stroke unit (or where available referred to a specialist TIA clinic if the person can be assessed within 24 hours) to facilitate rapid specialist assessment and management.	C [107–110, 120, 121]
• Those identified as low risk (e.g. ABCD^2 score <4 and without AF or carotid territory symptoms or crescendo TIA should commence initial therapy (e.g. aspirin) and then be managed in the community by a general practitioner or private specialist or, where possible, be referred to a specialist TIA clinic and seen within seven days.	GPP

1.6 Standardised assessment

Complete assessment requires input from all members of the stroke team. Such assessments are fundamental to identifying deficits, setting goals and planning for management. It is recommended that all assessments occur, where possible, soon after admission, ideally within two days, with the stroke team working together so as not to burden the patient by duplicating questions. Weekend cover and workforce shortages are ongoing issues for many centres and will affect the timeliness of assessments. Although reassessment is useful for monitoring recovery, evaluating the success of interventions and assisting in planning, the timing of such re-assessments should consider the needs of the patient along with the usefulness of the findings.

Where possible a patient's premorbid functioning, both general and domain-specific, should be determined in order to compare with current results. Given the enormous variety of assessment tools and measures it is beyond the scope of these guidelines to make specific recommendations regarding which measures or tools should be used in each circumstance. Staff should choose specific tools on the basis of their validity, reliability and availability, and their validity in a stroke population. Staff should be trained in the use of the chosen tools. The use of a detailed assessment (which may take considerable time) must be balanced against the need to provide early and active interventions. The use of a detailed assessment must balance the need to provide early and active interventions against the need for an accurate identification of the patient's strengths and weaknesses to inform which interventions would be beneficial.

Communication of assessment findings to the patient and family/carer is essential.

1.6 Standardised assessment	Grade
Clinicians should use validated and reliable assessment tools or measures that meet the needs of the patient to guide clinical decision-making.	GPP

1.7 Goal setting

Active involvement of stroke survivors and their families/carers was an important component in the stroke unit care trials.[5] One systematic review (19 RCTs) examining the effectiveness of goal planning in rehabilitation found limited evidence that goal planning can influence patient adherence to treatment regimes and strong evidence that prescribed, specific, challenging goals can improve immediate patient performance in some specific clinical contexts.[122] There is clear consensus, both within the EWG and in published literature, that goal setting is beneficial for the rehabilitation process and should always take place with the stroke survivor and family/carer.[123] Goals developed in team meetings should be 'signed off' as agreed upon by the stroke survivor and/or family/carer. Outcome measures based on goal-attainment scales can be considered by the team to improve the use of goal setting.

1.7 Goal setting		Grade
a)	Stroke survivors and their families/carers who are involved in the recovery process should have their wishes and expectations established and acknowledged.	GPP
b)	Stroke survivors and their families/carers should be given the opportunity to participate in the process of setting goals unless they choose not to or are unable to participate.	B [5]
c)	Health professionals should collaboratively set goals for patient care. Goals should be prescribed, specific and challenging. They should be recorded, reviewed and updated regularly.	C [122]
d)	Stroke survivors should be offered training in self-management skills that include active problem-solving and individual goal setting.	GPP

1.8 Team meetings

Ongoing communication between the members of the stroke team is a key element of an organised stroke service. Data from trials included in the stroke unit meta-analysis showed that organised stroke units were characterised by formal weekly meetings as well as one or more informal meetings of the multidisciplinary team.[41]

While this evidence relates to the total stroke unit 'package' rather than the individual elements of that package, team meetings appear essential to foster good communication and coordinated services. Telemedicine facilities should be considered in rural and remote centres to effectively link members of the team.

1.8 Team meetings		Grade
	The multidisciplinary stroke team should meet regularly (at least weekly) to discuss assessment of new patients, review patient management and goals, and plan for discharge.	C [41]

1.9 Patient and carer/family support

1.9.1 Information and education

The provision of information and education is particularly important for stroke survivors and their families/carers.[4] This may need to be offered repeatedly over various time frames as information needs change.[4] Information should be provided in a language and format that can be understood.[124]

An updated Cochrane review[125] characterised interventions into two types:

- 'passive interventions' where information was provided on a single occasion and there was no subsequent systematic follow-up or reinforcement procedure
- 'active interventions', where purposeful attempts were made to allow the participants to assimilate the information and a plan for subsequent clarification and consolidation or reinforcement was agreed.

The review (17 RCTs) found that for stroke survivors, both active and passive interventions significantly improved knowledge, but active interventions had greater benefits for anxiety and depression.[125] There were no effects on activity, participation or mortality for either intervention.[125] For family/carers, any information provision improved knowledge but there was no effect on family/carer mood, QOL or satisfaction. One previous systematic review (10 RCTs) found interventions targeting family education that involved more active interventions resulted in a greater increase in knowledge than passive interventions.[126]

Numerous other trials have assessed interventions to educate stroke survivors and their families/carers, particularly after discharge from hospital. In most of these trials the intervention was multifactorial and it is difficult to gauge the effect of education or information provision alone (hence such trials were excluded from the most recent Cochrane review).[125] The NSF can provide written information (including consumer versions of these guidelines) and fact sheets that can be used as part of a comprehensive education program (see www.strokefoundation.com.au). Special consideration and attention is needed for people with aphasia.

1.9.1 Information and education		Grade
a)	All stroke survivors and their families/carers should be offered information tailored to meet their needs using relevant language and communication formats.	A [125]
b)	Information should be provided at different stages in the recovery process.	B [125]
c)	Stroke survivors and their families/carers should be provided with routine, follow-up opportunities for clarification or reinforcement of the information provided.	B [125]

1.9.2 Family meetings

Early and ongoing communication between the stroke team, stroke patient and their family/carer is a key element of an organised stroke service. Communication is established through formal and informal meetings to initially discuss assessment results on admission, plan management including intervention goals during the acute and rehabilitation hospital stay and plan for discharge from hospital. Formal family meetings involve some or all members of the stroke team but may not occur in every case. However,a description of trials included in the stroke unit meta-analysis found the patient and their family/carer often attended the regular informal meetings of the multidisciplinary team[41] and all services should incorporate processes that inform and involve the patient and their family/carer in all aspects of care.

1.9.2 Family meetings	Grade
The stroke team should meet regularly with the patient and their family/carer to involve them in management, goal setting and planning for discharge.	C [41]

1.9.3 Counselling

Many aspects of life are affected by stroke and complex adjustments are required not only for the stroke survivor but also for the family and carer. Observational studies have found that family dynamics have an impact on rehabilitation; for example, a well-functioning family has been shown to be associated with improved function for stroke survivors.[127, 128] The needs of the patient and carer/family will change during the stages of care, going from acute care where there is often an initial crisis to discharge and community re-integration which may highlight significant changing social roles. Palliation may also require careful support for the carer/family.

Evidence for counselling is limited with most studies based in the community setting. A systematic review of various interventions (10 RCTs), including counselling targeting family education and adjustment, concluded that there was evidence for the benefits of an active educational counselling approach.[126] A RCT (n=62) found an information package and three visits from a social worker trained in family counselling provided functional and social benefits but had no impact on stroke survivor depression, anxiety, understanding, skill levels or health status.[129] One RCT (n=213) included in the above review found problem-solving counselling plus education that began in hospital was more effective than routine care or education alone.[130] Some of the trials in the review above are discussed in sections 1.4.1 Community rehabilitation and follow-up services, 1.9.1 Information and education, and 8.7 Carer support. Evidence for counselling in those with depression is discussed in 7.11 Mood disturbance.

Once the stroke survivor has returned to the community, the general practitioner plays an important role in providing a coordinated approach to accessing relevant counselling services under the Medicare mental health plans.

1.9.3 Counselling	Grade
Counselling services should be available to all stroke survivors and their families/carers and can take the form of:	
• an active educational counselling approach	B [126]
• information supplemented by family counselling	C [129]
• a problem-solving counselling approach.	C [130]

1.9.4 Respite care

Respite care can be defined as any service or group of services designed to provide temporary relief and/or rest for carers. Providing care for stroke survivors is often a challenge both physically and emotionally. Evidence on respite care is sparse and there are no stroke-specific studies. A systematic review of respite care for people with dementia and their carers found no quality studies to draw conclusions from on the benefits of respite care for carers.[131]

1.9.4 Respite care	Grade
Stroke survivors and their carers/families should have access to respite care options. The respite care may be provided in their own home or in an institution.	GPP

1.10 Palliative care

Fourteen per cent of acute stroke patients admitted to hospital die in hospital (9% within seven days)[11] and approximately 20% die as a result of the stroke in the first 30 days.[132] A systematic review of the palliative care needs of stroke patients identified only seven studies.[133] The review showed that carers of stroke patients have different needs to those involved in specialist palliative care in cancer. They require more support, particularly as they are likely to be older and in poor health, and caring for their family members in difficult circumstances, often unsupported.

Evidence on palliative care in stroke is lacking. Only one observational study was identified that developed and implemented a care pathway for palliative care in acute stroke. The study reported improved processes of care based on national standards compared to care provided prior to the pathway.[134]

While there are a number of systematic reviews on palliative care (primarily for cancer), there are insufficient studies to support specific interventions.[135, 136] An RCT that compared an inpatient palliative care service (IPCS) with usual care demonstrated greater patient satisfaction, more advanced directives at first hospitalisation discharge, reduced intensive care unit (ICU) admissions on subsequent hospitalisation, and lower total health costs for patients in the IPCS intervention.[137] While not specific to stroke the results may be applicable to those with stroke but implementation is dependent on the availability of such services in Australia. There is evidence from systematic reviews to suggest that communication skills training can have a small beneficial effect on behaviour change in health professionals working with people with cancer.[138, 139] Education and training may be provided to those caring for stroke patients and their families to assist in the care of non-complex patients where specialist services are not routinely involved.

People with stroke who are dying and their families and carers should receive care consistent with the principles and philosophies of palliative care in accordance with the *Standards for Providing Quality Palliative Care for All Australians*.[140] This includes an integration of the physical, psychological, spiritual, cultural and social needs of all those involved. An accurate assessment of prognosis or imminent death should be made for patients with severe stroke or those who are deteriorating.

Practical end-of-life issues, such as the use of medical power of attorney and advance care directives, should be discussed. Organ donation may be sensitively raised if appropriate. Issues of bereavement may become part of the responsibility of the stroke team.

1.10 Palliative care		Grade
a)	An accurate assessment of prognosis or imminent death should be made for patients with severe stroke or those who are deteriorating.	GPP
b)	Stroke patients and their families/carers should have access to specialist palliative care teams as needed and receive care consistent with the principles and philosophies of palliative care.	B [137]
c)	A pathway for stroke palliative care can be used to support stroke patients and their families/carers and improve care for people dying after stroke.	D [134]

1.11 Stroke service improvement

Stroke unit care has been shown to involve higher rates of adherence to key processes of care.[106] Thus it is important to monitor key processes and patient outcomes to foster improved service delivery. One important strategy to improve quality of care involves the process of audit and feedback. Audit and feedback have been found to produce small to modest improvements from a large number of wide-ranging studies in one Cochrane review (n=118 studies).[141] Audit and feedback have also been successfully used locally and internationally to both prompt service improvement and demonstrate improved services.[142,143] However, quality-improvement activities often use a multifaceted strategy such as educational meetings, reminders, printed material, or opinion leaders with or without audit and feedback.[141, 144]

One cluster RCT 145 in UK primary care (n=76 practices) found a multifaceted approach led to a 36% increase (95% CI 4–78) in diagnosis of atrial fibrillation, and improved treatment of TIA (OR of complying with guidelines 1.8, 95% CI 1.1–2.8). The approaches used included guideline recommendations, audit and feedback, interactive educational sessions, patient prompts and outreach visits. Several quality improvement programs incorporating data collection, team planning review, decision support education, key opinion leaders and team planning have demonstrated improvements in processes and outcomes for patients.[146, 147]

Based on the experience from the National Sentinel Audit of Stroke in the UK, a cycle of comprehensive audit at least every two years has been established in Australia by the NSF in the National Stroke Audit (see Appendix 4 for more information). However, services may benefit from more frequent audit (e.g. registry of all patients) based on a smaller number of key indicators (e.g. stroke unit access, timely imaging, aspirin within 48 hours, and secondary prevention measures on discharge) by providing the ability to monitor continuous quality improvement activities.

1.11 Stroke service improvement		Grade
a)	All stroke services should be involved in quality improvement activities that include regular audit and feedback ('regular' is considered at least every two years).	B [141]
b)	Indicators based on nationally agreed standards of care should be used when undertaking any audit.	GPP
c)	General practitioners should keep a register (or be able to extract this from current practice datasets) which enables audit and review of relevant stroke and TIA management.	B [145]

CHAPTER

TWO

Stroke recognition and pre-hospital care

Stroke recognition and pre-hospital care

Early recognition of stroke symptoms, the subsequent response of individuals to having a stroke or TIA, and the timing and method by which people are transferred to hospital are critical to ensuring optimal outcomes for stroke patients.[30, 148] In this hyper-acute phase of care, the ambulance service has a central coordinating role. Stroke patients should not only receive a high triage priority, comparable to other similarly lethal or disabling medical emergencies, but the ambulance service should also facilitate early notification of the receiving hospital and ensure that a hospital with a stroke unit is selected, where such hospitals exist.

One cluster RCT (n=75 720) of a population-based intervention (letter, bookmark and sticker) reduced delays to hospital presentation in women but not in men.[149] Another RCT (n=274) failed to demonstrate any difference after six weeks between two different poster messages aiming to improve knowledge.[150] Other population-based before-after studies focussed on television and/or print media, have been shown to increase knowledge of stroke.[151–153] Other innovative education interventions have also been found to improve stroke knowledge.[154–157] While the link between increased knowledge and actions taken is complex, several studies have found that population-based awareness interventions reduce delays to hospital and increase the number of stroke presentations to ED.[158–160] The FAST mnemonic (Face, Arm, Speech, Time) identified 88.9% of stroke and TIA cases in one cohort study.[161] The FAST mnemonic is used for public awareness campaigns in Australia, New Zealand, the UK and parts of Europe. Education of ambulance staff and ED staff regarding the signs of stroke and the critical nature of stroke increased the use of ambulance transport, decreased admission delays and increased the number of patients receiving thrombolysis.[21, 28, 162]

A multifaceted strategy that includes high-priority assignment by ambulance services and early notification to hospital EDs improves acute stroke management.[14–16, 26]

Several validated pre-hospital screening tools have been developed, for example, the Los Angeles Pre-hospital Stroke Screen and the Melbourne Ambulance Stroke Screen (MASS).[31, 163–165]

Specific training for ambulance personnel improves diagnostic accuracy and reduces pre-hospital delays.[13, 14] For example, a one-hour training session based on the only Australian tool, the MASS, increased the diagnostic accuracy of pre-hospital emergency service staff from 78 to 94%.[14]

A large cluster RCT (n=4900) based in Italy found a pre-hospital care pathway which included the use of validated tools, selection criteria for pathway activation, preferential transportation to known stroke specialist centres, communication links (pre-hospital notification) and education led to a non-significant increase in the number of patients being transferred to a stroke unit and significantly more patients receiving rt-PA.[17] Importantly the protocol of bypass did not greatly lengthen transportation times in suburban regions (+13 mins).[17] Multiple observational studies have also found pre-hospital services organised for hospital bypass (i.e. preferential transportation to known stroke specialist centres) led to a modest improvement in access to proven stroke interventions (stroke unit care, rt-PA).[20, 26, 162]

Currently only one in five Australian hospitals report arrangements with local ambulance services.[32] Ambulance services throughout Australia are state-based and have differing geographic, clinical and administrative arrangements. Ambulance services should work closely with their local clinical networks to establish pre-notification strategies for stroke. Additionally, hospital bypass requires 24-hour specialist staffing of stroke units which is not consistently available in Australia.

Stroke recognition and pre-hospital care		Grade
a)	The general public should receive ongoing education on how to recognise the symptoms of stroke and the importance of early medical assistance.	B [149, 151]
b)	Stroke patients should be assigned a high priority by ambulance services.	C [14–16, 26, 162]
c)	Ambulance services should use a validated rapid pre-hospital stroke-screening tool and incorporate such tools into pre-hospital assessment of people with suspected stroke.	B [31, 163–165]
d)	Health and ambulance services should develop and use prenotification systems for stroke.	C [17, 26, 162]
e)	Ambulance services should preferentially transfer suspected stroke patients to a hospital with stroke unit care.	C [13, 17, 26, 166, 167]

CHAPTER

THREE

Early assessment and diagnosis

Early assessment and diagnosis

The aim of assessment of a patient with suspected stroke or TIA is to confirm the diagnosis, identify and treat the cause, and guide early rehabilitation and relevant early secondary prevention to prevent complications or stroke reoccurrence. Appropriate diagnosis of stroke and immediate referral to a stroke team is vital given advances in hyper-acute treatments. Strong working relationships are required between ED staff and the stroke team to improve timely assessment and early management.

3.1 Transient ischaemic attack

There are strong similarities between minor ischaemic stroke and TIA and therefore the same principles of assessment and management, including secondary prevention, should be applied. This section discusses aspects of care that are specific for patients with TIA. The organisation of care for patients with TIA is discussed in 1.5 Services for TIA.

Definition and prognosis

TIA is defined as rapidly developed clinical signs of focal or global disturbance of cerebral function lasting less than 24 hours, with no apparent non-vascular cause. Given TIAs rarely last longer than one hour, a revised definition has been proposed as a 'brief episode of neurological dysfunction caused by a focal disturbance of brain or retinal ischaemia, with clinical symptoms lasting less than 1 hour, and without evidence of infarction'.[168]

The risk of subsequent stroke after TIA was shown to be 5.2% (95% CI 3.9–6.5) at seven days in one meta-analysis [120] and 3.5%, 8.0%, and 9.2% at 2, 30, and 90 days after TIA, respectively, in another meta-analysis.[169] Both analyses reported substantial heterogeneity due to different study methods, settings, and interventions.[120, 169] A significant proportion of the risk is within the first 48 hours, necessitating early diagnostic workup and early interventions to prevent further events.

Assessment

Rapid expert assessment and management have been shown to reduce rates of subsequent stroke (see 1.5 Services for TIA). As with stroke, the diagnosis of TIA is based on careful clinical history and examination. It is vital that an accurate history and clinical assessment should initially be undertaken to elicit the onset and nature of symptoms, and to identify treatable causes that can reduce the risk of further events. Input from a stroke expert may improve diagnosis and decision-making regarding the likely cause of the TIA and the investigations that are needed.[110]

Factors which have been found to be prognostic indicators of the risk of subsequent stroke after TIA include age >60, diabetes mellitus, longer symptom duration (> 10 mins), motor or speech symptoms of TIA, and high blood pressure (BP) (> 140/90 mmHg).[170] The ABCD^2 tool includes these risk factors.

ABCD^2 TOOL[170]
A = Age: ≥ 60 years (1 point)
B = Blood pressure: ≥140 mmHg systolic and/or 90 mmHg diastolic (1 point)
C = Clinical features: unilateral weakness (2 points), speech impairment without weakness (1 point)
D = Duration: > 60 mins (2 points), 10–59 mins (1 point)
D = Diabetes (1 point)

The tool has a maximum score of 7; based on a study looking at the original ABCD tool, a cut-off score of 4 has been suggested to differentiate between high and low risk.[171] Several studies have questioned the utility of this tool.[107, 172, 173] One systematic review (20 validation studies, 9808 subjects and 456 strokes at seven days) found the predictive value to be a modest but clinically useful 0.72 AUC.[121] This review found the predictive value varied significantly between studies, but 75% of the variance was accounted for by study method and setting with the methodologically less robust studies (retrospective case-note reviews) found to have lower stroke prediction rates. The ABCD^2 score has been found to be useful in making decisions about further investigations and management in several overseas studies.[173–175] If used, the ABCD^2 score should be considered in addition to other factors that suggest the patient is at high risk of a stroke such as tight carotid stenosis, a new diagnosis of AF or two or more TIAs within the last week (known as 'crescendo TIA'). Patients with tight carotid stenosis or AF account for approximately 25% of patients with TIA.[176] Further studies in more recent cohorts, particularly in Australian populations which use more aggressive preventative interventions, are needed to better understand the usefulness of the ABCD^2 tool.

Electrocardiography (ECG) should be conducted routinely to screen for AF. Studies have found that 5–8% of patients

with subsequent stroke after TIA have AF which has not been found to be related to higher scores on risk stratification tools.[176–178] Clearly a new diagnosis of AF or non-therapeutic INR levels would indicate a patient is at high risk and further rapid investigations and management are required.[179]

Early (within 24 hours) carotid investigations should be carried out routinely for patients with suspected anterior circulation TIAs (see 3.3 Imaging) as the presence of symptomatic carotid disease increases the risk of stroke in patients with TIA.[180, 181] The prevalence of carotid disease has been reported to be 5–17% in recent cohort studies.[173, 182, 183] Where symptomatic carotid stenosis is found, early (within two weeks) carotid endarterectomy significantly reduces the risk of subsequent stroke (see 5.7 Carotid surgery).

Brain imaging should also be conducted. The presence of new brain CT changes within 48 hours after TIA was found to predict stroke risk in a retrospective prognostic study; however, such changes were only identified in a small number of cases (4%).[184] As with ischaemic stroke, CT is useful to exclude conditions that could mimic TIA such as subdural haematoma or brain tumour and should be carried out early in all patients.[185]

Magnetic resonance imaging (MRI) with diffusion-weighted imaging (DWI) is the imaging strategy of choice for patients with suspected TIA with studies detecting ischaemic changes signifying infarction in 16–67% of those with TIA.[186] A positive MRI test has been found to correlate with increased risk of subsequent stroke.[182, 186–188] MRI with DWI increases the utility of the ABCD^2 tool to more acceptable levels.[182, 183, 187–189] AF (OR 2.75, 95% CI 1.78–4.25) and ipsilateral ≥ 50% carotid stenosis (OR 1.93, 95% CI 1.34–2.76) were associated with positive MRI (one systematic review).[186] The routine use of MRI for patients with TIA is currently limited to the less than 20% of hospitals in large urban centres.[190, 191] In settings with limited or no brain or carotid imaging facilities referral within 24 hours should be made to the nearest centre where these tests can be quickly carried out.

The measurement of D-dimer or C-reactive protein levels does not improve the accuracy of clinical or imaging assessment[192] but lipoprotein-associated phospholipase A2 levels may provide useful information.[192]

3.1 Transient ischaemic attack		Grade
a)	All patients with suspected TIA should have a full assessment that includes a detailed history and clinical, prognostic (e.g. ABCD^2 score) and investigative tests (e.g. blood tests, brain and carotid imaging and ECG) at the initial point of healthcare contact, whether first seen in primary or secondary care.	B [109, 110, 121]
b)	Patients identified as high risk (e.g. ABCD^2 score >3 and/or any one of AF, carotid territory symptoms or crescendo TIA should undergo: • urgent brain imaging (preferably MRI with DWI), 'urgent' being immediately where available, but within 24 hours) • carotid imaging should also be undertaken urgently in patients with anterior circulation symptoms who are candidates for carotid re-vascularisation. In settings with limited access to these investigations, referral within 24 hours should be made to the nearest centre where such tests can be quickly conducted.	B [121, 184, 186, 193, 194]
c)	Patients classified as low-risk (e.g. ABCD^2 score <4 without AF or carotid territory symptoms or who present more than one week after last symptoms should have brain and carotid imaging (where indicated) as soon as possible (i.e. within 48 hours).	B [121, 185, 193, 194]
d)	The following investigations should be undertaken routinely for all patients with suspected TIA: full blood count, electrolytes, erythrocyte sedimentation rate (ESR), renal function, lipid profile, glucose level, and ECG.	GPP

3.2 Rapid assessment in the emergency department

Initial clinical assessment remains the cornerstone in the diagnosis of stroke and TIA. Further investigations and brain imaging are undertaken to confirm the diagnosis and are essential for a decision on intervention.[195, 196] The initial assessment should at a minimum determine whether the patient has acute, focal or neurological deficits.[196]

A small number of studies have found generally good diagnostic accuracy (approximately 90% sensitivity) in emergency medical staff compared to stroke specialists.[197–199] The selection of hyper-acute therapy often depends on confirmation of diagnosis by a stroke specialist as approximately 20–30% of cases are incorrectly diagnosed as stroke or TIA irrespective of who makes the diagnosis.[200] The reliability of bedside

clinical assessment improves with experience and confidence suggesting the need for a close working relationship between ED staff and stroke specialists, and the development of rapid referral processes.[195, 199]

A standardised assessment tool should be used to improve reliability of assessment and several stroke-specific scales have been developed.[196] The more commonly used acute assessment scales, for example, the National Institutes of Health Stroke Scale (NIHSS) and the Scandinavian Stroke Scale (SSS), only measure stroke impairment or severity but such scales have prognostic value.[201–203] Such scales require experience and formal training.

Of the diagnostic screening tools that have been developed specifically for ED staff to aid in rapid assessment and referral, only the Recognition of Stroke in the Emergency Room (ROSIER) scale has been adequately studied.[204] This scale incorporates elements of history and physical assessment in line with tools developed for the pre-hospital setting but also includes other important elements such as consciousness (Glasgow Coma Scale), BP and blood glucose. ROSIER has been found to sensitively identify stroke mimics thereby helping ED staff make appropriate referrals to the stroke team.[204] The usefulness of ROSIER has also been confirmed in a subsequent small Irish study.[205] ROSIER has not been validated for use by non-medical staff. Other stroke screening tools developed primarily for the pre-hospital setting have not been directly compared.

The National Institute of Clinical Studies has published an ED Stroke and TIA care bundle that focuses on implementation of key components of assessment and management of stroke and TIA. This resource can be accessed from http://www.nhmrc.gov.au/nics/programs/emergency/stroke_tia.htm.

3.2 Rapid assessment in the emergency department		Grade
a)	Initial diagnosis should be reviewed by a clinician experienced in the evaluation of stroke.	C [195, 199, 200]
b)	Emergency department staff should use a validated stroke screening tool to assist in rapid accurate assessment for all people with stroke.	C [204, 205]
c)	Stroke severity should be assessed and recorded on admission by a trained clinician using a validated tool (e.g. NIHSS or SSS).	C [201, 203, 206]

3.3 Imaging

Brain imaging

Stroke and TIA are clinical diagnoses; brain imaging is needed to confirm cerebral ischaemia or haemorrhage and exclude stroke mimics. MRI DWI has high sensitivity (0.99, 95% CI 0.23–1.00) and specificity (0.92, 95% CI 0.83–0.97) for acute stroke.[207] CT has high specificity (1.00, 95% CI 0.94–1.00) but low sensitivity (0.39, 95% CI 0.16–0.69).[207] CT is sensitive to ICH in the acute phase but not after 8–10 days when MRI should be used to differentiate ICH and ischaemic stroke.[185] To confirm diagnosis and differentiate ICH from ischaemic stroke, MRI is now considered the imaging modality of choice. The longer imaging time and the limited availability of MRI scanners in many centres compared to CT limit the routine application of MRI and it is likely that CT will remain the imaging modality of most use for the foreseeable future. One modelling study reported the most cost-effective strategy in acute stroke is for all patients to undergo immediate imaging.[185]

Advanced MRI and CT imaging techniques may be used to identify ischaemic but potentially viable brain tissue and thus guide intervention decisions in the hyper-acute phase. To date there is no evidence of differences in outcomes between plain CT and advanced imaging.[194]

Carotid imaging

For patients with carotid territory symptoms where large artery disease is suspected, carotid-imaging studies should be performed. Systematic reviews and individual patient data meta-analysis indicate that non-invasive imaging provides good diagnostic accuracy in patients with 70–99% stenosis (sensitivity 0.85–0.95, specificity 0.85–93) compared to intra-arterial angiography.[193, 208, 209] Non-invasive methods (contrast-enhanced magnetic resonance angiography [CE-MRA], Doppler ultrasound, MRA, CT angiography [CTA]) have similar accuracy with CE-MRA having the highest accuracy. Non-invasive imaging for symptomatic events was much less accurate for patients with 50–70% stenosis, but this conclusion is based on limited data.[193]

Carotid surgery is most beneficial early after non-severely disabling stroke (see 5.7 Carotid surgery) and hence carotid imaging should be undertaken as part of the initial diagnostic workup in selected patients. One modelling study found Doppler ultrasound was the most useful strategy for assessing patients soon after a TIA or mild stroke and led to earlier surgery.[194] Non-invasive tests tend to overestimate stenosis, but this is less of an issue when surgery is performed within two weeks due to the benefits

of earlier surgery. When patients present after a few weeks, more specific imaging, such as CE-MRA or CTA, is needed to ensure that only those with definite 70–99% stenosis undergo endarterectomy.[194] The availability of resources will determine which strategy is adopted locally. Intra-arterial angiography conferred no advantage over non-invasive imaging.[194]

Cardiac imaging

There is insufficient evidence to recommend routine cardiac imaging.[210] Echocardiography may be considered as a tool to help identify a potential cardioembolic source in selected patients, for example those with a history of cardiac abnormalities or an abnormal ECG where there are no current indications for anticoagulation, or those with stroke of unknown origin after standard diagnostic workup.[211] Transthoracic echocardiography (TTE) is less invasive but less sensitive than transoesophageal echocardiography (TEE) in detecting sources of cardiac emboli in patients with TIA or stroke.[211] TEE also appears more useful than TTE in deciding whether to begin anticoagulation therapy.[212]

3.3 Imaging		Grade
a)	All patients with suspected stroke should have an urgent brain CT or MRI ('urgent' being immediately where facilities are available but within 24 hours). Patients who are candidates for thrombolysis should undergo brain imaging immediately.	A[185, 207]
b)	A repeat brain CT or MRI and acute medical review should be considered urgently when a patient's condition deteriorates.	GPP
c)	All patients with carotid territory symptoms who would potentially be candidates for carotid re-vascularisation should have urgent carotid imaging.	B [193, 209, 213]
d)	Further brain, cardiac or carotid imaging should be undertaken in selected patients: • where initial assessment has not identified the likely source of the ischaemic event • with a history of more than one TIA • likely to undergo carotid surgery.	B [193, 194]

Once a clinical diagnosis of stroke has been made, additional investigations are used to confirm the diagnosis and to determine the cause of the event, specifically if it is cardiac or carotid in origin. Routine investigations should include full blood count, electrolytes, erythrocyte sedimentation rate, C-reactive protein, renal function, cholesterol and glucose levels although direct evidence is lacking for each of these investigations. An ECG should also be conducted routinely to detect AF.[209] If clinical history, imaging and routine investigations do not adequately identify the underlying cause then further investigations may be warranted. Some tests should be regularly repeated as part of monitoring during the acute phase, taking into account individual patient needs. For example, thrombophilia screening may be needed if there is a family history of recurrent thrombosis in young adulthood (particularly for patients less than 50 years old). A Holter monitor (24–72 hours) alone or in combination with an event loop recorder may be useful in detecting intermittent AF but only a small number of new cases (4.6–7.7%) are found using such investigations.[214] While biomarker tests have been suggested as an aid to diagnosis (particularly for cardioembolic or haemorrhagic stroke) there is little indication that such tests or a combination of tests are more effective than existing screening tools or clinical expertise, and further research is needed.[215–219]

3.4 Investigations		Grade
a)	The following investigations should be routinely carried out in all patients with suspected stroke: full blood count, electrocardiogram, electrolytes, renal function, fasting lipids, erythrocyte sedimentation rate and/or C-reactive protein and glucose.	GPP
b)	Selected patients may require the following additional investigations: catheter angiography, chest X-ray, syphilis serology, vasculitis screen and prothrombotic screen. These tests should be performed as soon as possible after stroke onset. Some of these tests may need to be performed as an emergency procedure in certain patients.	GPP

CHAPTER

FOUR

Acute medical and surgical management

Acute medical and surgical management

This chapter covers medical management in the acute phase of care. Importantly, several other critical components of very early assessment (including screening) and management should be routinely provided in addition to those discussed in this chapter. These include 6.2.1 Dysphagia, 7.1 Nutrition and hydration, 7.10 Incontinence and 7.13 Deep venous thrombosis or pulmonary embolism. Furthermore, rehabilitation should commence in the acute phase (see 6.1 Amount and timing of rehabilitation).

4.1 Thrombolysis

Access to thrombolysis remains low in Australia (~3% of all ischaemic stroke patients).[11] However some Australian centres have achieved thrombolysis rates of 20%.[26] Only 39% of patients arrive within 4.5 hours and pre-hospital delays (particularly time to seek medical help) remain one of the main challenges.[11] Intravenous rt-PA was licensed by the Australian Therapeutic Goods Administration for use within three hours in acute ischaemic stroke in October 2003. Intra-arterial and mechanical clot retrieval are discussed separately (see 4.2 Neurointervention).

One updated Cochrane review (26 RCTs) examined four different thrombolytic agents: rt-PA, streptokinase, recombinant pro-urokinase, and urokinase, 56% of the data coming from trials of rt-PA.[12] Only 0.5% of the data came from patients over 80 years of age. Thrombolysis in all trials and all agents combined resulted in a significant reduction in the combined end-point of death or disability (OR 0.81, 95% CI 0.73–0.90). Thrombolysis (all agents pooled) showed a net benefit, but is associated with a risk of intracerebral haemorrhage (ICH) at the end of three or six month follow-up (OR 3.49, 95% CI 2.81–4.33). The effect of rt-PA on death or dependency was similar whether given within three hours (OR 0.69, 95% CI 0.44–1.09) or later than three hours after stroke (OR 0.88, 95% CI 0.73–1.06), although there is a strong trend towards better outcome with earlier intervention (I^2=25%, p=0.09). There were no differences between agents in terms of symptomatic intracranial haemorrhage (sICH), death or dependency but this conclusion is based on indirect comparisons and heterogeneity was noted. More robust data are needed before agents other than rt-PA can be recommended. Concurrent antithrombotic therapy increased adverse events with the odds of death by the end of follow-up found to increase (antithrombotic therapy within 24 hours of thrombolysis OR 1.92, 95% CI 1.43-2.57; no antithrombotic drugs within the first 10–14 days OR 0.89, 95% CI 0.58-1.37). These conclusions are however based on non-randomised comparisons. The review concluded that thrombolytic therapy appears most beneficial if provided in experienced centres in highly selected patients. Widespread use in routine clinical practice in non-organised stroke care is not recommended.[12]

Another pooled analysis (six rt-PA trials) confirmed that intervention with rt-PA had a clear net benefit in reducing the odds of death or dependency if given within three hours.[220] Odds of functional independence were 30% greater with a 12% absolute difference between the rt-PA intervention group and controls.[220] Using data from the same six RCTs included in the pooled analysis, the NNT/NNH estimates are 3.6/65 (0–90 minutes), 4.3/38 (91–180 minutes), 5.9/30 (181–270 minutes), and 19.3/14 (271–360 minutes).[221] The ECASS III RCT (included in the updated Cochrane review[12]) found rt-PA to be effective when provided up to 4.5 hours after stroke onset (OR 1.34, 95% CI 1.02–1.76). There was a significant increase in sICH (2.7% vs 0.3%) but no significant effect on deaths (6.7% vs 8.2%).[222] A systematic review (seven trials including the ECASS III study) confirmed that rt-PA given 3–4.5 hours after stroke onset is associated with an increased chance of favourable outcome (OR 1.31, 95% CI 1.10–1.56) with no significant difference in mortality (OR 1.04, 95% CI 0.75–1.43) compared to placebo.[223]

Phase IV studies and large registries have shown rt-PA to be as safe (with often lower adverse events reported) and effective in clinical practice as in the major trials.[224–226] Careful patient selection, strict protocol adherence including close monitoring of patient vital signs (particularly high blood pressure which is clearly associated with poor outcomes)[227, 228] audit and quality improvement processes are strongly recommended for all centres delivering rt-PA.[229]

The available evidence shows that intravenous rt-PA therapy is beneficial for selected patients but should be delivered in well-equipped and skilled EDs and/or stroke care units with adequate expertise and infrastructure for monitoring, rapid assessment and investigation of acute stroke patients.[229] Collaboration between clinicians in pre-hospital emergency services, emergency medicine, neurology and neuroradiology is recommended to enable prompt identification of potentially eligible patients, expert patient selection and audit and quality improvement initiatives.[229] Models for improving access to rt-PA for rural and regional centres including telestroke and or transfer protocols urgently need to be developed and tested to ensure greater equity of services across Australia.

Advanced MR and CT imaging may help identify ischaemic but potentially viable brain tissue in patients considered for thrombolysis, particularly those presenting beyond the currently accepted maximum time window for rt-PA (4.5 hours). While thrombolysis based on MRI selection has been shown to attenuate infarct growth[230], overall, advanced imaging has not been shown in RCTs to have any effect on patient outcomes (see 3.3 Imaging).[12, 231] Of the many observational studies, the largest registry (n=1210) reported that MRI selection significantly reduced symptomatic intracranial hemorrhage (OR 0.52, 95% CI 0.27–1.0) compared to standard CT selection. Beyond three hours, MRI significantly predicted a favorable outcome (OR 1.47, 95% CI 1.02–2.12). Under three hours and for all secondary end-points, there was a trend in favor of MRI-based selection over standard CT-based intervention.[232]

One systematic review (six RCTs and three non-randomised trials) found sonothrombolyis (ultrasound-assisted thrombolysis) increased the likelihood of complete recanalisation for high-frequency applications compared to routine rt-PA alone (OR 2.99, 95% CI 1.70–5.25) and did not increase the risk of sICH (OR 1.26, 95% CI 0.44–3.60). Low-frequency ultrasound led to higher rates of sICH compared to rt-PA alone (35.7% vs 17.2%).[233]

The failure to implement stroke thrombolysis is an international problem but numerous studies have demonstrated rates of up to 20% are achievable. In Australia, new models of care need to be developed and assessed and it is likely that, given the international experience, “one-size-fits-all” solutions will fail. Local and network interventions will need to be developed and evaluated. Such interventions may need to include telemedicine resources and training for regional and rural centres, systems-level coordination and changes, and appropriate numbers of trained acute stroke personnel with obvious implications for ongoing training and support. Given the potential risks of thrombolysis, there is the potential for adverse outcomes with inappropriate use, and routine audit and ongoing quality improvement will be important to identify problem areas and local solutions.

4.1 Thrombolysis		Grade
a)	Intravenous rt-PA in acute ischaemic stroke should only be undertaken in patients satisfying specific inclusion and exclusion criteria.	A [12]
b)	Intravenous rt-PA should be given as early as possible in carefully selected patients with acute ischaemic stroke as the effect size of thrombolysis is time-dependent. Where possible, therapy should commence in the first few hours but may be used up to 4.5 hours after stroke onset.	A [12, 223]
c)	Intravenous rt-PA should only be given under the authority of a physician trained and experienced in acute stroke management.	B [12]
d)	Thrombolysis should only be undertaken in a hospital setting with appropriate infrastructure, facilities and network support including:	
	• access to an multidisciplinary acute care team with expert knowledge of stroke management who are trained in delivery and monitoring of patients receiving thrombolytic therapy	GPP
	• pathways and protocols available to guide medical, nursing and allied health acute phase management, in particular acute blood pressure management	C [224, 227 234]
	• immediate access to imaging facilities and staff trained to interpret images.	GPP
e)	A minimum set of de-identified data from all patients treated with thrombolysis should be recorded in a central register to allow monitoring, review, comparison and benchmarking of key outcomes measures over time.	C [225]
f)	The commencement of aspirin for patients who have received thrombolysis should be delayed for 24 hours (usually after a follow-up scan has excluded significant bleeding).	GPP

4.2 Neurointervention

Neurointerventional therapy in this section includes intra-arterial (IA) thrombolysis and mechanical clot removal. Most of the reported studies reported have been small observational studies based in highly specialised centres (i.e. those with advanced imaging, neurosurgical specialisation and appropriate infrastructure). There are currently only a few very large urban centres which offer such services in Australia.

One updated Cochrane review[12] identified four IA thrombolysis RCTs, two using urokinase and two using recombinant pro-urokinase. IA thrombolysis resulted in a significant reduction in the combined odds of death or dependency at follow-up (OR 0.49, 95% CI 0.31–0.79). The largest RCT (n=180) of IA thrombolysis (in addition to heparin) found high recanalisation rates (66% vs 18%, p<0.001), similar mortality, improved outcomes (p=0.04) but higher sICH (10% vs 2%, p=0.06).[235]

One systematic review involving 13 case series describing outcomes for IA thrombolysis or IV thrombolysis in basilar artery occlusion found no difference in outcomes between IV or IA thrombolysis even though significantly greater recanalisation rates were observed.[236] One small RCT of IA thrombolysis within 24 hours in posterior circulation strokes reported possible improved outcome but numbers were too small for meaningful analysis.[237] A subsequent large registry cohort found 68% of patients with BAO had a poor outcome (mRS >3). No statistically significant superiority was found for any intervention strategy (antiplatelet therapy, IA or IV thrombolysis).[238] More robust data are required.

No RCTs were found for mechanical clot removal. A systematic review (23 small observational studies) found those treated with clot removal devices were 14.9 times (95% CI, 4.4–50.0) more likely to have a good outcome (mRS ≤ 2) and 2.2 times less likely to die (95% CI, 0.98–5.1) after adjustment for age, sex, and pre-intervention NIHSS.[239] A good outcome (mRS<2) was reported in 36% of the pooled population. However, the mortality rate was 29% and the haemorrhage rate 22%.[239] More robust data are required.

Large tertiary centres could organise facilities for IA thrombolysis to allow appropriate referral for highly selected patients within the metropolitan areas. In rural areas, appropriate network arrangements would also facilitate such referral (see 1.2.5 Telemedicine and networks). It is highly likely that these services will continue to be limited due to the small number of trained personnel and associated high costs.

4.2 Neurointervention		Grade
a)	Intra-arterial (IA) thrombolysis within six hours can be used in carefully selected patients.	B [12]
b)	Each large tertiary centre should consider establishing facilities and systems for IA thrombolysis.	GPP
c)	There is insufficient evidence to recommend the use of mechanical clot removal in routine clinical practice. Consideration should be given to enrolling patients in a suitable clinical trial evaluating this intervention.	GPP

4.3 Antithrombotic therapy

An updated Cochrane review (12 RCTs) found consistent but modest net reduction in death or disability (NNT=79) of acute phase antiplatelet therapy in ischaemic stroke.[240] Almost all of the data were from trials with aspirin therapy (160–300 mg) that commenced within 48 hours and continued in the weeks following stroke onset.[240] While there was a small increase in intracranial haemorrhage there was a definite net benefit.[240] Two RCTs testing early (within 24 hours) clopidogrel plus aspirin[241] or extended-release dipyridamole plus aspirin[242] in patients with TIA or minor ischaemic stroke have reported similar or potential benefits compared to aspirin monotherapy. Large (well-powered) RCTs are needed before therapy other than aspirin alone can be recommended in routine clinical care.

If patients receive thrombolysis, aspirin should be deferred for at least 24 hours and only prescribed if follow-up brain imaging has excluded intracranial haemorrhage (see 4.1 Thrombolysis). Another updated Cochrane review (24 RCTs) found no evidence in ischaemic stroke that early anticoagulant therapy (standard unfractionated heparin, low-molecular-weight heparins, heparinoids, oral anticoagulants or thrombin inhibitors) reduced the odds of death or dependency (OR 0.99, 95% CI 0.93–1.04).[243] Although there were fewer recurrent ischaemic strokes (OR 0.76, 95% CI 0.65–0.88) and fewer pulmonary emboli (OR 0.60, 95% CI 0.44–0.81), Early anticoagulant therapy was associated with an increase in symptomatic ICH (OR 2.55, 95% CI 1.95–3.33) and extra-cranial haemorrhages (OR 2.99, 95% CI 2.24–3.99).[243] Another meta-analysis (seven RCTs) similarly found no overall effect of anticoagulant treatment on death or dependency in acute cardio-embolic stroke (OR 1.0, 95% CI 0.82–1.24).[244]

Uncommon presentations such as arterial dissection may prompt consideration of early anticoagulation. Arterial dissection involves a tear developing in the inner lining

of the artery, which increases the likelihood of clotting and stroke. Dissection is rare (2.5% of all strokes) but is more frequent (5–22%) for patients less than 45 years old.[245] There is currently no RCT evidence for the preferred antithrombotic therapy. A systematic review of 26 small, lower-level studies suggested there was no difference in outcomes between antiplatelet and anticoagulation therapy with only a small number (0.5%) of ICH.[245]

4.3 Antithrombotic therapy		Grade
a)	Aspirin orally or via a nasogastric tube or suppository (for those with dysphagia) should be given as soon as possible after the onset of stroke symptoms (i.e. within 48 hours) if CT/MRI scans exclude haemorrhage. The first dose should be at least 150 to 300 mg. Dosage thereafter can be reduced (e.g. 100 mg daily).	A [246]
b)	The routine use of early anticoagulation in unselected patients following ischaemic stroke/TIA is NOT recommended.	A [247]

4.4 Acute phase blood pressure lowering therapy

While there is strong evidence for lowering BP for secondary prevention (see 5.3 Blood pressure lowering), treatment within the first 48 hours remains controversial with both high and low BP found to negatively affect patient outcomes.[248, 249] Large drops in BP appear to lead to poorer outcomes while modest lowering interventions may produce benefits.[250] BP should be lowered to <185 mmHg systolic blood pressure (SBP) and <110 mmHg diastolic blood pressure (DBP) for ischaemic stroke patients eligible for thrombolysis (see 4.1 Thrombolysis).

There have been a number of studies investigating different agents for controlling BP. One Cochrane review (65 RCTs) of BP lowering within 24 hours of an acute CVD event (six RCTs specific to stroke, all assessing calcium channel blockers, found no difference in mortality at 10 days (RR 0.81, 95% CI 0.54–1.21).[251] Another updated Cochrane review (12 RCTs) of BP lowering within one week of stroke found angiotensin-converting enzyme (ACE) inhibitors, angiotensin receptor antagonists, calcium channel blockers, clonidine and glyceryl trinitrate each lowered BP while phenylephrine appeared to increase BP.[252] There is no evidence that therapy reduces mortality or improves functional outcomes.[252]

One RCT (25 sICH patients and 147 ischaemic stroke patients with SBP>160 mmHg) found that labetalol or lisinopril can effectively reduce BP without adverse events. IV labetalol worked more rapidly than oral labetol and may have a better safety profile.[253] No difference in death or dependency at two weeks was found but 3-month mortality was halved (9.7% vs 20.3%, HR 0.40, 95% CI 0.2–1.0). The study was underpowered for clear outcomes data and a larger study is needed. Potential adverse events for those with ICH were also reported at two weeks but numbers are too low (14 vs 3) for meaningful analysis.[253] In the absence of clear data there was consensus that for patients with severe hypertension, commencing or increasing BP therapy should be considered. Close monitoring of BP is recommended for all patients (see 4.7 Physiological monitoring).

There is currently insufficient evidence to recommend precise BP thresholds or targets in acute primary ICH. There is a general consensus that severe sustained elevated BP (e.g. SBP>180 mmHg) can be treated, especially if there is evidence or suspicion of raised intracranial pressure. Evidence from the pilot phase of the INTERACT trial[254] has shown that more intensive BP lowering did not appear to be associated with any major hazard (e.g. haematoma growth) in the first few hours after stroke onset. The results of the INTERACT-2 and other trials will be available in the coming years to determine clinical efficacy and help define the ideal BP targets for patients in the acute phase.

4.4 Acute phase blood pressure lowering therapy		Grade
a)	In ischaemic stroke, if blood pressure is more than 220/120 mmHg, antihypertensive therapy can be started or increased, but blood pressure should be cautiously reduced (e.g. by no more than 10–20%) and the patient monitored for signs of neurological deterioration.	GPP
b)	In acute primary intracerebral haemorrhage where severe hypertension is observed on several occasions within the first 24 to 48 hours of stroke onset, antihypertensive therapy (that could include intravenous treatment) can be used to maintain a blood pressure below 180 mmHg systolic (mean arterial pressure of 130 mmHg).	GPP
c)	Pre-existing antihypertensive therapy can be continued (orally or via nasogastric tube) provided there is no symptomatic hypotension or other reason to withhold treatment.	GPP

4.5 Surgery for ischaemic stroke and management of cerebral oedema

Cerebral oedema in the infarcted or peri-lesional brain tissue often leads to early deterioration and death.[255] Hemicraniectomy for ischaemic stroke should be considered for large life-threatening, space-occupying brain oedema or middle cerebral artery (MCA) infarcts where prognosis is poor, so called 'malignant infarction'.[256] A meta-analysis (three RCTs) found decompressive surgery combined with medical therapy reduced mortality and improved functional outcomes compared to medical therapy alone.[256] These benefits were seen only in selected patients who fulfilled clear inclusion criteria (e.g. 18–60 years old, who can undergo surgery within 48 hours of symptom onset and with clinical deficits suggesting significant MCA involvement).[256] Given the prognosis for patients with malignant infarction, an urgent referral for a neurosurgical opinion is strongly recommended.

One Cochrane review failed to find any RCTs for the use of angioplasty and stenting for intra-cranial artery stenosis.[257] Evidence from case-series studies with three or more cases demonstrated an overall peri-operative rate of stroke of 7.9%, of death 3.4%, and of stroke or death 9.5%. Further data are required before clear conclusions can be made regarding this intervention.

One Cochrane review (seven RCTs) found corticosteroid treatment has no benefit and may in fact cause harm and is therefore not recommended.[258]

Another Cochrane review (11 RCTs) found osmotherapy with glycerol reduced short-term (~1 week) mortality in those with ischaemic stroke (OR 0.65, 95% CI 0.44–0.97) but this reduction was no longer significant when all strokes were considered (OR 0.78, 95% CI 0.58–1.06) or at the end of scheduled trial follow-up (OR 0.98, 95% CI 0.73–1.31).[259] Two RCTs found a non-significant improvement in a good outcome at the end of follow-up (OR 0.73, 95% CI 0.37–1.42). Osmotherapy should only be considered in selected cases (e.g. while assessing whether to proceed with decompressive surgery).[259]

According to a Cochrane review (three small RCTs), there is insufficient evidence on the effects of mannitol in acute stroke.[260]

Hyperventilation has not been rigorously evaluated in stroke but short-term benefits have been found in patients with traumatic brain injury.[261]

4.5 Surgery for ischaemic stroke and management of cerebral oedema		Grade
a)	Selected patients (18–60 years, where surgery can occur within 48 hours of symptom onset) and with large middle cerebral artery infarction should be urgently referred to a neurosurgeon for consideration of decompressive hemicraniectomy.	A [256]
b)	Corticosteroids are NOT recommended for management of patients with brain oedema and raised intracranial pressure.	A [258]
c)	Osmotherapy and hyperventilation can be trialled while a neurosurgical consultation is undertaken, or in patients whose condition is deteriorating due to raised intracranial pressure.	C [259, 261]

4.6 Intracerebral haemorrhage management

In general the management of ICH is similar to that for ischaemic stroke (e.g. rapid assessment, routine investigations, and prevention of complications). This section addresses medical and surgical management specific to patients with ICH.

Medical management

Haematoma growth is predictive of mortality and poor outcomes after ICH.[262] A Cochrane review (six RCTs) found recombinant activated factor VII (rFVIIa) reduced haematoma growth but did not reduce death or dependency at three months (RR 0.91, 95% CI 0.72–1.15).[263] The use of rFVIIa in the treatment of ICH should be considered experimental and further trials are needed before recommendations on its usefulness in routine clinical practice can be made.[264]

The neuroprotective agents that have been tested (e.g. gavestinel) have shown no clear benefits for patients with ICH.[265] Citicoline has been evaluated in a very small Phase I study and further larger studies are needed.[266] Corticosteroids, glycerol and mannitol have all failed to show benefits for patients with ICH.[259, 260, 267]

While there is consensus that ICH due to anticoagulation therapy should be urgently reversed there is no clear consensus about which strategies to choose due to the lack of good quality data.[268, 269] Traditional approaches include administration of fresh-frozen plasma (FFP) and vitamin K, with prothrombin complex concentrate becoming more widely used in recent times.[259, 268, 269] Off-label use of rFVIIa alone or in combination with FFP has also been reported in small observational studies but is viewed as experimental only.[270, 271]

Management of BP is particularly important in ICH (see 4.4 Acute blood pressure lowering therapy) and is currently the subject of a large Australian RCT (INTERACT-2).

Surgical management

An updated Cochrane review (10 RCTs) found surgery (including craniotomy, stereotactic endoscopic evacuation or stereotactic aspiration) for supratentorial ICH results in significant reduction in the combined odds of death or dependency at final follow-up (OR 0.71, 95% CI 0.58–0.88).[272] However, there was variability in the trial outcomes and caution should be taken when interpreting the results. Less invasive surgery may lead to better outcomes (OR 0.66 stereotactic techniques vs OR 0.82 craniotomy) but this is only an indirect comparison between the two techniques and no firm conclusions can be made until direct trial comparisons are available. The largest trial included in the review (STICH) found no clear benefits for routine surgery over conservative management.[273] Another systematic review (seven RCTs including the STICH trial) suggested that there is no overall benefit.[274] Subgroup analysis found two specific groups of patients who may benefit from particular surgical approaches: patients with deep ICH who undergo stereotactic surgery and patients with superficial (<1 cm from surface) haematoma who undergo craniotomy.[273, 274] The risks and benefits of surgery need to be carefully considered and balanced against the options that medical therapy can provide.

There is currently no prospective RCT looking at surgery for those with cerebellar ICH. There is general agreement that surgery should be considered if cerebellar haematomas are >3 cm in diameter or if hydrocephalus occurs, although advanced age and coma reduce favourable outcomes.[275]

4.6 Intracerebral haemorrhage management		Grade
a)	The use of haemostatic drug treatment with rFVIIa is currently considered experimental and is NOT recommended for use outside a clinical trial.	B [264]
b)	In patients with ICH who were receiving anticoagulation therapy prior to the stroke and who have elevated INR, therapy to reverse anticoagulation should be initiated rapidly e.g. using a combination of prothrombin complex concentrate and vitamin K.	D [268, 269]
c)	Patients with supratentorial ICH should be referred for neurosurgical review if they have hydrocephalus.	GPP
d)	Surgery for supratentorial haemorrhage can be considered in carefully selected patients. If undertaken, surgery should be performed within 72 hours. The strongest evidence for benefit with surgery is for patients aged <85, a Glasgow Coma Score of 5–15 having altered consciousness or severe neurological deficit and presenting within 24 hours.	C [272]
e)	Surgical evacuation may be undertaken for cerebellar hemisphere haematomas >3 cm diameter in selected patients.	GPP

4.7 Physiological monitoring

One small RCT[276] and three non-RCTs[277–279] have found that monitoring in the first two days after stroke enhances the benefits of conventional stroke unit care. The preferred intensity (e.g. continuous or every 2–6 hours) and duration (e.g. 24–72 hours) of such monitoring are still unclear and further larger studies including cost-effectiveness data are required. Patients who receive rt-PA (see 4.1 Thrombolysis) should be regularly monitored but the importance of beginning early rehabilitation should also be taken into account.

4.7 Physiological monitoring		Grade
	Patients should have their neurological status (e.g. Glasgow Coma Scale), vital signs (including pulse, blood pressure, temperature, oxygen saturation, and glucose levels) and respiratory pattern monitored and documented regularly during the acute phase, the frequency of such observations being determined by the patient's status.	C [277–280]

4.8 Oxygen therapy

An updated Cochrane review (six RCTs) of hyperbaric oxygen therapy concluded that there are no significant differences in the death rate at six months (RR 0.61, 95% CI 0.17–2.2, p=0.45).[281] One quasi-RCT found no benefits of routine low-oxygen therapy for the first 24 hours in stroke patients.[282] A small RCT of eight hours of high-flow normobaric oxygen therapy started within 12 hours of onset in patients with perfusion-diffusion 'mismatch' on MRI found short-term improvements in stroke severity scales but no difference in patient outcomes at three months.[283] A recent RCT found that low-level nocturnal normobaric oxygen therapy commencing within 72 hours of stroke onset increased mean nocturnal oxygen saturation by 2.5% and reduced episodes of desaturation but produced no difference in any other outcomes.[284]

Many centres represented in the stroke unit trials data had management policies for oxygen therapy.[41] It was the consensus of the EWG that patients found to be hypoxic (<95% oxygen saturation) at any time (i.e. from pre-hospital to post-acute) should be given supplemental oxygen.

4.8 Oxygen therapy		Grade
a)	Patients who are hypoxic (i.e. <95% oxygen saturation) should be given supplemental oxygen.	GPP
b)	The routine use of supplemental oxygen is NOT recommended in acute stroke patients who are not hypoxic.	C [282]

4.9 Glycaemic control

Hyperglycaemia after stroke is found in one-third of patients although the reported incidence varies between 8% and 83% depending on the cohort and definition.[285] Previously undetected diabetes is found in 16–24% of patients admitted with stroke.[286, 287] Observational data indicate that hyperglycaemia fluctuates in the first 72 hours in both non-diabetic and diabetic patients even with current best practice.[288] Observational data also reveal poorer outcomes for non-diabetic patients with hyperglycaemia.[285] Glucose intolerance after stroke is also common (approximately 25%) [287, 289] and linked to higher stroke recurrence (see 5.8 Diabetes management).[290]

Acute monitoring and management therefore appear important although the volume of evidence is not large. Tight early glucose control via various regimes (e.g. IV insulin) has been shown in several small RCTs to be feasible and relatively safe, although demanding for staff.[291–295] A large follow-up of one study investigating aggressive maintenance of euglycaemia via glucose-potassium-insulin infusion failed to demonstrate benefits.[296] This is consistent with a large meta-analysis of surgical and medical trials (29 RCTs, including 3 stroke trials) of patients in ICU which failed to demonstrate significant reduction in mortality and found significantly higher risks of hypoglycaemia.[297]

While there is consensus that hyperglycaemia needs management, further data are needed to determine the most appropriate strategies. Implementation of effective glycaemic control requires education of nursing staff across all shifts, which can be challenging. Glucometers also need to be readily available.

4.9 Glycaemic control		Grade
a)	On admission, all patients should have their blood glucose level monitored and appropriate glycaemic therapy instituted to ensure euglycaemia, especially if the patient is diabetic.	GPP
b)	An early intensive approach to the maintenance of euglycaemia is currently NOT recommended.	B [296]

4.10 Neuroprotection

A large number of neuroprotective agents have been studied in clinical trials; however, none have demonstrated clear benefits and hence cannot be recommended for routine use.[298–301] The most recent agent studied in a large trial, NXY-059, failed to show any benefits.[302, 303]

There are too few data on other groups of agents including colony-stimulating factors (including erythropoietin, granulocyte colony-stimulating factor and analogues),[304] theophylline, aminophylline, and caffeine and analogues[305] and further trials are required before clear conclusions can be drawn. A number of initial small trials have found potential benefits for albumin,[306] edaravone,[307] minocycline[308] and arundic acid (ONO2506)[309] but larger trials are required to confirm these preliminary results. Citicoline may improve the chance of a good recovery at three months (OR 1.38, 95% CI 1.10–1.72)[310]; a further large Phase III trial is ongoing.

Recent studies have assessed the feasibility of reducing body temperature (via physical cooling or acetaminophen) as an acute intervention. While such interventions appear promising,[303, 311–314] a Cochrane review (eight RCTs/CCTs) found cooling via pharmacological or physical methods does not reduce the combined risk of death or dependency (OR 0.9, 95% CI 0.6–1.4) or death alone (OR 0.9, 95% CI 0.5–1.5). Both methods were associated with a non-significant increase in the occurrence of infections.[315]

A subsequent large RCT (n=1400)[316] of paracetamol (6 g) <12 hours in all patients with temperature 36–39°C showed a non-significant trend to improved outcomes (OR 1.20, 95% CI 0.96–1.50). Post hoc analysis in those with temperatures of 37–39°C found significant improvement indicating paracetamol may be appropriate only where fever occurs rather than routinely applied to all stroke patients (see 4.11 Pyrexia management). Further robust trials are needed, particularly for physical cooling.

Observational studies suggest that receiving statin therapy prior to stroke may have a neuroprotective effect. One small RCT in patients with ischaemic stroke (n=89) compared the effect of continuing statin therapy (20 mg/day atorvastin) to ceasing therapy in the acute phase (first three days). Statin withdrawal was found to be associated with a 4.7-fold increase in the combined risk of death or dependency at three months and an 8.67-fold increase in the risk of early neurological deterioration.[317] In contrast, a study of commencing new statin therapy (simvastatin 40 mg/day for the first week, then 20 mg/day) for patients admitted within 3–12 hours found no difference in biological markers or function at 90 days.[318] While there was a significant reduction in impairment (>4 NIHSS, 46.4% vs 17.9%) by the third day of treatment, there was also a non-significant increase in mortality and a greater incidence of infections (OR 2.4, 95% CI 1.06–5.4) in the simvastatin group.[319] Further large interventional studies are needed to clarify the role of continuing or commencing statin therapy in acute stroke patients.

4.10 Neuroprotection		Grade
a)	Putative neuroprotectors (including hypothermic cooling) should only be used in a randomised controlled trial.	A [302, 305, 315, 320, 321]
b)	Patients with acute ischaemic stroke who were receiving statins prior to admission can continue statin treatment.	B [317]

4.11 Pyrexia management

Pyrexia is associated with poorer outcomes after stroke.[322] The most common causes of pyrexia are chest or urinary infections.[323]

Paracetamol and physical cooling for those with pyrexia have been found to be modestly effective therapies to reduce temperature in acute stroke.[312, 324] A subsequent Phase III RCT of early administration (within 12 hours of stroke onset) of high-dose paracetamol (6g) resulted in a non-significant trend to improved outcomes (adjusted OR 1.20, 95% CI 0.96–1.50).[316] Adverse events were similar in trial and placebo groups (8% vs 10%. respectively).

Post hoc analysis suggested significant effects for those with baseline temperature of 37–39°C (OR 1.43, 95% CI 1.02–1.97) but this should be confirmed in another similar size trial.

One small RCT (n=60) found a significant reduction in infection and fever using prophylactic antibiotic therapy with mezlocillin plus sulbactam after severe acute ischaemic stroke.[325] However, there was an increase in adverse events. A larger study is required.

Clearer data are also needed to reach a consensus definition of fever in stroke.

4.11 Pyrexia		Grade
	Antipyretic therapy, comprising regular paracetamol and/or physical cooling measures, should be used routinely where fever occurs.	C [316, 324]

4.12 Seizure management

The reported incidence of post-stroke seizures varies widely, ranging from 2–33% for early seizures (<7 days) and 3–67% for late seizures (>7 days).[326] Three per cent of acute stroke patients across Australia were found to have had an early seizure.[32] People with severe stroke, haemorrhagic stroke, and/or a stroke involving the cerebral cortex are at increased risk of developing seizures, but there is still debate about risk factors.

Multiple Cochrane reviews have reported on the effectiveness of different anti-convulsant medications (e.g. carbamazepine, phenytoin, phenobarbitone, oxcarbazepine, lamotrigine) for people with seizures.[327–329] One Cochrane review on managing seizures post stroke failed to identify any RCTs that met the inclusion criteria.[330] Findings from three studies identified but not included in the review suggest that lamotrigine may be more useful than carbamazepine[331–333] although further trials are needed before firm conclusions can be drawn. There was consensus that general principles of seizure management using anti-convulsant medication are appropriate for stroke patients with recurrent seizures although the preferred medication, dosages and duration of treatment are unclear.

4.12 Seizure management	Grade
Anti-convulsant medication should be used for people with recurrent seizures after stroke.	GPP

4.13 Complementary and alternative therapy

Complementary and alternative therapies for stroke cover a range of practices including acupuncture, homoeopathy, traditional Chinese herbal medicine, aromatherapy, music therapy, Reiki therapy, conductive education, naturopathy, reflexology and osteopathy. This section focuses on acute interventions only.

One Cochrane review (14 RCTs) found no clear benefit from acupuncture treatment of acute ischaemic or haemorrhagic stroke.[334] Several traditional Chinese herbal medicines have been included in Cochrane reviews.[335–343] Some therapies report improvement in impairment (e.g. Ginkgo biloba, Dan shen, Sanchi, Acanthopanax) but it is unclear if they improve important outcomes such as death and dependency, or measures of functional activity and participation. Few adverse events are reported. Methodological limitations of trials of most traditional Chinese interventions, including acupuncture, make conclusions difficult. No additional robust trials for other therapies were found and hence no conclusions can be drawn. Herbal preparations may lead to harmful interactions with certain medications and should be discussed with relevant health professionals.

Since complementary medicine may relate to particular cultural backgrounds or other belief systems, health professionals should be aware of and sensitive to the needs and desires of the stroke survivor and the family/carer. Health professionals should be willing to discuss the effectiveness of therapy and different options of care within the context of the current healthcare system.

4.13 Complementary and alternative therapy		Grade
a)	The routine use of the following complementary and alternative therapies is NOT recommended:	
	• acupuncture	B [334]
	• traditional Chinese herbal medicines.	B [335, 337–339, 341–344]
b)	Health professionals should be aware of different forms of complementary and alternative therapies and be prepared to discuss these with stroke survivors and their families/carers.	GPP

CHAPTER

FIVE

Secondary prevention

Secondary prevention

A person with stroke has an accumulated risk of subsequent stroke of 43% over 10 years with an annual rate of approximately 4%.[345] The rate of strokes after TIA is significantly higher (up to 10% after three months) suggesting greater opportunities to prevent stroke after TIA.[120] Secondary prevention therefore relates to both stroke and TIA. Long-term management of risk factors, particularly medication compliance, is the primary role of GPs and good communication between secondary and primary carers is essential.

5.1 Lifestyle modifications

Evidence for behaviour-changing strategies targeting lifestyle factors to prevent recurrence of stroke is limited and often derived from cohort studies of primary prevention.

5.1.1 Smoking

Smoking increases the risk of ischaemic stroke due to vascular narrowing and changes in blood dynamics.[346–349] Its role in haemorrhagic stroke is not as clear.[346, 350] While no RCTs have been conducted, observational studies have found the risk from smoking decreases after stopping smoking with the risk completely disappearing after five years.[351, 352]

Several Cochrane reviews have examined different therapies for stopping smoking. Nicotine replacement therapy is beneficial and doubles the chances of smoking cessation.[353] Some antidepressants, for example bupropion and nortriptyline but not selective serotonin-reuptake inhibitors, aid long-term smoking cessation.[354] Varenicline, a nicotine receptor partial agonist, has recently been developed for long-term smoking cessation with a threefold success rate compared with non-drug quit attempts.[355] Varenicline has also been found to be more effective than the antidepressant bupropion.[355] A number of behavioural therapies delivered by different health professionals in different settings have demonstrated modest effects on smoking cessation in general populations and should be provided via an individualised approach either in a group or on a one-to-one basis.[356–359] One good example of such behavioural therapies is telephone counselling, which improved smoking cessation rates, particularly when three of more call-backs are made.[360]

5.1.2 Diet

Diet has an impact on a number of risk factors and can provide additional benefits to pharmacological interventions in people with vascular disease. Reducing sodium in people with cardiovascular disease, especially in those with high BP, modestly reduces BP and may therefore help to prevent stroke.[361, 362] A meta-analysis of cohort studies found a diet high in fruit and vegetables (more than five servings per day) reduced the risk of stroke.[363, 364] Meta-analysis of cohort studies also found a diet high in oily fish was associated with a lower risk of stroke.[361] Reduced dietary fat has also been shown to reduce cardiovascular disease.[365] A diet that is low in fat but high in fruit and vegetables has been shown to be effective in risk reduction for those with cardiovascular disease.[366–369] Similar dietary modification has been shown to be beneficial for those with dyslipidemia [370–372] and obesity in controlling hypertension.[373] Supplementary antioxidants and vitamins have not been found to reduce stroke.[374, 375]

National guidelines listing recommendations for dietary intake are available and provide useful general information.[376]

5.1.3 Physical activity

There is strong evidence from meta-analysis of cohort studies that physical activity has a protective effect against stroke.[377, 378] Cardiorespiratory fitness training is feasible for stroke survivors and can lead to improved aerobic fitness, walking speed, and endurance.[379, 380] While there are insufficient data to evaluate the impact of physical activity on secondary stroke prevention it would be logical to assume that adequate exercise would reduce the risk of subsequent cardiovascular events including stroke. Physical activity also has clear benefits for reducing hypertension in at-risk people[381] and improving glycaemic control for those with type 2 diabetes.[382] National guidelines recommend at least 30 minutes of moderate-intensity physical activity on most, preferably all, days of the week.[383, 384]

5.1.4 Obesity

Obesity and being over-weight is thought to be associated with an increased risk of stroke, and it has been suggested that weight loss may lead to a reduced risk of primary stroke. One study found that markers of abdominal adiposity showed a graded and significant association with risk of stroke/TIA.[385] A Cochrane review failed to find any RCTs evaluating weight reduction for primary prevention of stroke.[386]

5.1.5 Alcohol

Excessive alcohol consumption increases the risk of stroke[387], so reducing alcohol levels could be expected to modify the risk of further strokes although no studies specific to secondary stroke prevention have been found. Light intake of alcohol (1–2 standard drinks) may be protective against stroke events.[387] National guidelines recommend limiting alcohol consumption to two standard drinks per day.[388]

A multifactorial behavioural intervention strategy that targets several risk factors can be effective. One study found a program of initiating tailored secondary prevention, including lifestyle interventions, while in hospital led to improved rates of adherence both prior to and three months after discharge.[389, 390] Educational interventions

during and after discharge have also reported improved adherence to dietary advice[80, 81] but other trials of post-discharge support have been mixed (see 1.3.1 Safe transfer of care from hospital to community). Systematic reviews have found behavioural techniques, for example dietary or motivational counselling, provided by specialist trained clinicians are effective in changing behaviour in primary care settings.[391, 392] A subsequent stroke study found simply providing the advice to change to a healthy diet modestly reduced CVD risk factors (BP, lipids and sodium intake).[393] Lifescripts is a national initiative which provides tools for primary care clinicians promoting risk factor management (see http://www.health.gov.au/internet/main/publishing.nsf/Content/health-pubhlth-strateg-lifescripts-index.htm).

5.1 Lifestyle modification		Grade
a)	Every stroke patient should be assessed and informed of their risk factors for a further stroke and possible strategies to modify identified risk factors. The risk factors and interventions include:	
	• stopping smoking: nicotine replacement therapy, bupropion or nortriptyline therapy, nicotine receptor partial agonist therapy and/or behavioural therapy	A [354–359]
	• improving diet: a diet low in fat (especially saturated fat) and sodium but high in fruit and vegetables	A [361, 363, 364, 366–369]
	• increasing regular exercise	C [377, 378]
	• avoiding excessive alcohol (i.e. no more than two standard drinks per day).	C [387, 388]
b)	Interventions should be individualised and delivered using behavioural techniques such as educational or motivational counselling.	A [356, 357, 359, 391]

5.2 Adherence to pharmacotherapy

Failure to take prescribed medication is a major barrier to optimal secondary prevention. In one large Swedish cohort the proportion of patients who continued using hospital-prescribed medication after two years was 74.2% for antihypertensive drugs, 56.1% for statins, 63.7% for antiplatelet drugs, and 45.0% for warfarin.[394] The literature concerning interventions to improve adherence to medications remains surprisingly weak.

An updated Cochrane review (78 RCTs) found only modest effects for interventions to improve adherence to medications, but few, if any, were specifically in the stroke population. Conflicting evidence for short-term interventions on compliance were found and very few studies reported changes in patient outcomes.[395] Almost all of the interventions that were effective for long-term compliance were complex, including combinations of more convenient care, information, reminders, self-monitoring, reinforcement, counselling, family therapy, psychological therapy, crisis intervention, telephone follow-up and supportive care. Another Cochrane review (eight RCTs) involving the use of dose administration aids or other reminder packing strategies found some improvements in terms of the number of pills taken but no appropriate data were available to make conclusions on the clinical outcomes.[396]

One subsequent RCT found a pharmacist-led education program can improve adherence to interventions to modify lifestyle factors, specifically BP and lipid levels, in a risk-free intervention that supplemented the usual care offered in an outpatient setting.[397] In one RCT, a follow-up over three years found that a brief education or counselling intervention, while having short-term effects on behaviour, did not have any long-term benefits with similar levels of controlled risk factors, medication compliance, and event rates.[398]

Two cohort studies have found a program of beginning tailored secondary prevention medications while in hospital is important for adherence after discharge.[389, 390] Commencing strategies early and regular follow-up may be key to improving medication adherence and improving secondary prevention.

5.2 Adherence to pharmacotherapy		Grade
	Interventions to promote adherence with medication regimes are often complex and should include combinations of the following:	
	• reminders, self-monitoring, reinforcement, counselling, family therapy, telephone follow-up, supportive care and dose administration aids	B [395, 396]
	• information and education in hospital and in the community.	B [395, 397]

5.3 Blood pressure lowering

High BP is the major risk factor for both first and subsequent stroke. Only 72% of eligible patients are discharged on BP-lowering therapy.[11] A systematic review (10 RCTs) found therapy to lower BP, even when initial BP was within normal range, reduced recurrent stroke (OR 0.71, 95% CI 0.59–0.86) and cardiovascular events (OR 0.69, 95% CI 0.57–0.85) in patients with a previous stroke or TIA.[399] Therapy reduced the rate of MI (OR 0.86, 95% CI 0.73–1.01) but did not lower all-cause mortality (OR 0.95, 95% CI 0.83–1.07).[399]

The most direct evidence of benefit is for the use of an ACE inhibitor (alone or in combination with a diuretic). However, most antihypertensive agents have been found to be effective (the exception being beta blockers).[400] A large-scale RCT (n=20 332) did not demonstrate a benefit of an angiotensin receptor blocker in addition to usual therapy in preventing recurrent stroke.[401]

The timing of commencing therapy remains unclear. Blood pressure therapy in acute care is discussed separately (see 4.4 Acute phase blood pressure lowering therapy). However, two small studies in those with mild stroke or TIA without major carotid disease found BP-lowering therapy (with an angiotensin II receptor antagonist or ACE inhibitor) was safe when commenced two to four days after stroke, although follow-up was short (two weeks).[402, 403] Commencement of secondary prevention medications, including BP lowering therapy, while in hospital appears to be important for improving rates of adherence after leaving hospital (see 5.2 Adherence to pharmacotherapy).[389, 390]

Lifestyle change including diet and exercise, either alone or in conjunction with pharmacotherapy, can also be used to reduce BP (see 5.1 Lifestyle modifications).

5.3 Blood pressure lowering		Grade
a)	All stroke and TIA patients, whether normotensive or hypertensive, should receive blood pressure lowering therapy, unless contraindicated by symptomatic hypotension.	A [399]
b)	New blood pressure lowering therapy should commence before discharge for those with stroke or TIA, or soon after TIA if the patient is not admitted.	B [402, 403]

5.4 Antiplatelet therapy

A systematic review (21 RCTs, n>23 000) of patients with previous ischaemic stroke or TIA found antiplatelet therapy significantly reduced the risk of subsequent serious vascular events including stroke, MI or vascular death (17.8% vs 21.4% controls).[404] Antiplatelet therapy has some adverse effects, particularly a small risk of haemorrhage, but the benefits outweigh the risks.[405] Although the benefits of antiplatelet therapy are well known and intervention can commence soon after stroke (see 4.3 Antithrombotic therapy), compliance drops off after discharge with 21% of stroke patients in Australia not taking any antiplatelet therapy according to primary care data.[406]

Aspirin remains the most readily available, cheapest and most widely used anti-platelet agent. A systematic review (10 RCTs) found aspirin reduced the risk of serious vascular events by about 13% (95% CI 4–21) in patients with previous ischaemic stroke or TIA.[407] Low doses (75–150 mg) are as effective as high doses (300–1300 mg) and are associated with a lower risk of gastrointestinal adverse effects.[404] The lowest therapeutic dose of aspirin remains unclear, but the DUTCH TIA trial showed that in more than 3000 patients with TIA, 30 mg was as effective as 283 mg in preventing serious vascular events.[407] A number of systematic reviews and one Cochrane review found that clopidogrel or extended release dipyridamole plus low-dose aspirin was more effective than aspirin alone.[408–410] No difference in the net risk of recurrent stroke or major haemorrhagic event was found in a large RCT (n=20 332) comparing clopidogrel and extended release dipyridamole plus low-dose aspirin (11.7% vs 11.4%, HR 1.03, 95% CI 0.95–1.11).[411]

One Cochrane review (three RCTs) found there was no difference between dipyridamole alone and aspirin in the avoidance of vascular death (RR 1.08, 95% CI 0.85–1.37) or the prevention of vascular events (RR 1.02, 95% CI 0.88–1.18).[409]

Several RCTs have found that the combination of low-dose aspirin (75–162 mg) and clopidogrel (75 mg) had no net benefit compared with clopidogrel alone (RRR 6%) or aspirin alone (RRR 7%) because any long-term benefits with combination therapy are offset by an increase in bleeding (1.7–2.6% vs 1.3%).[412–414] Combined therapy using aspirin and clopidogrel should be considered only where clear indications exist (i.e. coexisting acute coronary disease or recent coronary stent).

5.4 Antiplatelet therapy		Grade
a)	Long-term antiplatelet therapy should be prescribed to all people with ischaemic stroke or TIA who are not prescribed anticoagulation therapy.	A [404]
b)	Low-dose aspirin and modified release dipyridamole or clopidogrel alone should be prescribed to all people with ischaemic stroke or TIA, taking into consideration patient co-morbidities.	A [411]
c)	Aspirin alone can be used, particularly in people who do not tolerate aspirin plus dipyridamole or clopidogrel.	A [404]
d)	The combination of aspirin plus clopidogrel is NOT recommended for the secondary prevention of cerebrovascular disease in people who do not have acute coronary disease or recent coronary stent.	A [412, 413]

5.5 Anticoagulation therapy

According to an updated Cochrane review (11 RCTs), anticoagulant therapy should not be routinely used in people with non-cardioembolic ischaemic stroke or TIA due to the risk of increased adverse events (fatal intracranial haemorrhage OR 2.54, 95% CI 1.19–5.45; major extracranial haemorrhage OR 3.43, 95% CI 1.94–6.08).[415]

Two separate Cochrane reviews (each with two RCTs) found that in patients with non-rheumatic AF and a recent TIA or minor ischaemic stroke, the benefits of anticoagulants outweigh the risks and anticoagulants are more effective than antiplatelet therapy for long-term secondary prevention.[416, 417] A large subsequent RCT (n=973) found that in stroke survivors over 75 years of age, warfarin was more effective than aspirin (RR 0.48, 95% CI 0.28–0.80).[418] There were no differences in the incidence of major haemorrhage.[418] Until recently, only warfarin had been found to be beneficial; however, a RCT (n=18 113) suggested dabigatran is an alternative to warfarin for secondary prevention in patients with ischaemic stroke/TIA who have AF (paroxysmal, persistent or permanent).[419] While more information is required regarding potential differences in adverse events (e.g. dyspepsia, MI, PE), dabigatran therapy does not require regular blood tests, and, importantly, appears to lower ICH rates. Dabigatran has not yet been approved for use in Australia.

Studies suggest that when using warfarin, the INR should be maintained within the therapeutic range more than 60–70% of the time in order to achieve overall benefits.[420, 421]

Monitoring needs to be considered as studies have shown INR control is variable and dependent on monitoring intensity and duration of anticoagulant therapy.[420, 422] One systematic review (36 RCTs) found more structured and intense monitoring (i.e. more than once monthly, using strict protocol-driven monitoring schemes during RCTs or in study groups that were evaluating self-managed monitoring) led to a small improvement (~5%) in time spent within INR 2–3.[422]

Uncertainty remains about the ideal time to commence therapy and no clear data are available to inform this decision. Trials generally enrolled patients after one or two weeks to reduce the risk of haemorrhage (only 12% of patients in the ESPRIT trial were enrolled within one week). One observational study (n=247) commenced appropriate anticoagulation therapy prior to discharge from acute hospital care. All patients were still complying with the therapy three months after leaving hospital.[389] International guidelines recommend delaying the start of treatment for two to four weeks for patients with acute stroke. Aspirin or other antiplatelet therapy should be used between an acute stroke event and the time when anticoagulation is commenced. For patients with TIA, anticoagulation therapy should be commenced as soon as imaging has excluded ICH or a stroke mimic as the cause of symptoms.

There were no trials found for anticoagulation therapy in people with ICH.

Compliance and the need for careful monitoring is a major issue. Anticoagulation therapy is consistently found to be under-used in primary practice. Many reasons for non-intervention using warfarin are not based on evidence.[423]

5.5 Anticoagulation therapy		Grade
a)	Anticoagulation therapy for secondary prevention for people with ischaemic stroke or TIA from presumed arterial origin should NOT be routinely used.	A [415]
b)	Anticoagulation therapy for long-term secondary prevention should be used in people with ischaemic stroke or TIA who have atrial fibrillation or cardioembolic stroke.	A [416, 417]
c)	In stroke patients, the decision to begin anticoagulation therapy can be delayed for up to two weeks but should be made prior to discharge.	C [389]
d)	In patients with TIA, anticoagulation therapy should begin once CT or MRI has excluded intracranial haemorrhage as the cause of the current event.	GPP

5.6 Cholesterol lowering

The most recent National Stroke Audit showed that 77% of eligible ischaemic stroke patients were on lipid-lowering therapy on discharge from hospital.[11] Records from a large Australian GP registry indicate that in the community this rate fell to 65%.[406] There is conflicting evidence regarding the link between elevated cholesterol and stroke subtypes. Epidemiological studies suggest that higher cholesterol levels are associated with a higher risk of ischaemic stroke but a lower risk of haemorrhagic stroke.[424]

Meta-analysis (14 RCTs) demonstrated that reduced stroke risk occurred within 12 months of commencing therapy and is related to low-density lipoprotein (LDL) cholesterol reduction.[425] Meta-analysis also demonstrated that statins have a good safety profile and are not associated with liver toxicity.[426, 427]

Two recent meta-analyses (four RCTs) and one Cochrane review (eight RCTs) based predominantly on two large RCTs [375, 428] all reported benefits from cholesterol-lowering therapy.[429–431] Statin therapy was found to marginally reduce all stroke in those with prior stroke or TIA (OR 0.88, 95% CI 0.77–1.00).[429–431] Statin therapy reduced subsequent ischaemic stroke (OR 0.80, 95% CI 0.70–0.92 [429, 430]; OR 0.78, 95% CI 0.67–0.92) 431 but this was partly offset by increase in haemorrhagic stroke (OR 1.73, 95% CI 1.19–2.50[429, 430]; OR 1.72 95% CI 1.20–2.46 [431]). Statin therapy reduces serious vascular events, defined as non-fatal stroke, non-fatal MI or vascular death (OR 0.74, 95% CI 0.67–0.82).[431] No difference in all-cause mortality rates was found (OR 1.00, 95% CI 0.83–1.20).[429, 431]

One study reported higher rates of adherence for statin therapy commenced before discharge from hospital.[432]

Lifestyle change strategies involving dietary modification have been shown to lower cholesterol levels in those with cardiovascular risks and should be used as an alternative or in addition to pharmacotherapy (see 5.2 Adherence to pharmacotherapy). According to the PBS, dietary modification and other lifestyle changes should be used either before or at the same time as drug therapy to reduce cholesterol and should be reviewed annually (see 5.1 Lifestyle modifications).

5.6 Cholesterol lowering		Grade
a)	Therapy with a statin should be used for all patients with ischaemic stroke or TIA.	A [430, 431]
b)	Statins should NOT be used routinely for haemorrhagic stroke.	B [430, 431]

5.7 Carotid surgery

Carotid disease detected early by non-invasive imaging (see 3.3 Imaging) usually requires independent verification by repeated tests.[194]

If carotid disease is confirmed, there is well-established evidence for the use of carotid endarterectomy (CEA) as the management of choice, particularly for symptomatic patients with ipsilateral moderate to severe stenosis (> 50% [NASCET criteria]).[433] The choice of carotid surgery or stenting is still under study but currently evidence favours CEA. Two systematic reviews (12 and 8 RCTs) found CEA to have a lower rate of any stroke or death within 30 days of intervention than stenting (OR 1.38, 95% CI 1.04–1.83).[434, 435] Stenting had lower rates of cranial neuropathy than CEA (OR 0.07, 95% CI, 0.03–0.20) but may be associated with increased re-stenosis.[435, 436] While stenting is not routinely recommended it may be considered as an alternative in certain circumstances, that is in patients who meet criteria for carotid endarterectomy but are deemed unsuitable due to conditions that make them technically unsuitable for open surgery (e.g. high carotid bifurcation, symptomatic carotid re-stenosis, previous neck radiotherapy, possible medical co-morbidities such as significant heart/lung disease or age >80 years). In these situations the risks of intervention are likely to be increased compared to other patients and the value of intervention versus medical therapy reduced.

The benefits of CEA for those with symptomatic stenosis are greatest among those with more severe stenosis, over 75 years, male, with recent stroke (rather than TIA), and who undergo surgery early.[433, 437] For stabilised patients, the greatest benefit was found if surgery was undertaken within two weeks (NNT=5) with less effect at 12 or more weeks (NNT=125).[437] The risks of surgery need to be considered and discussed with the patient and their family/carer. For example, gender, age and co-morbidity should be carefully considered in patients with symptomatic stenosis between 50% and 69%, as the balance between benefit and risk is less than that for more severe degrees of stenosis.[433, 437] There is no net benefit of CEA for those with symptomatic stenosis <50%.[438] One systematic review (47 studies) found no difference in operative risk of stroke or death between early and later surgery in stable patients but did find a much higher risk for unstable patients (crescendo TIA and stroke in evolution) undergoing early surgery.[439]

While the low risk of stroke in patients with asymptomatic carotid stenosis of 60–99% can be reduced even further by surgery, the overall effect of surgery is small.[440] CEA for asymptomatic carotid stenosis is more beneficial for men than women, and for younger rather than older patients.[440] There is no clear association between stenosis severity and stroke risk for asymptomatic stenosis >60% and identification of a high-risk sub-group with asymptomatic carotid disease is difficult.[440] With advances in medical

therapy, the overall community benefit of surgery for asymptomatic stenosis is thought to be small and the best approach for these patients is controversial.[440–442]

It is important that centres undertaking CEA participate in ongoing, independent and systematic audits of surgical complication rates[443] as this often determines the balance between benefits and harms, particularly for those with 50–69% stenosis. The evidence suggests low complication rates are needed (<6%) in patients with 70–99% stenosis to achieve net benefits.[438] Extremely low complication rates (<3%) are indicated where centres are considering CEA for patients with symptomatic stenosis of 50–69% or asymptomatic stenosis 60–99%.[438, 440]

Treatment with antiplatelet therapy (predominantly aspirin monotherapy) commencing either before or after CEA has been shown to reduce stroke recurrence although no effects were found on other outcomes.[444] In two studies, combination therapy of clopidogrel and aspirin has been found to be beneficial using surrogate markers (e.g. microembolic signals on carotid ultrasound); however, no patient outcomes have been reported (see 4.3 Antithrombotic therapy).[445, 446]

Implementation of best practice for carotid surgery requires:

- availability of well-trained sonographers with validated reproducible carotid imaging in an appropriate vascular or imaging centre
- availability of skilled specialists with clinical and interventional experience
- appropriate referral processes to facilitate rapid assessment and intervention
- appropriate skilled staff and processes to undertake routine audits.

5.7 Carotid surgery		Grade
a)	Carotid endarterectomy should be undertaken in patients with non-disabling carotid artery territory ischaemic stroke or TIA with ipsilateral carotid stenosis measured at 70–99% (NASCET criteria) only if it can be performed by a specialist surgeon with low rates (<6%) of peri-operative mortality/morbidity.	A [433, 435, 438]
b)	Carotid endarterectomy can be undertaken in highly selected ischaemic stroke or TIA patients (considering age, gender and co-morbidities) with symptomatic carotid stenosis of 50–69% (NASCET criteria) or asymptomatic carotid stenosis >60% (NASCET criteria) only if it can be performed by a specialist surgeon with very low rates (<3%) of peri-operative mortality/morbidity.	A [435, 438, 440]
c)	Eligible stable patients should undergo carotid endarterectomy as soon as possible after the stroke event (ideally within two weeks).	A [437]
d)	Carotid endarterectomy should only be performed by a specialist surgeon in centres where outcomes of carotid surgery are routinely audited.	B [438, 443]
e)	Carotid endarterectomy is NOT recommended for those with symptomatic stenosis <50% (NASCET criteria) or asymptomatic stenosis < 60% (NASCET criteria).	A [438, 440]
f)	Carotid stenting should NOT routinely be undertaken for patients with carotid stenosis.	A [435, 436]

5.8 Diabetes management

Diabetes and glucose intolerance post stroke have been found to be independent risk factors for subsequent strokes.[290, 447, 448] Hyperglycaemia in the first few days after stroke is very common and levels fluctuate (see 4.9 Glycaemic control). Assessment of glucose tolerance after stroke or TIA would allow identification and subsequent management of patients with undiagnosed diabetes or glucose intolerance and provide additional secondary prevention measures for stroke recurrence.

Evidence for the management of diabetes is primarily based on primary prevention. Important aspects of care include aggressive management of BP and cholesterol, careful management of glycaemic status using behavioural modification (e.g. diet and exercise) and pharmacotherapy. National guidelines for the management of diabetes are available (www.nhmrc.gov.au/PUBLICATIONS/synopses/di7todi13syn.htm) and the relevant recommendations should be followed.

5.8 Diabetes management	Grade
Patients with glucose intolerance or diabetes should be managed in line with national guidelines for diabetes.	GPP

5.9 Patent foramen ovale management

Patent foramen ovale (PFO) is more common in patients with cryptogenic stroke, especially those aged under 55.[449] While much debated, PFO has not been found to increase the risk of subsequent stroke or death after cryptogenic stroke.[449–451] There are subgroups that may be at increased risk, for example, if PFO is present in combination with an atrial septal aneurysm, but further studies are needed to identify these groups.

Two systematic reviews[449, 452] have identified only one RCT[453] for medical management that compared warfarin (INR 1.4–2.8) to aspirin (325 mg). No differences in recurrent stroke or death rates over two years were found. Warfarin use was associated with higher rates of minor bleeding.

No RCT has compared surgical closure to standard medical care and case-series data are conflicting. One systematic review (10 studies) suggested surgery is beneficial compared to medical care.[452] Three subsequent studies failed to find any difference in stroke recurrence and reported non-significant increase in harms.[454–456] Until clear evidence comes from RCTs, no recommendation can be made on the surgical closure of PFO.

5.9 Patent foramen ovale		Grade
a)	All patients with ischaemic stroke or TIA, and a PFO should receive antiplatelet therapy as first choice.	C [453]
b)	Anticoagulation therapy can also be considered taking into account other risk factors and the increased risk of harm.	C [453]
c)	There is insufficient evidence to recommend PFO closure.	GPP

5.10 Hormone replacement therapy

Observational studies had suggested that hormone replacement therapy (HRT) may have a protective effect against CVD events.[457] However, meta-analysis of 10 RCTs found no protective effect of HRT for any cardiovascular outcomes.[458] Several meta-analyses (7–31 RCTs) found that HRT increased the risk of stroke by 29–44%.[458–460] The stroke event was more severe for those who had been taking HRT.[459] The increased risk was found to be significant only for ischaemic stroke but not for TIA or haemorrhagic stroke.[461] All the data on the risk of stroke associated with HRT come from trials of primary prevention. HRT also significantly increases the risk of VTE.[458, 459]

Some women may still wish to continue with HRT for control of menopausal symptoms and an enhanced QOL. In these situations, the decision whether to continue HRT should be discussed with the patient and based on an overall assessment of risk and benefit.

5.10 Hormone replacement therapy	Grade
Following a stroke event, HRT should be stopped. The decision whether to start or continue HRT in patients with a history of previous stroke or TIA should be discussed with the individual patient and based on an overall assessment of risk and benefit.	B [458–461]

5.11 Oral contraception

Stroke in women of child-bearing age is uncommon, with a rate of 28 strokes per 100 000 women aged 15–44 reported in a community-based incidence study.[132] Observational studies on the association between oral contraception and stroke risk have only looked at primary prevention and it is unclear whether the results can be extrapolated to secondary prevention. Several meta-analyses have reported conflicting findings depending on the oral contraceptive formulations used which included pills with high concentrations of estrogens (>50 ug), newer combination pills and progesterone-only pills.

One meta-analysis (14 case-controlled studies) found the risk of stroke was significantly increased with combined low-dose pills (OR 2.12, 95 %CI,1.56–2.86).[462] Another meta-analysis (4 cohort studies and 16 case-controlled studies) found combined low-dose oral contraceptives increased stroke risk overall (OR 1.79, 95% CI 1.62–1.97) but found significant heterogeneity (p<0.001).[463] In this study, pooled analysis found no significant difference in stroke risk in the four cohort studies (OR 0.95, 95% CI 0.51–1.78), but increased risk in the 16 case studies (OR 2.13, 95% CI 1.59–2.86).[463] One Australian cohort study found no statistical increase in risk with combined low-dose oral contraception (OR 1.76, 95% CI 0.86–3.61; p=0.124).[464] Another meta-analysis (six case-controlled studies) of progesterone-only pills showed no increase in the risk of stroke (OR 0.96, 95% CI 0.70–1.31).[465]

The risk of stroke associated with oral contraception appears to increase for women who suffer from migraine, particularly migraine with aura.[466] Stroke risk with oral contraception may also be linked to those who smoke or are hypertensive although the association is less clear.[465] If an association between oral contraception and stroke does exist, it is likely to be small in relative and absolute terms given the small number of events in this age group, particularly in women younger than 35 years who do not smoke and are normotensive.

5.11 Oral contraception	Grade
The decision whether to start or continue oral contraception in women of child-bearing age with a history of stroke should be discussed with the individual patient and based on an overall assessment of risk and benefit. Non-hormonal methods of contraception should be considered.	C [462, 463, 465]

CHAPTER

SIX

Rehabilitation

Rehabilitation

Rehabilitation is a holistic process that should begin the first day after stroke with the aim of maximising the participation of the person with stroke in the community. To achieve this, tailored interventions that focus on impairment, activity and participation levels (based on the World Health Organisation International Classification of Functioning model) should be considered. This chapter discusses interventions targeting impairments (sensorimotor, communication and cognitive) and activities. Chapter 7 discusses secondary impairments or complications, that is, impairments that result from the primary impairments. Chapter 8 discusses aspects of care related to participation or reintegration into the community.

6.1 Amount, intensity and timing of rehabilitation

6.1.1 Amount and intensity of rehabilitation

Observational studies have found that stroke patients often receive very little rehabilitation in the acute phase of care.[467] Most people are able to tolerate an increase in rehabilitation time.[468] Programs providing increased intensity are often provided in the context of more organised services and it is unclear if there is a minimal threshold for benefit. UK guidelines recommend that patients in the early stages of recovery should have as much therapy as they are willing and able to tolerate but stipulate a minimum of 45 minutes daily for each therapy that is required.[469]

Walking and Activities of Daily Living (ADL)

A systematic review (20 RCTs) found a small but significant benefit on ADL if at least 16 hours of additional physical therapy (i.e. occupational therapy and physiotherapy), are delivered within the first six months after stroke (SES 0.13, 95% CI 0.06–0.23).[470] Increasing practice was also found to be beneficial for extended ADL and gait speed but not for dexterity.[470] The mean duration of additional therapy provided in the trials was approximately one hour per day. The median amount of physical therapy provided per patient in the stroke unit trials was 45 minutes of physiotherapy and 40 minutes of occupational therapy per weekday.[41]

Task-orientated circuit class training has been suggested as a method of increasing the amount of practice while making efficient use of therapist time.[471] One systematic review (six RCTs) found such training improved walking distance (SES 0.43, 95% CI 0.17–0.68) and walking speed (SES 0.35, 95% CI 0.08–0.62).[471]

An RCT of video self-modelling (i.e. exercise performance videoed with subsequent feedback from a therapist using the video-footage) was found to be an effective and efficient way of increasing the amount of practice, which improved standing performance but not walking or quality of life.[472]

Upper limb activity

Interventions to improve upper limb activity, particularly constraint-induced movement therapy (CIMT) or electromechanical and robot-assisted therapy, may increase the amount of practice (see 6.3.5 Upper limb activity). However, analysis of five RCTs specific to UL included in one systematic review noted above found no effect of increased training intensity (SMD 0.03, 95% CI –0.13–0.19).[470] A post hoc analysis of 14 RCTs on repetitive training (CIMT or repetitive task training) found no effect for studies that provided up to 20 hours of intervention (SMD 0.22, 95% CI –0.12–0.57) but a modest effect for studies that provided over 20 hours of training (SMD 0.42, 95% CI 0.10–0.75).[473] A subsequent trial of CIMT found early (mean 10 days post stroke) intense therapy resulted in less functional improvements at 90 days than less intense CIMT commencing later or routine therapy.[474]

Communication

One systematic review (10 RCTs and non-RCTs) of studies examining the intensity of aphasia therapy found benefits for more intense therapy over a shorter period of time.[475] Four positive trials in this review provided an average of 8.8 hours of therapy per week for an average of 11.2 weeks (three hours per week was the minimum intensity of any positive trial). The four negative trials provided an average of two hours per week for an average of 22.9 weeks. One subsequent systematic review (10 trials) found increased intensity was associated with positive outcomes in language impairment but did not state a target threshold.[476] The interventions provided ranged in amount and intensity and were tailored to individuals. An additional RCT reported that in the first 12 weeks post stroke, people with aphasia may find it difficult to tolerate intensive therapy.[477] Another RCT of very early aphasia therapy (within median 3.2 days of stroke onset) for people with moderate to severe aphasia found daily therapy, five days a week aiming for at least 45 minutes per session, was well tolerated and improved recovery more than only one session per week.[478] Overall, the current evidence appears to indicate that there should be at least two hours therapy each week during the acute and rehabilitation phases of recovery.

Dysphagia

One RCT found a higher intensity of intervention for dysphagia lowers the risk of complications (chest infections) in acute stroke (see 6.2.1 Dysphagia).[479]

6.1.1 Amount and intensity of rehabilitation		Grade
a)	Rehabilitation should be structured to provide as much practice as possible within the first six months after stroke.	A [470]
b)	For patients undergoing active rehabilitation, as much physical therapy (physiotherapy and occupational therapy) should be provided as possible with a minimum of one hour active practice per day at least five days a week.	GPP
c)	Task-specific circuit class training or video self-modelling should be used to increase the amount of practice in rehabilitation.	B [471, 472]
d)	For patients undergoing active rehabilitation, as much therapy for dysphagia or communication difficulties should be provided as they can tolerate.	C [475, 477–479]
e)	Patients should be encouraged by staff members, with the help of their family and/or friends if appropriate, to continue to practice skills they learn in therapy sessions throughout the remainder of the day.	GPP

6.1.2 Timing of rehabilitation

Patients managed in acute stroke units that have active rehabilitation programs generally spend less time in bed and more time standing, walking and being active.[480] Studies indicate that commencing rehabilitation within hours or days of stroke is feasible and may help recovery. The amount of therapy that can be tolerated in this early phase remains to be elucidated.

Early mobilisation

Early mobilisation (i.e. sitting out of bed, standing and walking within 24 hours of stroke onset) has been described as an important component of stroke unit care[41] and there is indirect evidence supporting the practice.[481] A Cochrane review of very early versus delayed mobilisation after stroke identified one RCT.[482] This Phase II study found early mobilisation was feasible and safe with those in the intervention group tolerating earlier and more frequent mobilisation well.[482] Based on this same trial, very early mobilisation was associated with a reduced likelihood of depression at seven days (OR 0.14, 95% CI 0.03–0.61).[483] and reduced costs of care.[484] Non-significant positive trends in patient outcomes (death or disability at three months) were found; however, the trial was not powered to detect changes in these outcomes and a large Phase III trial is ongoing.[482] Another recent small (n=32) RCT of early mobilisation versus intensive monitoring post stroke found that patients in the early mobilisation group were more likely to walk by day five and less likely to have immobility-related complications.[485]

Upper limb activity

A few trials of upper limb activity commenced within two weeks of onset.[486–488] One subsequent trial of CIMT demonstrated that it can be used within the first week of recovery after admission to a rehabilitation unit but it is unclear if the intensity of therapy should be reduced in the acute phase.[474]

Communication

An RCT of very early aphasia therapy, commencing within median 3.2 days of stroke onset, for people with moderate to severe aphasia found daily therapy, five days a week (average two hours therapy per week) for the first few weeks improved communication outcomes compared to only one session per week (average 11 mins therapy per week).[478] This study also demonstrated a greater rate of improvement of aphasia severity and verbal efficiency for those treated daily in the very early recovery phase.[478]

6.1.2 Timing of rehabilitation		Grade
a)	Patients should be mobilised as early and as frequently as possible.	B [482]
b)	Treatment for aphasia should be offered as early as tolerated.	B [478]
c)	Upper limb training should commence early. CIMT is one approach that may be useful in the first week after stroke.	C [474]

6.2 Sensorimotor impairment

6.2.1 Dysphagia

Dysphagia is a common consequence of acute stroke with a reported incidence of 47% in the most recent national audit.[11] Dysphagia is associated with an increased risk of complications, such as aspiration pneumonia, dehydration and malnutrition.[479, 489] Dysphagia was also found to lead to poor clinical outcomes (chest infection, death, disability, discharge destination, longer LOS) reinforcing the need for early detection and management.[490]

Adherence to a formal dysphagia screening protocol reduces the incidence of pneumonia in acute stroke patients.[491, 492] Another study implementing evidence-based acute care involving dysphagia screening, referral and assessment demonstrated improved process and patient outcomes.[493] Further studies are needed to clarify the key elements that improve outcomes, including identifying which screening tool is most useful.

Several systematic reviews agree on the value of early screening using bedside tools.[494, 495] Due to variability in the studies, three systematic reviews were unable to conclude which screening tool was most useful.[495–497] While most tests had sensitivities of 70–90% some were much lower, the lowest reported being 42%. Specificity ranged from 22% to 67% in one review[496] and 59% to 91% in another.[495] Subsequent studies of bedside clinical screening have demonstrated similar sensitivities with other bedside tests.[498–504] Two recent well-developed and validated tests include the Gugging Swallowing Screen (GSS)[502] and the Toronto Bedside Swallowing Screening test (TOR-BSST).[503] The GSS involves indirect and then direct swallowing tests. Accuracy was good: sensitivity 100%, specificity 50–69%, PPV 74–81%, NPV 100%, area under ROC curve 0.933. Inter-rater reliability was excellent.[502] The TOR-BSST was designed to be used by any professional trained in assessment of stroke across all settings and includes five items: Kidd water swallow test, pharyngeal sensation, tongue movement and general dysphonia, voice before and voice after. Overall (acute and rehabilitation phases) accuracy (sensitivity 91.3%, specificity 66.7%, PPV 50–77%, NPV 90–93%) was similar to other tests. Inter-rater reliability was also very good (ICC 0.92).[503] The combination of a bedside screening test and monitoring of oxygen saturations improves the sensitivity of earlier bedside tests (87–100%).[498, 500, 505] The gag reflex was not found to be a valid screen for dysphagia and should therefore not be used.[496, 497]

Screening tools have been developed for use by non-specialist staff who must undertake essential training prior to using such tools.[496] Ideally the initial screen would be undertaken by a speech pathologist as part of a comprehensive assessment. However, it is not feasible to offer such a service 24 hours a day, seven days a week, hence consideration needs to be given to resource and training requirements for establishing and maintaining effective dysphagia screening. Additional resources may need to be considered for initial and ongoing training (particularly in view of the high staff turnover in some ED departments) and the development of local protocols for ensuring routine implementation of swallow screening (including rostering that ensures appropriately trained staff are available on all shifts).

Videofluoroscopic modified barium swallow (VMBS) study is considered the reference standard to confirm swallowing dysfunction and presence of aspiration. Factors limiting its use include: the relatively complex, time-consuming and resource-intensive nature of the test; the small exposure to radiation; and the difficulty of positioning patients appropriately. In addition, the results can be difficult to interpret and variation among individual raters may occur.[495] There is no agreed criterion for when a VMBS study is required and local policies should be developed that take into consideration local resources and the potential limitations noted above.

Fibre-optic endoscopic evaluation of swallowing (FEES) has also been used as a reference standard in studies assessing dysphagia screening tools[498–501] and has been found to have similar sensitivity and specificity to VMBS.[506] FEES is portable (possibly allowing more immediate access and saving time), requires less staff and is therefore cheaper, and reduces radiation exposure.[506] FEES is generally well tolerated but is associated with a small increase in nose bleeds (6%) and adverse effects on SBP, HR and oxygen saturation (although not severe).[507] While speech pathologists currently coordinate and conduct VMBS studies, only specialists with recognised training and credentials can conduct FEES and it is therefore not commonly available in Australia.

Strategies to prevent complications and restore the normal swallow have been described as either direct/compensatory (such as fluid and diet modification, safe swallowing strategies and optimising the position of the stroke survivor while eating) or indirect (such as oral musculature exercises and stimulation of the oral and pharyngeal structures).[508] Discussion about the intensity of interventions is included in 6.1 Amount and timing of rehabilitation.

A systematic review (15 RCTs) of a range of interventions concluded there was general support for dysphagia interventions but as few RCTs used the same intervention or outcomes the interpretation of the evidence was limited.[509] Two RCTs within this review found compensatory and intervention-swallowing techniques in combination with texture-modified diets can increase safe swallowing. Due to significant heterogeneity, no conclusions could be made about the effect of dietary texture modifications and/or alteration of fluid viscosity (four trials).[509] One subsequent RCT found spoon-thick consistency reduced the risk of aspiration compared with fluid consistency (RR 0.13, 95% CI 0.04–0.39).[504]

One Cochrane review found insufficient evidence (one trial, n=66) to determine the effects of acupuncture on dysphagia.[510]

In a number of small trials, both neuromuscular electrical stimulation (NMES) and thermal tactile stimulation (TTS) reduced the severity of swallow impairment.[511–513] In one small subsequent small RCT (n=25), no difference between NMES and conventional therapy was found. Both interventions resulted in measurable improvement according to patient's perception, nutrition and oral motor function test but not according to videoradiographic findings suggesting patient perception of improvement in swallowing may be erroneous.[514] Another small quasi-RCT (n=28) found sensory stimulation plus TTS is better than TTS alone.[515] Electrical stimulation remains an evolving area of dysphagia treatment. Possible contraindications must be assessed (e.g. pregnancy, presence of a pacemaker). Electrical stimulation should only be considered by clinicians experienced with this intervention and applied according to published parameters. Further information can be obtained from Speech Pathology Australia (www.speechpathologyaustralia.org.au/library/Neuromuscular_Electrical_Stimulation_NMES_Position_Statement.pdf).

Therapy targeting specific muscle groups (e.g. 'Shaker' therapy) appears beneficial for people with specific dysphagia (two small RCTs (n=27, n=9).[516, 517] Another small RCT (n=26) found that repetitive transcranial magnetic stimulation (rTMS) in addition to usual care may improve functional swallowing as measured by bedside assessment).[518]

Dysphagia usually improves within a few weeks following stroke; however, it can persist, requiring long-term intervention and/or alternative feeding strategies (see 7.1 Hydration and nutrition). Patients with significant dysphagia who are unable to manage their secretions sometimes undergo a tracheostomy. Management of such patients should incorporate relevant local and international protocols regarding tracheostomy as well as the specific dysphagia interventions outlined below.

6.2.1 Dysphagia		Grade
a)	Patients should be screened for swallowing deficits before being given food, drink or oral medications. Personnel specifically trained in swallowing screening using a validated tool should undertake screening.	B [494, 495]
b)	Swallowing should be screened for as soon as possible but at least within 24 hours of admission.	GPP
c)	The gag reflex is not a valid screen for dysphagia and should NOT be used as a screening tool.	B [496, 497]
d)	Patients who fail the swallowing screening should be referred to a speech pathologist for a comprehensive assessment. This may include instrumental examination e.g. VMBS &/or FEES. Special consideration should be given to assessing and managing appropriate hydration. These assessments can also be used for monitoring during rehabilitation.	GPP
e)	Compensatory strategies such as positioning, therapeutic manoeuvres or modification of food and fluids to facilitate safe swallowing should be provided for people with dysphagia based on specific impairments identified during comprehensive swallow assessment.	B [479]
f)	One or more of the following methods can be provided to facilitate resolution of dysphagia:	
	• therapy targeting specific muscle groups (e.g. 'Shaker' therapy)	C [516, 517]
	• thermo-tactile stimulation	C [511, 513, 515]
	• electrical stimulation if it is delivered by clinicians experienced with this intervention, applied according to published parameters and employing a research or quality framework.	C [512]
g)	Dysphagic patients on modified diets should have their intake and tolerance to diet monitored. The need for continued modified diet should be regularly reviewed.	GPP
h)	Patients with persistent weight loss and recurrent chest infections should be urgently reviewed.	GPP
i)	All staff and carers involved in feeding patients should receive appropriate training in feeding and swallowing techniques.	GPP

6.2.2 Weakness

Weakness is the most common impairment after stroke with approximately 70% of survivors presenting with arm or leg weakness.[11]

One systematic review (15 RCTs) found strength training had a small positive effect on both strength (SMD 0.33, 95% CI 0.13–0.54) and activity (SMD 0.32, 95% CI 0.11–0.53).[519] There was very little effect on spasticity (SMD –0.13, 95% CI –0.75–0.50).[519] Strength training was defined as interventions that involved attempts at repetitive, effortful muscle contractions and included biofeedback, electrical stimulation, muscle re-education, progressive resistive exercise and mental practice. Upper limb strength training was found to improve grip strength (SMD 0.95, 95% CI 0.005–1.85) but did not improve measures of activity.[520] Strength training was effective after mild and moderate stroke.[520]

A systematic review (18 RCTs, 11 specific to stroke) of electrical stimulation found modest beneficial effects on strength in several studies but variability limited clear conclusions.[521] Electromyographic biofeedback may maximise the benefits of electrical stimulation.

One further systematic review (11 studies) found high-intensity resistance training increased strength, gait speed and functional outcomes and improved QOL without exacerbation of spasticity.[522]

Overall, effect sizes were generally small. Heterogeneity was noted which probably reflects patient selection, different muscle groups, and different interventions and intensities.

6.2.2 Weakness	Grade
One or more of the following interventions should be used for people with reduced strength:	
• progressive resistance exercises	B [519, 520, 522]
• electrical stimulation	B [519, 521]
• electromyographic biofeedback in conjunction with conventional therapy.	C [519]

6.2.3 Loss of sensation

Although almost 50% of stroke survivors are assessed as having sensory deficits[11], there is limited evidence regarding interventions to improve sensation. One systematic review (14 studies) described studies that utilised active training (exercises to train sensory function e.g. proprioceptive training) and passive stimulation (non-specific cutaneous stimulation).[523] Only studies of active training used measures of sensation as a primary outcome and therefore pooling of data across the studies was not conducted.[523] All included studies had small sample sizes, used a variety of outcome measures and had methodological limitations and no clear conclusions were made about active training.

Individual studies included in this review reported that tactile and proprioceptive sensation were improved by sensory-specific training in some studies[524–527] but not all studies.[528, 529] Tactile sensation of novel, untrained stimuli was also improved by sensory training designed to facilitate transfer.[530] Meta-analysis of outcomes from task-specific and transfer-enhanced approaches to sensory retraining across 30 single-case experiments supports the effectiveness of both modes of training.[531] Sensory-specific training has been reported to improve activity levels in some studies but there are inconsistent effects on proprioception.[523] There is conflicting evidence on the benefits of non-specific cutaneous stimulation for sensation[532, 533] but activity levels may be improved.[523]

6.2.3 Loss of sensation		Grade
a)	Sensory-specific training can be provided to stroke survivors who have sensory loss.	C [524–527]
b)	Sensory training designed to facilitate transfer can also be provided to stroke survivors who have sensory loss.	C [530]

6.2.4 Visual field loss

Visual field loss occurs in approximately one-third of stroke survivors[11] and usually affects half of the field of vision in both eyes (homonymous hemianopia). Visual impairments can cause significant functional difficulties, and can include diplopia (double vision), difficulties with ocular convergence (both eyes looking at the same point), impaired saccadic movement (both eyes looking from one point to another), oversensitivity to light, nystagmus (rapid involuntary rhythmic movement of eyes from midline to one side) and dry eyes. Pre-existing visual deficits should be clarified as many stroke survivors are elderly where normal visual loss is common.

Evidence for interventions aimed at visual dysfunction is limited. Restorative (visual field training) and compensatory approaches (hemianopic reading training and visual exploration training) have been described in a large narrative review of mainly low-level trials.[534] Limited evidence based on two systematic reviews was found for visual scanning compensatory strategies.[535, 536] The evidence for visual field training was inconsistent.[535, 536] Not enough evidence on eye movement disorders such as diplopia or convergence has been found to make conclusions about appropriate interventions.[536]

Four related RCTs have been identified. Treatment with 15-diopter Fresnel prisms improved visual perception test scores but not ADL function in stroke patients with homonymous hemianopia.[537] Computer-based training of stimulus detection increased the ability to detect visual stimuli in people with brain injury (including stroke).[538] Visual attention retraining was no more beneficial than traditional perceptual training in improving on-road driving performance in stroke survivors.[539] (see 8.2 Driving) Vision restoration therapy with attentional cueing was found to be superior to vision restoration therapy alone but there were methodological limitations to this study.[540]

Single eye patching for diplopia (often alternating on a daily basis) is common practice. Eye patching provides practical compensation for diplopia but has disadvantages (e.g. reduced stimulation to the affected eye, decreased depth perception, spatial bias).[541] If function is affected, an eye patch can help maximise the effects of active therapy and can be removed during other parts of the day.

6.2.4 Visual field loss		Grade
a)	Stroke survivors who appear to have difficulty with recognising objects or people should be screened using specific assessment tools, and if a visual deficit is found, referred for comprehensive assessment by relevant health professionals.	GPP
b)	Fresnel Prism glasses (15-diopter) can be used to improve visual function in people with homonymous hemianopia.	C [537]
c)	Computer-based visual restitution training can be used to improve visual function in people with visual field deficits.	C [538]

6.3 Physical activity

6.3.1 Sitting

Sitting training that involves getting people to reach beyond arm's length when sitting, ideally while undertaking everyday tasks (e.g. reaching for a cup), were beneficial according to two RCTs.[542, 543] Other sitting training strategies including additional therapy sessions aimed at lateral weight transfer or general trunk exercises had mixed results[544, 545] probably reflecting the particular outcome measures used. Vibration or standing frames are not effective.[546, 547]

6.3.1 Sitting	Grade
Practising reaching beyond arm's length while sitting with supervision/assistance should be undertaken by people who have difficulty sitting.	B [542, 543]

6.3.2 Standing up

One Cochrane review (seven RCTs) found repetitive task-specific training has consistent, moderate benefits on the ability to stand from sitting (SMD 0.35, 95% CI 0.13–0.56).[487] The use of biofeedback via a force platform may have additional benefits for standing up based on two small studies (SMD 0.85, 95% CI –0.15–1.84).[548]

6.3.2 Standing up	Grade
Practising standing up should be undertaken by people who have difficulty in standing up from a chair.	A [487, 548]

6.3.3 Standing

One systematic review (eight RCTs) found no significant differences in standing balance after visual feedback therapy (e.g. postural sway with eyes open SES 0.20, 95% CI –0.12–0.53; weight distribution SES 0.40, 95% CI –0.06–0.86).[549] Repetitive task training (reaching in standing) also found no significant differences with intervention (SMD 0.29, 95% CI –0.06–0.63) based on one Cochrane review (three RCTs).[487] Another Cochrane review (seven RCTs) involving force platform feedback (visual feedback alone or in combination with auditory feedback) improved stance symmetry (visual feedback alone SMD –0.68, 95% CI –1.31– –0.04; visual and auditory feedback WMD –4.02, 95% CI –5.99– –2.04) but not sway in standing, clinical balance outcomes or measures of independence.[550] No intervention approach (orthopaedic, neurophysiologic, motor learning) was found to be superior to any other in improving balance in another Cochrane review (five RCTs).[551]

6.3.3 Standing	Grade
Task-specific standing practice with feedback can be provided for people who have difficulty standing.	B [487, 549, 550]

6.3.4 Walking

A large number of trials have been undertaken to improve walking after stroke. However, no intervention approach (orthopaedic, neurophysiologic, motor learning) has been found to be superior to any other.[551]

One Cochrane review (14 RCTs) found repetitive, task-specific training significantly improved walking distance (MD 54.6 m, 95% CI 17.5–91.7), walking speed (SMD 0.29, 95% CI 0.04–0.53) and ADL (SMD 0.29, 95% CI 0.07–0.51).[487] There was also borderline statistical significance for functional ambulation as measured by the Functional Ambulation Classification or Motor Assessment Scale walking criteria (SMD 0.25, 95%CI 0.00–0.51) and global motor function as measured by Motor Assessment Scale or Rivermead Gross Function subscale (SMD 0.32, 95% CI –0.01–0.66). No difference in QOL or long-term outcomes (6 or 12 months) was found. There was no evidence of adverse effects.[487]

A systematic review found that rhythmic cueing of cadence improved walking speed (SMD 0.97, 95% CI –0.10–1.22) and step length (SMD 1.26, 95% CI 0.20–2.33) based on three RCTs.[548] The same systematic review found that joint position biofeedback had a moderate mean effect (SMD 1.29, 95% CI –0.78–3.37) based on five RCTs.[548] One Cochrane review (13 RCTs) found EMG biofeedback did not improve step length or walking speed compared to conventional therapy.[552] A systematic review (five RCTs) found addition of electrical stimulation to conventional therapy did not confer benefits on unstimulated walking speed (SMD –0.02, 95% CI –0.30–0.26) or step length SMD 0.35, 95% CI –0.93–1.63).[548]

High-intensity resistance training improved gait speed and functional outcomes (see 6.2.2 Weakness). Likewise, fitness training has a significant positive effect on walking (see 7.8 Loss of cardiorespiratory fitness).

One Cochrane review (11 RCTs) found that electromechanical-assisted gait training in combination with usual physiotherapy increased the odds of becoming independent in walking (OR 3.06, 95% CI 1.85–5.06), and increased walking capacity (MD 34 m in six minutes, 95% CI 8–60).[553] The intervention did not increase walking velocity significantly (MD 0.08 m/sec, 95% CI 0.01–0.17).[553]

Another Cochrane review (15 RCTs) found no differences between treadmill training, with or without body weight support, and other interventions.[554] Among participants who could walk independently at the start of intervention, treadmill training with body weight support may produce higher walking speeds (MD 0.09 m/s, 95% CI –0.02–0.20). Adverse events occurred more frequently in participants receiving treadmill training but these were not judged to be clinically serious events.[554] Results from subsequent studies are mixed. Three subsequent RCTs reported that treadmill training improved aspects of walking (speed, step length) and fitness compared to conventional therapy or control (stretching).[555–557] Another RCT reported that treadmill training improved walking speed but not walking distance compared to strength training.[558] A further RCT found no difference between body weight support treadmill training and conventional walking training.[559]

One systematic review (13 non-RCTs) suggests that use of an ankle-foot orthosis (AFO) is associated with a non-significant trend to improved walking speed in people with foot drop.[560] Many subsequent cross-over RCTs on AFOs have methodological limitations (e.g. unclear randomisation procedures, underpowered). Some studies found AFO use improved walking speed[561–564] and other aspects of gait symmetry (e.g. stance duration).[563–568] Two studies failed to find any difference in walking speed[564, 567] and step length.[567] Stroke survivors reported improved satisfaction/confidence when using AFOs.[562, 567] AFO use should be reviewed regularly to ensure appropriate fit and benefits.

Five RCTs of virtual reality training (VRT) in chronic stroke patients were identified.[569–573] Interventions and outcomes were mixed but all studies reported positive results on different measures related to walking. All studies were underpowered and all except one[570] showed no difference at follow-up. Further research is required.

One RCT reported no change in walking speed or step length but did find improved ambulation, as measured by the Functional Ambulation Classification, and improved satisfaction with the use of a walking cane in non-ambulant stroke survivors undertaking rehabilitation.[567] This study has methodological limitations and further trials are needed before recommendations on routine care can be made.

6.3.4 Walking		Grade
a)	People with difficulty walking should be given the opportunity to undertake tailored, repetitive practice of walking (or components of walking) as much as possible.	A [487)]
b)	One or more of the following interventions can be used in addition to conventional walking training outlined in (a):	
	• cueing of cadence	B [548]
	• mechanically-assisted gait (via treadmill or automated mechanical or robotic device)	B [553]
	• joint position biofeedback	C [548]
	• virtual reality training.	C [569–573]
c)	Ankle-foot orthoses, which should be individually fitted, can be used for people with persistent drop foot.	C [560–568]

6.3.5 Upper limb activity

In this section arm function is used to describe proximal upper limb (UL) function (i.e. shoulder/elbow) whereas hand function is used to describe distal UL function (i.e. wrist and hand/fingers). Overall there is much less evidence for effective interventions than for other activities such as standing up or walking.

One systematic review (five RCTs) found neurophysiological approaches (Bobath) were no more effective for both arm function (SWD 0.11, 95% CI –0.14–0.36) and hand function (SWD 0.13, 95% CI –0.19–0.44) than other approaches.[548]

One Cochrane review (14 RCTs) found no effect for repetitive task training on arm function (SMD 0.17, 95% CI –0.03–0.36) or hand function (SMD 0.16, 95% CI –0.07–0.40) after training or after 6–12 months (SMD –0.02, 95% CI –0.31–0.26).[487] The use of a low-cost, non-robotic device to enable repetitive practice in those with severe paresis resulted in a significant improvement in arm function after training and two-month follow up.[574] Three RCTs found training that involves initial and short-term use of trunk restraint in addition to task-specific training can improve shoulder/elbow function and reduce compensations.[575–577]

One systematic review (nine RCTs, two non-randomised trials) found that bilateral movement training significantly improved motor recovery post stroke (ES 0.73, 95% CI 0.66–0.80).[578] However studies were small and included different interventions, patient populations (subacute vs chronic) and outcomes. Subsequent RCTs had conflicting results.[579–583]

One systematic review (13 RCTs) of electrical stimulation found modest improvement in arm function (SWD 0.47, 95 %CI –0.03–0.97) but no difference in hand function (SMD 0.12, 95% CI –0.34–0.59).[548] EMG-triggered electrical stimulation appears more effective than normal electrical stimulation (five RCTs).[548] Another systematic review (eight RCTs, most of which were conducted more than six months after stroke) specific to hand and finger extensor stimulation found no significant difference in effects between EMG-triggered electrical stimulation and usual care as measured by the Fugl-Meyer Motor Assessment Scale for the upper extremity (SES 0.10, 95% CI –0.43–0.64).[584] Most studies had poor methodological quality, low statistical power and insufficient intervention contrast between experimental and control groups.[584]

In another systematic review only four of sixteen studies involving stroke reported benefits of augmented feedback (mostly EMG biofeedback) but no pooling of data was undertaken.[585] One subsequent review (five RCTs) found EMG biofeedback in addition to routine therapy produced modest improvements in arm function (SMD 0.41, 95% CI 0.05–0.77).[548]

Conflicting effects were found in a systematic review (10 RCTs) of robotic interventions.[488] Meta-analysis found an overall moderate but non-significant effect of robotic intervention on motor recovery (SES 0.65, 95% CI –0.02–1.33). The intervention group received almost 20 minutes more therapy on average than controls. The methodological quality of the included studies also varied.[488] A Cochrane review (11 RCTs) found electromechanical and robot-assisted arm training improved arm motor function and strength (SMD 0.68, 95% CI 0.24–1.11 and SMD 1.03, 95% CI 0.29–1.78 respectively) but did not improve activities of daily living (SMD 0.29, 95% CI –0.47–1.06).[586]

One systematic review (21 RCTs) found constraint-induced

movement therapy had clear benefits for arm function (SMD 0.73, 95% CI 0.54–0.91).[548] There was a small and non-significant benefit for hand function (SMD 0.17, 95% CI –0.07–0.42).[548] A Cochrane review (19 RCTs) found moderate improvements in arm function (SMD 0.72, 95 CI 0.32–1.12) and modest improvements in disability immediately after intervention (SMD 0.36, 95% CI 0.06–0.65) although no difference was found at follow-up.[486] Methodological concerns were also noted (e.g. inadequate allocation concealment, small study sizes).[486] Most studies involved stroke survivors four or more months after stroke. Studies only included participants with a minimum of 10 degrees active finger/wrist extension, no cognitive or balance difficulties, no pain, spasticity or limitation in range of movement and clear non-use.

Mental practice with motor imagery improves arm function (four RCTs) (SMD 0.84, 95% CI 0.34–0.33).[548]

Some evidence on mirror therapy, repetitive transcranial magnetic stimulation (rTMS) and virtual training is emerging but this is considered exploratory and further large robust trials are needed. Mirror therapy (three RCTs) has been found to improve some measures of impairment (e.g. range of motion) and UL activity (e.g. Brunnstrom stages for the hand and upper extremity, FIM self-care score or Fugl-Meyer sub-scores for the upper extremity).[587–589] rTMS (nine RCTs) for UL recovery has conflicting effects.[590–597] Most studies involved short duration (often single sessions). Two of the larger trials involving daily sessions for 8–10 days reported contradictory results.[596, 597] Two systematic reviews on virtual therapy reported conflicting results.[598, 599] Methodological concerns were clearly noted in both reviews and no clear conclusions can be drawn. Three subsequent RCTs found virtual therapy is feasible in subacute or chronic phase and is generally as effective as conventional UL therapy with occasional additional benefits in motor performance.[57, 600, 601]

Interventions regarding activities of daily living also involve the upper limb and should be considered (see 6.4 Activities of daily living).

6.3.5 Upper limb activity		Grade
a)	People with difficulty using their upper limb(s) should be given the opportunity to undertake as much tailored practice of upper limb activity (or components of such tasks) as possible. Interventions which can be used routinely include:	
	• constraint-induced movement therapy in selected people	A [548]
	• repetitive task-specific training	B [487]
	• mechanical assisted training.	B [586]
b)	One or more of the following interventions can be used in addition to those listed above:	
	• mental practice	B [548]
	• EMG biofeedback in conjunction with conventional therapy	C [548, 584]
	• electrical stimulation	C [548]
	• mirror therapy	C [587–589]
	• bilateral training.	C [578]

6.4 Activities of daily living

Assessment and management of daily activities fall into two areas:

- personal ADL including basic self-maintenance tasks such as showering, toileting, dressing, and eating
- extended ADL including domestic and community tasks such as home maintenance, management of financial affairs and community access, including driving.

Interventions targeting specific areas such as sensorimotor impairments and motor activities, cognition, communication, leisure and driving impact all impact on activities of daily living.

A Cochrane review (nine RCTs) found OT interventions focused on personal ADL reduced the likelihood of a poor outcome (OR 0.67, 95% CI 0.51–0.87, NNT 11) and increased personal ADL scores (SMD 0.18, 95% CI 0.04–0.32).[98] It was unclear which specific factors contributed to these benefits, for example, simple practice effect or intervention-specific effects. The trials included took place during rehabilitation in the community with no trials in the hospital setting. Early OT involvement was typical of units described in the stroke unit trialist collaboration.[41] Another Cochrane review (14 RCTs) found rehabilitation therapy services in the community within the first year after stroke reduced the odds of a poor outcome (OR 0.72, 95% CI

0.57–0.92) and improved personal ADL scores (SMD 0.14, 95% CI 0.02–0.25).[602] A subsequent cluster RCT[99] carried out in 12 nursing and residential homes found that the intervention group receiving OT interventions (targeted at improving independence in personal ADLs such as feeding, dressing, toileting, bathing, transferring and mobilising) were less likely to deteriorate or die and improved in functional measures compared to controls. Training should occur in the actual environment of task performance as often as possible or in an environment that has been designed to replicate the home or other environment as closely as possible.

A review and meta-analysis (eight RCTs) found occupational therapy interventions in the community were associated with improved scores reflecting extended ADL (WMD 1.61, 95% CI 0.72–2.49).[603] One subsequent RCT found that a simple intervention by an occupational therapist increased the likelihood of people getting out of the house as often as they wanted to as well as the number of actual outdoor journeys.[604] The trial compared the distribution of leaflets describing local transport options (control group) with the additional delivery of up to seven individual sessions in the home over a three-month period (intervention group). Participants in the intervention group were escorted by therapists on walks, bus and taxi trips until they felt confident to go out alone. They were assisted to return to driving in some cases, find alternatives to cars and buses, or become more independent with aids and equipment. After four months (median six sessions) twice as many people from the intervention group reported getting out as often as they wanted to (RR 1.72, 95% CI 1.25–3.27), compared to the control group. Between-group differences were maintained at 10 months.[604]

An updated Cochrane review (10 RCTs) and a subsequent systematic review (11 RCTs) of amphetamine use found a non-significant trend towards increased mortality (OR 2.78, 95% CI 0.75–10.23) and improved motor function (WMD 3.28, 95% CI 48–7.08).[605 606] No difference was found in combined death or dependency but effects were found for blood pressure and heart rate increases.[606]

Two Cochrane reviews (14 RCTs or quasi-RCTs in early phase, five RCTs in subacute/chronic phase) found that acupuncture is relatively safe (a 1.5% incidence of severe adverse events) but there is no clear evidence of benefit in any phase of recovery.[334, 340] Another systematic review (34 RCT or quasi-RCTs) of treatments that combined acupuncture and traditional Chinese herbal medicines noted methodological concerns and concluded there was scant information regarding effect on motor recovery.[607] Information on alternative therapy for acute stroke is found in 4.13. Complementary and alternative therapy.

6.4 Activities of daily living		Grade
a)	Patients with difficulties in performance of daily activities should be assessed by a trained clinician.	A [98, 602]
b)	Patients with confirmed difficulties in personal or extended ADL should have specific therapy (e.g. task-specific practice and trained use of appropriate aids) to address these issues.	B [98, 603]
c)	Staff members and the stroke survivor and their carer/family should be advised regarding techniques and equipment to maximise outcomes relating to performance of daily activities and sensorimotor, perceptual and cognitive capacities.	GPP
d)	People faced with difficulties in community transport and mobility should set individualised goals and undertake tailored strategies such as multiple (i.e. up to seven) escorted outdoor journeys (which may include practice crossing roads, visits to local shops, bus or train travel), help to resume driving, aids and equipment, and written information about local transport options/alternatives.	B [604]
e)	Administration of amphetamines to improve ADL is NOT recommended.	B [605, 606]
f)	The routine use of acupuncture alone or in combination with traditional herbal medicines is NOT recommended in stroke rehabilitation.	B [334, 340, 607]

6.5 Communication

Sixty-seven percent of acute stroke patients are admitted with speech/communication deficits (aphasia, dyspraxia of speech and dysarthria).[11] Communication deficits can be complicated by hearing and visual loss or the need to have a tracheostomy. An audiology assessment may be useful as hearing loss is particularly common in the elderly population and can impact on assessment. Visual loss or neglect associated with the stroke should also be addressed as it impacts on communication. Cultural and linguistic diversity and cognitive communication difficulties also need to be considered.

6.5.1 Aphasia

The term 'aphasia' is used here not to signify absolute loss of language but to incorporate the full spectrum of language deficit severity. It is used synonymously with 'dysphasia' for the purposes of this document. For discussion of intensity of treatment of aphasia see 6.1 Amount and timing of rehabilitation.

One systematic review examined six screening tools and found the Frenchay Aphasia Screening Test was the most thoroughly evaluated and widely used measure with sensitivity of 87% and specificity of 80%.[608] This test was developed in the UK to be used by health professionals other than speech pathologists and includes references specific to European countries. This must be taken into account when using the tool in the Australian setting. While there is a range of other screening tests reported in the literature, further evaluation of their reliability, validity and practical application is needed.

A Cochrane review (12 RCTs) demonstrated that evidence for therapy for communication deficits is limited with most of the trials having methodological shortcomings and small numbers.[609]

Another Cochrane review (10 RCTs) found insufficient evidence for various pharmacological interventions for aphasia although there was weak evidence (due to methodological concerns and possible harms) for piracetam to improve language (OR 0.46, 95% CI 0.3–0.7).[609] One small RCT found dextroamphetamine and moderately intensive speech therapy to be beneficial compared to speech therapy and placebo during the post-acute phase.[610] One additional small RCT found significant short- and long-term improvement with memantine when used alone or with constraint-induced language therapy (CILT) in stroke survivors with chronic aphasia.[611]

A systematic review (one RCT, two CCTs and two case series) found CILT was associated with a modest positive effect on impairment and activity in stroke survivors with chronic aphasia.[476]

Like CILT, therapies targeting specific underlying deficits or optimising preserved abilities, for example, phonological therapy and semantic therapy[320] or the use of gesture (iconic and cued articulation)[321], improved language function.

Interventions delivered via computer have been found to provide some benefits.[612–614]

Communication deficits need to be carefully considered when providing information to stroke survivors and carers. One study found that the reading level for those with aphasia was well below that provided in written material.[124] Small case series have found that modifying written materials using aphasia-friendly principles significantly improved the comprehension of the materials for people with aphasia.[615, 616]

Use of volunteers, including communication partners, with training in either basic communication techniques or in the particular communication needs of the stroke survivor, has been shown to be an effective adjunct to aphasia therapy in improving functional communication.[617, 618]

Studies of group versus individual therapy have produced conflicting results. A Cochrane review (only one trial) found no difference between individual and group interventions, although the authors of the study had reported a difference.[609] A subsequent trial reported a beneficial effect of group training.[619]

A non-systematic review of single case studies[620] reported positive effects of augmentative and alternative communication devices for people with severe aphasia. However there was no transfer of benefits into everyday activities.

6.5.1 Aphasia		Grade
a)	All patients should be screened for communication deficits using a screening tool that is valid and reliable.	C [608]
b)	Those patients with suspected communication difficulties should receive formal, comprehensive assessment by a specialist clinician.	GPP
c)	Where a patient is found to have aphasia, the clinician should:	
	• document the provisional diagnosis	GPP
	• explain and discuss the nature of the impairment with the patient, family/carers and treating team, and discuss and teach strategies or techniques which may enhance communication	GPP
	• in collaboration with the patient and family/carer, identify goals for therapy and develop and initiate a tailored intervention plan. The goals and plans should be reassessed at appropriate intervals over time.	GPP
d)	All written information on health, aphasia, social and community supports (such as that available from the Australian Aphasia Association or local agencies) should be available in an aphasia-friendly format.	D [615, 616]
e)	Alternative means of communication (such as gesture, drawing, writing, use of augmentative and alternative communication devices) should be used as appropriate.	GPP
f)	Interventions should be individually tailored but can include:	
	• treatment of aspects of language (including phonological and semantic deficits, sentence-level processing, reading and writing) following models derived from cognitive neuropsychology	C [320]
	• constraint-induced language therapy	B [476]
	• the use of gesture	D [321]
	• supported conversation techniques	C [617, 618]
	• delivery of therapy programs via computer.	C [612]
g)	The routine use of piracetam is NOT recommended.	B [621]
h)	Group therapy and conversation groups can be used for people with aphasia and should be available in the longer term for those with chronic and persisting aphasia.	C [619]
i)	People with chronic and persisting aphasia should have their mood monitored.	GPP
j)	Environmental barriers facing people with aphasia should be addressed through training communication partners, raising awareness of and educating about aphasia in order to reduce negative attitudes, and promoting access and inclusion by providing aphasia-friendly formats or other environmental adaptations. People with aphasia from culturally and linguistically diverse backgrounds may need special attention, for example, from trained healthcare interpreters.	GPP
k)	The impact of aphasia on functional activities, participation and quality of life, including the impact upon relationships, vocation and leisure, should be assessed and addressed as appropriate from early post-onset and over time for those chronically affected.	GPP

6.5.2 Dyspraxia of speech

Due to its rarity in isolation, studies examining interventions for dyspraxia of speech (impaired planning and sequencing of muscles used for speech) often include participants with a coexisting aphasia. Clinical strategies described in the literature address either the accuracy of articulatory placement and transitioning (including modelling, feedback on the accuracy of articulatory positions, shaping of speech and non-speech sounds using oral exercises and the use of words of increasing length and phonetic complexity) or the prosody of speech with timing or melody.[622] Few of these approaches have been tested empirically and no RCTs have been identified.[622]

One systematic review (58 single-subject studies or small case series) grouped and described studies according to four treatment interventions: promotion of improved articulatory kinematic functioning; rate/rhythm control; intersystemic facilitation/reorganisation (utilising relatively intact systems/abilities to facilitate speech production); and augmentative and alternative communication.[623] Half of the studies focused on articulatory kinematic functioning such as sound training techniques including modelling, visual cueing, integral stimulation and articulatory placement cueing. The PROMPT system which uses tactile cues on the face and neck to cue the articulatory position of the target sound was also noted in this review.[623] While most studies reported some improvements the overall evidence is weak.

There is growing evidence for the application of motor relearning principles used widely in rehabilitation of other deficits following stroke to people with dyspraxia of speech.[624–626]

6.5.2 Dyspraxia of speech		Grade
a)	Patients with suspected dyspraxia of speech should receive comprehensive assessment.	GPP
b)	Interventions for speech motor skills should be individually tailored and can target articulatory placement and transitioning, speech rate and rhythm, increasing length and complexity of words and sentences, and prosody including lexical, phrasal, and contrastive stress production. In addition, therapy can incorporate:	
	• integral stimulation approach with modelling, visual cueing, and articulatory placement cueing	D [623]
	• principles of motor learning to structure practice sessions (e.g. order in which motor skills are practised during a session, degree of variation and complexity of behaviours practised, intensity of practice sessions) and delivery of feedback on performance and accuracy	D [624–626]
	• PROMPT therapy.	D [623]
c)	The use of augmentative and alternative communication modalities such as gesture or speech-generating devices is recommended for functional activities.	D [623]

6.5.3 Dysarthria

One Cochrane review found no quality studies to guide clinical decisions for treatment of dysarthria in non-progressive brain damage[627] although there is evidence for the management of dysarthria in other neurological populations (e.g. Parkinson's disease). Interventions described in the literature address the phonatory, respiratory, prosodic, articulatory and resonatory aspects of speech production and include stimulation of muscle function (with oral musculature exercises, biofeedback or thermal stimulation), augmentative communication devices, prosthetic devices (e.g. palatal lifts), compensatory strategies (such as decreased rate) and interventions to assist the listener in interpreting dysarthric speech.[627]

Generally, small low-level studies were identified. Biofeedback is effective in changing intensity and increasing loudness.[628] A voice amplifier is effective in increasing loudness.[628, 629] Lee Silverman Voice Treatment (LSVT) improved loudness, articulatory precision and speech intelligibility.[630] Subjective ratings by participants and partners also showed some improvements in communication, participation and wellbeing but there was a lack of compliance at follow-up. LSVT requires significant training.

An individually tailored intervention program (conversation and reading aloud of connected speech and of single words) of 16 sessions over an eight-week period may be useful but results were inconsistent (one small series).[631] Using a computer increased the amount of practice by 37% but no difference in outcome to conventional therapy was found.[632] A palatal lift can be effective in cases of velopharyngeal incompetence to correct hypernasality and improve speech production[633–635] but the relevance of this intervention to current practice in Australia is unclear.

If alternative and augmentative communication devices are required (i.e. where speech remains unintelligible), practice with specific devices should preferably occur before discharge from hospital.

6.5.3 Dysarthria		Grade
a)	Patients with unclear or unintelligible speech should be assessed to determine the nature and cause of the speech impairment.	GPP
b)	Interventions for the treatment of dysarthria can include:	
	• biofeedback or a voice amplifier to change intensity and increase loudness	D [628, 629]
	• intensive therapy aiming to increase loudness (e.g. Lee Silverman Voice Treatment)	D [630]
	• the use of strategies such as decreased rate, over-articulation or gesture	GPP
	• oral musculature exercises.	GPP
c)	People with severe dysarthria can benefit from using augmentative and alternative communication devices in everyday activities.	GPP

6.5.4 Cognitive communication deficits

A stroke in the non-dominant hemisphere can result in cognitive communication difficulties which can be described as right hemisphere syndrome (RHS).[636] Individuals with RHS may present with reduced attention, neglect, high-level cognitive-linguistic (e.g. word finding) and discourse impairments), and affective (e.g. facial expression), prosodic (e.g. 'melody' of speech) and pragmatic (e.g. turn-taking) disorders which impact on their communication success, literacy and participation in vocational and social life.[637] There is currently a lack of controlled clinical trials to make conclusions regarding interventions for RHS.[638]

6.5.4 Cognitive communication deficits	Grade
Stroke patients with cognitive involvement who have difficulties in communication should have a comprehensive assessment, a management plan developed and family education, support and counselling as required.	GPP

6.6 Cognition

This section provides an overview of assessment of cognitive and perceptual impairment. Specific impairments are discussed in the following sections in more detail. Cognitive impairment commonly involves attention, memory, orientation, language, executive functions, neglect, apraxia and agnosia. Stroke has also been linked to dementia with one systematic review (30 cohorts) finding approximately 10% of patients had dementia before first stroke, 10% developed new dementia soon after first stroke, and more than a third had dementia after recurrent stroke.[639]

Cognitive impairment is common in acute stroke with 45% of patients with cognitive deficit on admission.[11] Cognitive impairment may be missed in those who present with mild stroke and can have a significant impact on life after stroke.[640]

6.6.1 Assessment of cognition

Early screening for cognitive impairment is important although no gold standard currently exists.[641, 642] Non-linguistic tests should be considered where communication deficits are present as language-based assessments are unsuitable for these patients.[642] Currently there are a significant number of screening and assessment tools used for neglect but there is no universally agreed gold standard.[643–645] As with neglect, there are a number of screening and assessment tools used to detect the presence of apraxia, however, there is no universally agreed gold standard.[646, 647] If cognitive or perceptual deficits are suspected (or found on screening) a more detailed assessment (including a functional assessment) conducted by a trained team member (e.g. neuropsychologist, occupational therapist, or speech pathologist) can clarify the types of impairments and guide the team in providing the most appropriate rehabilitation interventions.

6.6.1 Assessment of cognition		Grade
a)	All patients should be screened for cognitive and perceptual deficits using validated and reliable screening tools.	GPP
b)	Patients identified during screening as having cognitive deficits should be referred for comprehensive clinical neuropsychological investigations.	GPP

6.6.2 Attention and concentration

Attention can be defined as the ability to redirect thoughts and actions towards a stimulus or event for a defined period of time, despite the presence of extraneous or unrelated stimuli. Attention is a fundamental component of most cognitive and perceptual processes and, as such, an impairment of attention may have a significant effect on function.

A Cochrane review (two RCTs) found that cognitive rehabilitation improved measures of alertness and sustained attention.[648] The review defined cognitive rehabilitation as any form of practice based on attention tasks with the aim of improving attention abilities. Only one trial included a measure of functional independence and this showed no significant change. Two trials failed to show a significant change in function with a range of interventions.[539, 649] A subsequent RCT [650] found attention process training (a multi-level intervention directed at sustained, selective, alternating, and divided attention) resulted in a significantly greater improvement on a measure of attention which combined auditory and visual attention scores although effects on other secondary measures were not significant.

6.6.2 Attention and concentration	Grade
Cognitive rehabilitation can be used in stroke survivors with attention and concentration deficits.	C [648, 650, 651]

6.6.3 Memory

An updated Cochrane review (two RCTs) found insufficient evidence to make conclusions about cognitive rehabilitation for memory deficits.[652] The review defined cognitive rehabilitation as any attempt to change memory function by practice, special internal methods or techniques, or compensatory strategies.

One RCT (n=143, approximately a quarter of whom were stroke survivors) demonstrated that an external cueing device (pager) can be effective in assisting with memory deficits.[653] A subsequent RCT (n=62) demonstrated that process-orientated memory training resulted in significant improvement compared to controls in auditory rote memory but not in auditory prose memory or prospective memory. The results suggest that the frequency of the training is important.[654]

6.6.3 Memory	Grade
Any patient found to have memory impairment causing difficulties in rehabilitation or adaptive functioning should:	
• be referred for a more comprehensive assessment of their memory abilities	GPP
• have their nursing and therapy sessions tailored to use techniques which capitalise on preserved memory abilities	GPP
• be assessed to see if compensatory techniques to reduce their disabilities, such as notebooks, diaries, audiotapes, electronic organisers and audio alarms, are useful	D [653]
• be taught approaches aimed at directly improving their memory	GPP
• have therapy delivered in an environment as like the patient's usual environment as possible to encourage generalisation.	GPP

6.6.4 Executive functions

Executive function is a broad term that includes abstract reasoning, initiation and inhibition of behaviour, planning, problem-solving and self-monitoring. Evidence for interventions in impaired executive function is sparse. One RCT demonstrated a positive effect on executive function when using a pager to prompt function.[653] A small RCT found the way in which therapy is delivered can impact upon task performance in a stroke population and careful attention is needed to the information provided during rehabilitation.[655]

6.6.4 Executive functions		Grade
a)	Patients considered to have problems associated with executive functioning deficits should be formally assessed using reliable and valid tools that include measures of behavioural symptoms.	GPP
b)	External cues, such as a pager, can be used to initiate everyday activities in stroke survivors with impaired executive functioning.	C [653]
c)	In stroke survivors with impaired executive functioning, the way in which information is provided should be considered.	C [655]

6.6.5 Limb apraxia

Apraxia is impaired planning and sequencing of movement that is not due to weakness, incoordination, or sensory loss. Speech dyspraxia is discussed separately (see 6.5.2 Dyspraxia of speech). There are few studies of interventions for apraxia, such as strategy training in ADL (e.g. verbalisation of actions), sensory stimulation (touching the limbs), proprioceptive stimulation (e.g. applying weight to the limbs), cueing, chaining (i.e. breaking tasks into individual steps), and normal movement approaches (in which a clinician guides the body through normal patterns of movement).

One Cochrane review (three RCTs) found no significant effect of specific therapeutic interventions on motor apraxia following stroke.[622] Based on two of the three RCTs in the Cochrane review, another systematic review concluded that apraxia can be treated effectively through specific cognitive rehabilitation.[656] The largest RCT included in these reviews involved strategy training (which included self-verbalisation, writing action sequence, and viewing pictures of action sequences) combined with OT, and resulted in greater gains in ADL than OT alone. Differences between groups disappeared at five-month follow-up.[657] A subsequent RCT[658] used specific interventions for limb apraxia (gestural or strategy training) and found there was significant improvement in ideational apraxia, ideomotor apraxia and gesture comprehension test. The study reported carry-over to improvement in performance in untreated tasks.[658]

6.6.5 Limb apraxia		Grade
a)	People with suspected difficulties executing tasks but who have adequate limb movement should be screened for apraxia and, if indicated, complete a comprehensive assessment.	GPP
b)	For people with confirmed apraxia, tailored interventions (e.g. strategy training) can be used to improve ADL.	C [657, 658]

6.6.6 Agnosia

Agnosia is the inability to recognise sounds, smells, objects or body parts (other people's or one's own) despite having no primary sensory deficits. It is a disabling and potentially dangerous condition in that people may fail to recognise dangerous objects, for example, using the stove or turning on the hot tap. Agnosia is usually described by the modality it affects (i.e. visual agnosia or auditory agnosia). The stroke survivor is often unaware of their problem.

It has been suggested that people with agnosia are most likely to benefit from brief compensatory interventions such as increasing their awareness of their deficit, followed by training to recognise stimuli using the senses or perceptual abilities that remain intact.[659] Such interventions may include, for example, using cues such as labels or pieces of Velcro stuck to objects, recognising faces by their distinctive features, verbal reasoning, or 'caller ID' for people with phonagnosia (inability to recognise people by their voice).[659] There are insufficient quality studies to guide recommendations regarding interventions for agnosia.

6.6.6 Agnosia		Grade
	The presence of agnosia should be assessed by appropriately trained personnel and communicated to the stroke team.	GPP

6.6.7 Neglect

Unilateral spatial neglect, or hemi-inattention, is the failure to attend to sensory or visual stimuli on or to make movements towards one side of the environment, typically the left side due to lesions in the right hemisphere. Unilateral spatial neglect has deleterious effects on all aspects of a person's ADL and is a predictor of functional outcome.[660]

An updated Cochrane review (12 RCTs) of cognitive rehabilitation found that there was no clear evidence for or against any of the interventions.[661] Cognitive rehabilitation was defined as therapeutic activities designed to reduce directly the level of cognitive deficits or the resulting disability, and could include structured therapy sessions, computerised therapy, prescription of aids and modification of the patient's environment. The RCTs included did not sufficiently distinguish between the different types of neglect, were generally of small sample size and used a variety of outcome measures making comparison difficult.[661]

Another wide-ranging systematic review identified 54 observational and experimental studies that included a variety of interventions such as visual scanning training (VST), limb activation, mental imagery, sustained attention training, feedback training, sensory stimulation, eye patching and prismatic adaptation to alleviate neglect.[662] The results were mixed. Long-term functional gains were found for VST, mental imagery, feedback training and prismatic adaptation.[662] The evidence was only considered conclusive for VST but the results of this review should be interpreted with caution due to the inclusion of mixed methodological studies.

An additional RCT found improved scanning performance when scanning training was combined with contra-lesion hand stimulation compared with scanning training alone.[663] Two other RCTs found right half-field eye patching and using prism lenses in addition to conventional therapy significantly improved neglect but did not generalise to changes in activity.[664, 665]

6.6.7 Neglect		Grade
a)	Any patient with suspected or actual neglect or impairment of spatial awareness should have a full assessment using validated assessment tools.	C [660, 661]
b)	Patients with unilateral neglect can be trialled with one or more of the following interventions:	
	• simple cues to draw attention to the affected side	GPP
	• visual scanning training in addition to sensory stimulation	C [662, 663]
	• prism adaptation	C [665]
	• eye patching	C [662, 664]
	• mental imagery training or structured feedback.	D [662]

CHAPTER

SEVEN

Managing complications

Managing complications

Management of secondary complications involves initial efforts at prevention. Where this is not successful, management involves strategies to reduce impairments. This chapter presents evidence for both prevention and reduction strategies. Importantly, many of the topics included in this chapter should commence immediately in the acute phase (e.g. nutrition and hydration, incontinence management) as well as being considered during post-acute and long-term care.

7.1 Nutrition and hydration

Dehydration is common after stroke due to swallowing impairment, immobility and communication difficulties and leads to poor outcomes.[666–669] Malnutrition is also common with Australian data indicating that 16–19% of admitted stroke patients are also suffering from malnutrition.[670, 671] Dehydration and malnutrition increase in the first week of hospitalisation and are associated with poor outcomes including increased complications and mortality. Constant monitoring is needed during hospital care.[670, 672, 673] The nutritional needs of those with haemorrhagic stroke may be higher than previously calculated and these patients may be at particular risk of malnutrition.[674] Additional evidence-based practice guidelines for the nutritional management of malnutrition in adult patients across the continuum of care are available.[675] For details on diet and secondary prevention of stroke see 5.1 Lifestyle modifications.

Validated nutritional screening tools should be used for patients with acute stroke on admission and at regular intervals throughout their hospital stay. A number of validated nutrition screening tools, including the Malnutrition Screening Tool (MST) and the Malnutrition Universal Screening Tool (MUST), have been used in studies of acute-phase hospitalised patients including those with stroke.[670, 671, 676, 677] Incorporating such screening tools into patient admission protocols and documentation may promote routine screening.

There is no universally accepted gold standard for the assessment of nutritional status in the acute stroke patient. Malnutrition is typically diagnosed using a number of parameters including unintentional weight loss, decreased oral intake and evidence of muscle wasting/subcutaneous fat loss. A number of validated assessment tools, including Subjective Global Assessment (SGA), Mini Nutritional Assessment (MNA) and patient-generated SGA (pgSGA) have been used in studies of patients in acute hospital and rehabilitation settings, including patients with stroke.[670, 678] Such validated tools should be used alone or in addition to objective nutritional parameters in the assessment of nutritional status.

Simple strategies such as making fluid accessible, offering preferred fluids and providing supervision during meals have been found to increase fluid intake in elderly people who are able to take fluids orally.[679, 680] Where additional hydration is required for patients unable to swallow, fluid can be administered via intravenous, subcutaneous or enteral routes (using a nasogastric [NG] tube or percutaneous endoscopic gastrostomy [PEG]). There is no clear evidence to suggest one route is more beneficial than any other[681] (see 6.2.1 Dysphagia).

One systematic review (55 RCT or quasi-RCTs including stroke-specific trials) found oral nutritional supplementation of elderly patients deemed to be undernourished at baseline reduces infectious complications (OR 0.72, 95% CI 0.53–0.97) and mortality (OR 0.66, 95% CI 0.49–0.90) when compared with placebo/standard care.[682] No effect was found for those not undernourished at baseline. A subsequent RCT found that intensive nutritional supplementation of undernourished patients admitted to specialist stroke rehabilitation improves motor recovery and increases the chance of being discharged home, compared to routine nutritional supplementation.[683] Given the observational data regarding poorer outcomes, it is considered good practice for staff to monitor food and fluid intake in order to maximise nutrition and improve outcomes for patients with acute stroke.

A prospective observational study also found early nutritional support (via tube feeding) improved outcomes for severe stroke patients compared to standard care.[684, 685] The FOOD trial found no significant difference in death and disability or incidence of pneumonia for patients provided with early NG feeding compared with intravenous or subcutaneous fluids only (without nutrition).[686] There was a non-significant trend for those who received early NG tube feeding to have a reduced risk of death but an increased likelihood of being severely disabled.[686] Unfortunately this trial was underpowered to confirm these findings.

There is conflicting evidence for the preferred method of enteral feeding for those with dysphagia. In by far the largest and most robust study, NG tube feeding in the first month after stroke was associated with increased functional recovery and was more likely to be associated with normal feeding six months after stroke when compared with PEG feeding.[687] Three other much smaller studies reported benefits of PEG feeding compared with NG feeding.[688–690] Given the FOOD trial is almost 10 times larger than other trials and much more robust, it is prudent to base decisions on this study, suggesting NG is preferred in the acute phase for those requiring enteral feeding.

Implementation of locally developed evidence-based guidelines for nutritional support linked to audit and feedback, and education of staff using opinion leaders and educational programmes resulted in improved adherence to guidelines by staff and fewer patient complications (infections).[493] Training and resourcing of staff is needed to ensure adequate monitoring of nutritional intake and proper use of nutritional risk screening tools.

7.1 Nutrition and hydration		Grade
a)	All stroke patients should have their hydration status assessed, monitored and managed. Appropriate fluid supplementation should be used to treat or prevent dehydration.	B [666, 667, 669, 679, 681]
b)	All patients with stroke should be screened for malnutrition.	B [670, 686]
c)	Patients who are at risk of malnutrition, including those with dysphagia, should be referred to a dietitian for assessment and ongoing management.	GPP
d)	Screening and assessment of nutritional status should include the use of validated nutritional assessment tools or measures.	B [675]
e)	Nutritional supplementation should be offered to people whose nutritional status is poor or deteriorating.	A [682]
f)	Nasogastric tube feeding is the preferred method during the first month post-stroke for people who do not recover a functional swallow.	B [687]
g)	Food intake should be monitored for all people with acute stroke.	GPP

7.2 Poor oral hygiene

Routine oral care can present a considerable challenge after stroke due to a variety of factors including physical weakness, dysphagia, lack of co-ordination and cognitive problems.

There is little evidence for strategies for maintaining or improving oral hygiene after stroke. A Cochrane review identified eight RCTs but only one provided stroke-specific information.[691] A staff-led oral care education training program delivered to nursing home care assistants showed that denture plaque scores were significantly reduced up to six months after the program. Staff knowledge and attitude toward oral care also improved significantly and was retained at six months. There was no change in other oral hygiene measures. Other evidence relating to oral care interventions is severely lacking, in particular with reference to care in hospital for those following stroke, and further research is needed.

7.2 Poor oral hygiene		Grade
a)	All patients, particularly those with swallowing difficulties, should have assistance and/or education to maintain good oral and dental (including dentures) hygiene.	GPP
b)	Staff or carers responsible for the care of patients disabled by stroke (in hospital, in residential care and in home care settings) can be trained in assessment and management of oral hygiene.	C [691]

7.3 Spasticity

Spasticity is defined as a motor disorder characterised by a velocity-dependent increase in tonic stretch reflexes (muscle tone) with exaggerated tendon jerks resulting from hyper-excitability of the stretch reflex as one component of the upper motor neuron syndrome.[692] There are conflicting views as to whether spasticity is a primary or secondary impairment. It may be present with other impairments such as contracture or shoulder pain (see 7.4 Contracture and 7.6.1 Shoulder pain). Spasticity is not a major determinant of activity limitation. Interventions to reduce spasticity should be considered when the level of spasticity interferes with activity or the ability to provide care to the stroke survivor.[693]

One systematic review (10 RCTs and 11 other clinical trials with mixed populations, the majority of whom were stroke patients) found that the evidence for stretching to reduce spasticity is inconclusive.[694] Some evidence was reported in individual studies supporting short-term effects of a stretching session but it is unclear how long effects last and further evidence is needed.[694] A thermoplastic resting wrist-and-finger splint did not significantly improve spasticity in the forearm/hand.[695]

Three systematic reviews (at least nine RCTs in each) were consistent and found botulinum toxin A decreased spasticity.[696–698] Few adverse events were reported with no differences between control and intervention groups. Global improvement noted by patients and carers based on the goal attainment scale was statistically significant. Effectiveness at the activity level is less clear and no change in QOL was found. Subsequent RCTs also reported reduced spasticity and improved goal attainment but no change in QOL.[699, 700] There are conflicting results from several small RCTs on the effect of botulinum toxin A on shoulder spasticity and pain with some trials showing reductions and others no change in pain or spasticity.[701–705] The current criteria for therapy with botulinum toxin A according to the PBS include treatment of moderate to severe spasticity (≥ 3 using the modified Ashworth scale) of the UL in adults following a stroke, as second-line therapy when standard management has failed (e.g. physiotherapy) or as an adjunct to physical therapy. The maximum number of interventions authorised is four per UL per lifetime with treatment delayed until three months in patients who do not have established severe contracture. Treatment should be discontinued if the patient does not respond after two interventions. This response is measured by a decrease of modified Ashworth scale greater than one in at least one joint (www.pbs.gov.au). The benefits of botulinum toxin A may be enhanced by electrical stimulation[706–708], use of night splints[709] and taping.[708] One small cross-over RCT (n=21) found that a tailored active therapy program was as effective as botulinum toxin A in reducing spasticity in the upper limb. However, it also found that injections in addition to therapy may improve the quality and amount of movement.[710]

Electrical stimulation did not decrease spasticity in one RCT [711] but did in two further RCTs.[344, 712] EMG biofeedback in combination with electrical stimulation has been shown to reduce spasticity in two RCTs.[711, 713] EMG biofeedback during exercise decreased spasticity with no harm being reported[714] as did the use of a dynamic splint.[715]

Intrathecal baclofen decreased severe spasticity[716–718] but adverse events such as infection and functional decline have been reported in a small proportion of cases.[719, 720] This intervention is currently uncommon in Australia.

The efficacy of oral anti-spastic medication was marginal at best, and accompanied by high levels of adverse reactions.[721] Two subsequent studies found little evidence for tolperisone[722] and tizanidine was not as effective as botulinum toxin A.[723]

7.3 Spasticity		Grade
a)	Interventions to decrease spasticity other than an early comprehensive therapy program should NOT be routinely provided for people who have mild to moderate spasticity (i.e. spasticity that does not interfere with a stroke survivor's activity or personal care).	GPP
b)	In stroke survivors who have persistent moderate to severe spasticity (i.e. spasticity that interferes with activity or personal care):	
	• botulinum toxin A should be trialled in conjunction with rehabilitation therapy which includes setting clear goals	B [696–698]
	• electrical stimulation and/or EMG biofeedback can be used.	C [344, 712–714]

7.4 Contracture

Contracture is a shortening of soft tissues that results in reduced joint range of motion (ROM) due to impairments (e.g. weakness or spasticity). Particularly common is loss of shoulder external rotation, elbow extension, forearm supination, wrist and finger extension, ankle dorsiflexion and hip internal rotation. People with severe weakness are particularly at risk of developing contractures as any joint or muscle not moved or lengthened regularly is at risk of soft tissue complications which eventually will limit movement and may cause pain. Although it is considered that soft tissues must be lengthened to prevent contracture, the most appropriate intervention to prevent or manage contracture is currently unclear with expert opinion divided.

Stretching using splints, machines or prolonged positioning to either prevent or reduce contraction has been studied in several generally small RCTs in addition to conventional (early comprehensive) therapy. Seven RCTs aiming to prevent contracture during in-patient rehabilitation in those with severe muscle weakness found a lack of benefit for stretching interventions.[724–730] Only two studies found benefit for isolated muscle groups (shoulder internal rotators in one study and shoulder abductors in the other).[726, 729] Poor compliance and increased pain have been reported with prolonged positioning of the upper limb.[724, 727] One RCT found no difference between tilt-table use and night splints in addition to conventional therapy for maintaining ankle ROM.[731] No benefits for specific stretching interventions to manage existing contracture have been found after the acute phase.[732–735] Interventions were in addition to comprehensive therapy in all trials. Such therapy may include passive movements of flaccid limbs in addition to interventions that stimulate early active movement. There is a lack of evidence for routine use of prolonged static stretches as a component of conventional therapy to prevent or manage contracture.

One RCT found the use of overhead pulleys increased ROM but may also increase adverse events such as shoulder pain; further evidence is required.[736]

Another RCT found manual ankle mobilisations plus functional training led to a small increase in ankle range of motion (5.5 degrees) but no functional benefits were found.[737]

One non-randomised trial found electrical stimulation of the forearm muscles increased range of motion at the wrist but the effects were only short term (i.e. benefits occurred while intervention was applied but quickly reduced when intervention ceased).[738] If used, electrical stimulation should aim to move the joint to the limits of its range in order to maximise its effect.

A systematic review (13 non-randomised studies predominantly of traumatic brain injury) of casting at the ankle, knee, wrist or elbow either with one cast or a series of casts suggested that casting improved range of motion but there was little or no effect on the level of spasticity or activity.[739] Methodological limitations limited clear conclusions.

To ensure that range of motion is maintained, muscles at risk of shortening should be monitored.

7.4 Contracture		Grade
a)	Conventional therapy (i.e. early tailored interventions) should be provided for stroke survivors at risk of or who have developed contracture.	GPP
b)	For stroke survivors at risk of or who have developed contractures and are undergoing comprehensive rehabilitation, the routine use of splints or prolonged positioning of muscles in a lengthened position is NOT recommended.	B [724, 725, 727, 730, 733–735, 740]
c)	Overhead pulley exercise should NOT be used routinely to maintain range of motion of the shoulder.	C [736]
d)	Serial casting can be used to reduce severe, persistent contracture when conventional therapy has failed.	GPP

7.5 Subluxation

There is no evidence that subluxation can be reduced after it has occurred; prevention is therefore paramount. Subluxation commonly occurs along with shoulder pain (see 7.6.1 Shoulder pain). Management of subluxation consists of strategies to prevent it worsening. Interventions aimed at reducing trauma to the shoulder, such as educating all staff, carers and stroke survivors, should prevent the occurrence of shoulder subluxation and pain resulting from weakness. Such education may include strategies to care for the shoulder during manual handling and transfers and advice regarding positioning.

One systematic review (seven RCTs) found that, compared with conventional therapy alone, electrical stimulation prevented some of the subluxation resulting from immobility as a result of weakness (WMD 6.5 mm, 95% CI 4.4–8.6) but did not reduce it once it had occurred (WMD 1.9 mm, 95% CI –2.3–6.1).[741] An additional RCT of intramuscular electrical stimulation found no effect on subluxation compared to intervention with a sling but did observe reduction in shoulder pain.[742, 743] In contrast, another RCT found functional electrical stimulation applied to supraspinatus and posterior deltoid muscles in stroke survivors with both shoulder subluxation and pain during rehabilitation reduced subluxation but not pain.[744]

One Cochrane review found there was insufficient evidence to draw conclusions on the effect of supportive devices such as slings and wheelchair attachments in preventing subluxation.[729] Low-level trials suggest that firm support from devices such as lap trays, arm troughs and triangular slings temporarily reduces an already subluxed shoulder, but support from extension slings such as the Bobath sling, hook harness slings and hemi slings does not.[741, 745–747] One additional study found the GivMohr sling reduced subluxation compared to the Roylan sling.[748]

7.5 Subluxation		Grade
a)	For people with severe weakness who are at risk of developing a subluxed shoulder, management should include one or more of the following interventions:	
	• electrical stimulation	B [741]
	• firm support devices	GPP
	• education and training for the patient, family/carer and clinical staff on how to correctly handle and position the affected upper limb.	GPP
b)	For people who have developed a subluxed shoulder, management may include firm support devices to prevent further subluxation.	C [729]

7.6 Pain

7.6.1 Shoulder pain

The cause of shoulder pain remains unclear. Shoulder pain often occurs secondarily or with other impairments (see 7.3 Spasticity, 7.4 Contracture and 7.5 Subluxation).

Electrical stimulation improved pain-free shoulder range of motion but there was not enough evidence to demonstrate that it prevented or reduced severity of shoulder pain (one Cochrane review).[749] Results from subsequent RCTs are mixed. Three studies failed to find any benefits of electrical stimulation.[744, 750, 751] Another study reported reductions in pain compared to an intervention using a sling.[742, 743] Electrical stimulation can prevent subluxation, which may impact on pain (see 7.5 Subluxation).

One Cochrane review (three trials) noted there was insufficient evidence to draw conclusions on the effect of supportive devices such as slings and wheelchair attachments in preventing pain.[729] The same Cochrane review found strapping delayed the onset of pain (WMD 14 days, 95% CI 9.7–17.8) but did not decrease the severity of pain (WMD –0.7 cm on a visual analogue scale, 95% CI –2.0–0.7).[729] One additional trial also found strapping of at-risk stroke patients delayed the onset of pain compared to controls.[752] Strapping consistently failed to improve range of motion or activity.[729, 752]

Only one RCT has assessed intra-articular corticosteroid injections specifically in a stroke population. The treatment did not significantly improve shoulder pain and a high percentage of people reported adverse effects.[753] Systematic reviews of corticosteroid injections (mostly subacromial rather than intra-articular) in non-stroke populations with shoulder pain due to rotator cuff disease, adhesive capsulitis or mixed etiologies have reported mixed results.[754–756] Study characteristics and methodological quality were variable making pooling of studies difficult.

Cryotherapy and Bobath therapy were not effective in reducing the frequency of pain in people with chronic shoulder pain but may reduce the reported severity of pain.[757] Ultrasound was not effective in reducing shoulder pain.[758]

Preventing contracture and subluxation should help to prevent pain. Interventions aimed at reducing trauma to the shoulder, such as educating all staff, carers and stroke

survivors, should also help to prevent shoulder pain. Such education may include strategies to care for the shoulder during manual handling and transfers, and advice regarding positioning. As there is no clear evidence for effective interventions once shoulder pain is already present in stroke patients, management should be based on evidence-based guidelines for acute musculoskeletal pain.[759]

7.6.1 Shoulder pain		Grade
a)	For people with severe weakness who are at risk of developing shoulder pain, management may include:	
	• shoulder strapping	B [729, 752]
	• interventions to educate staff, carers and people with stroke about preventing trauma.	GPP
b)	For people who develop shoulder pain, management should be based on evidence-based interventions for acute musculoskeletal pain.	GPP
c)	The routine use of the following interventions is NOT recommended for people who have already developed shoulder pain:	
	• corticosteroid injections	C [753]
	• ultrasound.	C [758]

7.6.2 Central post-stroke pain

CPSP occurs in approximately 2–8% of stroke survivors[760] and is a superficial and unpleasant burning, lancinating, or pricking sensation, often made worse by touch, water or movement. While the evidence for interventions for CPSP is inconclusive, a trial of different interventions should be considered where CPSP interferes with functional tasks.

A Cochrane review (61 RCTs) found tricyclic antidepressants and venlafaxine were very effective for neuropathic pain (NNTs ~3).[761] There is evidence to suggest that other antidepressants may be effective but numbers of participants are insufficient to calculate robust NNTs. None of these studies focused on people with stroke and hence it is unclear to what extent these findings can be generalised to stroke survivors with CPSP. Selective serotonin-reuptake inhibitors are generally better tolerated by patients than tricyclic antidepressants but more high-quality studies are required. The known cardiotoxic risks of tricyclic antidepressants (especially in overdose) need to be balanced by the analgesic benefits for more elderly patients with stroke.

Another Cochrane review (12 RCTs, only one of which included CPSP) reported that carbamazepine was more effective than placebo but was not significantly different to amitriptyline (OR 3.3, 95% CI 0.8–13.8) in post-stroke pain. The relative benefit was 2.1 (95% CI 1.5–2.7) for carbamazepine producing at least moderate pain relief in any neuropathic pain. The NNT for moderate relief from carbamazepine in any neuropathic pain was 2.5 (95% CI 1.8–3.8). The event rate across the active arms of the trials was an average of 69%. However, carbamazepine only has a small effect on reducing CPSP.[762, 763] Another updated Cochrane review (seven small RCTs) found tramadol is effective for neuropathic pain (NNT to reach at least 50% pain relief was 3.8, 95% CI 2.8–6.3).[764] None of these studies focused on stroke patients and hence it is unclear to what extent these findings can be generalised to people with CPSP. Other pharmacotherapy has been advocated specifically for CPSP, without any clear evidence of benefit.[765–768]

Other forms of pain relief including transcutaneal electrical nerve stimulation, acupuncture or psychological interventions (e.g. desensitisation or cognitive behavioural therapy) have also been suggested and can be considered prior to or concurrently with medication but evidence for these is also limited.[769] Surgical and chemical sympathectomy interventions require further evidence.[770] If the reason for the pain remains unclear, then referral to a pain specialist team should be considered.

7.6.2 Central post-stroke pain		Grade
a)	People with stroke found to have unresolved CPSP should receive a trial of:	
	• tricyclic antidepressants e.g. amitriptyline first, followed by other tricyclic agents or venlafaxine	B [761]
	• anticonvulsants e.g. carbamazepine.	C [771]
b)	Any patient whose CPSP is not controlled within a few weeks should be referred to a specialist pain management team.	GPP

7.7 Swelling of the extremities

People who are upright (standing or sitting) with their arm or leg hanging and immobile as a result of weakness are at risk of developing swelling of the hand and foot. Limited robust evidence exists for interventions to prevent and treat swelling. Electrical stimulation to mimic the action of the muscle pump was more effective than elevation alone in reducing swelling.[772] Intermittent pneumatic compression was not effective in reducing swelling when provided in addition to routine therapy.[773] Dynamic pressure garments were beneficial in reducing swelling.[715] Continuous passive motion with elevation was more effective than elevation alone in reducing swelling.[774] Elevation of the limb should aim to be higher than the level of the heart to reduce swelling. Encouraging active movement where possible should also be considered to prevent or reduce swelling.

7.7 Swelling of the extremities		Grade
a)	For people who are immobile, management can include the following interventions to prevent swelling in the hand and foot:	
	• dynamic pressure garments	C [715]
	• electrical stimulation	C [772]
	• elevation of the limb when resting.	GPP
b)	For people who have swollen extremities, management can include the following interventions to reduce swelling in the hand and foot:	
	• dynamic pressure garments	C [715]
	• electrical stimulation	C [772]
	• continuous passive motion with elevation	D [774]
	• elevation of the limb when resting.	GPP

7.8 Loss of cardiorespiratory fitness

Severe cardiovascular de-conditioning occurs as a result of the immobility imposed early after stroke.[775] Two relevant meta-analyses were identified. A systematic review (seven RCTs) found cardiorespiratory training improved peak VO_2 (SES 0.42, 95% CI 0.15–0.69) and peak workload (SES 0.50, 95% CI 0.26–0.73).[379] There was also a significant homogeneous SES in favour of cardiorespiratory training to improve walking speed (SES 0.26, 95% CI 0.05–0.48) and walking endurance (SES 0.30, 95% CI 0.06–0.55).[379] The recently updated Cochrane review (24 RCTs) confirmed that cardiorespiratory training improves physical fitness (e.g. peak VO_2, $p<0.0001$), walking speed (MD 6.47 m/min, 95% CI 2.37–10.57), and gait endurance (MD 38.9 m, 95% CI 14.3–63.5).[776] Overall, no increase in adverse events was found but there are too few data to determine the effect of fitness training on death and dependency.[776] Studies mainly used ergometry (cycle, treadmill or Kinetron) but task-related circuit training was also used. Fitness training requires sufficient muscle mass to achieve a cardiorespiratory effect and hence sufficient strength in lower limb muscles is required to achieve intervention targets and benefits.

7.8 Loss of cardiorespiratory fitness		Grade
a)	Rehabilitation should include interventions aimed at increasing cardiorespiratory fitness once patients have sufficient strength in the large lower limb muscle groups.	A [379, 776]
b)	Patients should be encouraged to undertake regular, ongoing fitness training.	GPP

7.9 Fatigue

Fatigue is a common long-term problem after stroke with estimates of prevalence ranging from 16% to 70%.[777] Fatigue is defined here as abnormal (or pathological) fatigue which is characterised by weariness unrelated to previous exertion levels and is usually not ameliorated by rest.[778] Normal fatigue, which is a general state of tiredness, can be improved with rest. The aetiology of fatigue after stroke is uncertain.[777] Recently, diagnostic criteria and an associated structured interview have been developed to identify which stroke patients have clinically significant fatigue.[779]

One Cochrane review identified only three RCTs studying interventions for fatigue post stroke.[777] Two trials of different medications (fluoxetine, tirilazad) and one trial of a chronic disease self-management program failed to show any effect on fatigue. Further studies are needed.

Health professionals should recognise patients with excess levels of fatigue and provide information and practical strategies such as negotiating therapy times and times for rest on a case-by-case basis. Enforced rest periods should not be used.

7.9 Fatigue		Grade
a)	Therapy for stroke survivors with fatigue should be organised for periods of the day when they are most alert.	GPP
b)	Stroke survivors and their families/carers should be provided with information and education about fatigue including potential management strategies such as exercise, establishing good sleep patterns, and avoidance of sedating drugs and excessive alcohol.	GPP

7.10 Incontinence

Dysfunction of the bladder and/or bowel may be caused by a combination of stroke-related impairments (e.g. weakness, cognitive or perceptual impairments). Forty-three per cent of stroke patients are incontinent of urine in the first 72 hours and 26% of patients are catheterised within one week of admission.[11]

7.10.1 Urinary incontinence

Several types of urinary incontinence occur after stroke and hence assessment is important to identify the distinct aetiology in order to begin targeted interventions. Diagnostic assessment has been described as a five-step sequential process.[780]

1. Clinical history-taking, including history of incontinence before the stroke, nature, duration and reported severity of symptoms, and exacerbating factors including diet, fluid and medications.
2. Validated scales that measure the severity of symptoms and impact of symptoms on QOL.
3. Physical examination, including abdominal, perineal (pelvic floor strength), rectal and neurological examinations and measurement of body mass index.
4. Simple investigations, including urinalysis, midstream specimen of urine, measurement of post-void residual volume, provocation stress test, frequency–volume charts and pad tests.
5. Advanced investigations, including urodynamics tests such as cystometry, urethral pressure measurement, pressure–flow studies, video-urodynamics and ambulatory monitoring.

Clinical history had high sensitivity (92%) but low specificity (56%) in determining a diagnosis of incontinence when compared to urodynamic testing.[780] Post-void bladder scanning may also be useful to guide assessment and management and has high specificity (84–89%) and sensitivity (82–86%) compared to urodynamics.[780] All patients should have a clinical history taken. If incontinence is identified after obtaining the clinical history, then a physical examination and simple investigations should be undertaken. Advanced investigations are not routinely justified but may be considered later for those whose incontinence has not resolved.

Evidence is lacking for effective interventions, particularly in the acute phase. One updated Cochrane review (12 RCTs) noted two studies that demonstrated benefits.[781] One study found that a structured functional approach to assessment and management in early rehabilitation increased the likelihood of being continent at discharge compared with a conventional neurodevelopmental approach. The other study demonstrated benefits of care provided by a specialist continence nurse compared with GP care once in the community. This review found trials of physical, behavioural, complementary and pharmacotherapy interventions were inconclusive and more robust data are needed to guide continence care after stroke.

Another systematic review (five trials) focused on behavioural approaches to manage urinary incontinence. This review found limited evidence that bladder retraining with urge suppression in combination with pelvic floor exercises reduced urinary incontinence.[782]

Two Cochrane reviews (3 and 61 RCTs) found that bladder training and/or anticholinergic drugs provided small benefits for people with urge incontinence in a general population.[783, 784] Other approaches described in the literature but without clear evidence include eliminating bladder irritants, prompted voiding, pelvic floor exercises, biofeedback, electrical stimulation and urge suppression techniques.[785] Containment aids (e.g. pads) may be used to prevent social inconvenience and embarrassment.

Functional incontinence is associated with normal bladder function, and may be related to cognitive and language deficits and/or physical immobility post stroke.[786] There are no studies regarding the treatment of functional incontinence specific to stroke. One Cochrane review (nine RCTs) found short-term benefits of prompted voiding interventions in a general population.[787] Other interventions described in the literature without clear evidence of effectiveness include eliminating or minimising environmental barriers to access toileting (e.g. appropriate equipment and/or clearly marked doors), habit training and appropriate clothing that accommodates the person's dexterity.

There is consensus that catheterisation should be avoided in stroke care. Where necessary, intermittent catheterisation is preferred over indwelling catheters for people requiring intervention in hospital.[788–790] Evidence suggests closed (sterile) catheterisation should be carried out by health professionals to reduce the risk of infection.[791] If intermittent catheterisation is still required after discharge from hospital, a clean self-catheterisation technique can be used.[789, 790]

7.10.1 Urinary incontinence		Grade
a)	All stroke survivors with suspected urinary continence difficulties should be assessed by trained personnel using a structured functional assessment.	B [780, 781]
b)	A portable bladder ultrasound scan should be used to assist in diagnosis and management of urinary incontinence.	B [780]
c)	Stroke survivors with confirmed continence difficulties should have a continence management plan formulated, documented, implemented and monitored.	C [781]
d)	The use of indwelling catheters should be avoided as an initial management strategy except in acute urinary retention.	GPP
e)	A community continence management plan should be developed with the stroke survivor and family/carer prior to discharge and should include information on accessing continence resources and appropriate review in the community.	GPP
f)	If incontinence persists the stroke survivor should be re-assessed and referred for specialist review.	GPP
g)	For people with urge incontinence:	
	• anticholinergic drugs can be trialled	B [783, 784]
	• a prompted or scheduled voiding regime program/ bladder retraining should be trialled	GPP
	• if continence is unachievable, containment aids can assist with social continence.	GPP
h)	For people with urinary retention:	
	• The routine use of indwelling catheters is NOT recommended. However if urinary retention is severe, intermittent catheterisation should be used to assist bladder emptying during hospitalisation. If retention continues, intermittent catheterisation is preferable to indwelling catheterisation.	GPP
	• If using intermittent catheterisation, a closed sterile catheterisation technique should be used in hospital.	C [791]
	• Where management of chronic retention requires catheterisation, consideration should be given to the choice of appropriate route, urethral or suprapubic.	GPP
	• If a stroke survivor is discharged with either intermittent or in-dwelling catheterisation, they and their family/carer will require education about management, where to access supplies and who to contact in case of problems.	GPP
i)	For people with functional incontinence, a whole-team approach is recommended.	GPP

7.10.2 Faecal incontinence

Faecal incontinence has been found to occur in 30% of acute stroke patients but only 11% are incontinent 3–12 months post stroke.[792] Symptoms of bowel dysfunction include constipation and diarrhoea. Toilet access and constipating drugs are two modifiable risk factors after stroke. Constipation is also common post stroke and an incidence of 66% was reported in one community-based study.[792] The research base for management of faecal incontinence and constipation is extremely limited and is based on patients in rehabilitation and community settings. Efforts should be made to effectively manage any problems during the acute period in order to prevent further complications. Further research in the acute phase is needed.

One RCT found a nurse-led assessment and education intervention was effective in improving 'normal' bowel movements and changing bowel-modifying lifestyle behaviours (diet and fluid intake). The intervention also influenced patient–GP interaction and physician prescribing patterns for laxatives.[793] There was a non-significant trend towards reduced faecal incontinence. This suggests that practical issues such as adequate fluid intake, use of stimulatory laxatives, dietary manipulation and modifying the environment are considerations in the management of bowel problems. One-fifth of all patients involved in this study (including half of all those who had faecal incontinence) were found to have faecal loading/impaction, emphasising the importance of a rectal examination in the evaluation of bowel problems or faecal incontinence.[793]

Two additional low-level trials were identified. One trial found a bowel regime (time of day plus suppository) that replicates pre-stroke function to be effective.[794] Another form of bowel training, digital stimulation of the anus, may also provide some benefit.[795] There is consensus that compensatory non-medical strategies (e.g. containment pads) can be useful to prevent social inconvenience and embarrassment.

7.10.2 Faecal incontinence		Grade
a)	All stroke survivors with suspected faecal continence difficulties should be assessed by trained personnel using a structured functional assessment.	B [793]
b)	For those with constipation or faecal incontinence, a full assessment (including a rectal examination) should be carried out and appropriate management of constipation, faecal overflow or bowel incontinence established and targeted education provided.	B [793]
c)	Bowel habit retraining using type and timing of diet and exploiting the gastro-colic reflex should be used for people who have bowel dysfunction.	C [794]
d)	If continence is unachievable, containment aids can assist with social continence.	GPP
e)	Education and careful discharge planning and preparation are required for any patient discharged with bowel incontinence.	GPP

7.11 Mood disturbance

Mood is frequently affected following a stroke. Depression is the most common mood disturbance with a meta-analysis of 51 observational studies finding approximately one-third of patients with depression after stroke.[796] Depression is slightly more common in women than men.[797] It is common in the acute, medium and long-term phases and often resolves within a few months of onset without any specific antidepressant therapy or active management.[796] Anxiety and emotional lability, which includes rapid fluctuation in mood and/or decreased inhibition of emotional expression, may also occur, either separately or in combination. While some people with mood disturbances may recover spontaneously over a few months, others may have problems that persist despite active interventions.[796] Generalised anxiety disorder and agoraphobia have been the most frequently identified anxiety disorders following stroke.[798] Physical disability, stroke severity and cognitive impairment are reported to predict ongoing problems with mood. Methodological limitations to current studies do not allow accurate predictive models to be developed.[799] Assessment can be difficult due to the complex interaction of stroke-specific deficits (especially aphasia or cognitive impairments) and the normal adjustment needed to cope with a potentially devastating situation. Assessment of abnormal mood may be via psychiatric interview using standard diagnostic criteria such as the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV). To assess depressed mood a self-or clinician-rated mood scale (e.g. Hamilton Depression Rating Scale, Geriatric Depression Inventory, Patient Health Questionnaire-9) can be used. Rating scales have been found to have adequate to good sensitivity but often lack specificity and hence should be supplemented with a clinical interview in order that a diagnosis be made. Assessment of anxiety in stroke is more difficult.[800, 801] For example, a clinical interview with modified DSM diagnostic criteria was employed to assess for generalised anxiety disorder in stroke.[802]

Furthermore, it is not always clear what contribution the physical symptoms of stroke make to the total score on a rating scale.[803] To counter this, scales have been specifically designed for use in medically ill populations, for example the Depression in the Medically Ill (DMI-10) scale, and these scales have been shown to perform well in discrimination of depression in the context of physical illness.[804] Scales specifically for people with aphasia have also been developed and some validation has been completed.[805]

An updated Cochrane review (14 RCTs) that compared pharmacological agents or psychological therapy versus placebo or standard care for the prevention of depression following stroke found that the small positive benefit of psychological strategies probably supports the use of more structured approaches to the delivery of education and advice targeting emotional recovery and adjustment to the effects of stroke.[806] Evidence to support the routine use of psychological approaches in stroke rehabilitation is limited, as is the generalisability of these findings to all stroke survivors due to the narrow inclusion and exclusion criteria for participants in these trials. There is inadequate evidence to support the routine use of antidepressants, psychostimulants and other drugs for preventing depression and improving recovery after stroke.[806]

Another updated Cochrane review (16 RCTs) for stroke survivors with existing depression found benefits of pharmacotherapy in terms of a complete remission of depression and a reduction (improvement) in scores on depression rating scales but an associated increase in adverse events. There was no evidence of benefits from psychotherapy.[807] The combination of psychotherapy with pharmacotherapy may be useful. One RCT[808] found that a brief psychosocial-behavioural intervention (problem-solving sessions and pleasant events scheduling) in addition to usual care (information booklet and normal medical care including use of antidepressants) is effective in reducing depression in both the short- and long- term compared to standard care alone.

A further updated Cochrane review (seven RCTs) found antidepressants could reduce the frequency and severity of crying or laughing episodes in people with emotional lability. The effect does not seem specific to one drug or class of drugs.[809]

A Cochrane review (24 RCTs) found that fitness training does not change mood.[776] Most subsequent trials of exercise have also found either no effects or a non-significant trend.[810–814]

No RCTs have been undertaken to evaluate electroconvulsive therapy (ECT) in stroke patients, and a robust systematic review of ECT in an elderly population with depression was unable to draw any conclusions due to the lack of good quality evidence.[815]

Many challenges remain regarding the assessment and management of depression. For example, there are no clear data to suggest duration of pharmacotherapy after a stroke, preferred dosage, expected rate of side effects or the best process for ending treatment. Little is known about assessment and management of anxiety after stroke despite its apparently high incidence. Patients and carers should be informed that mood problems after stroke are common at any stage in recovery and should be encouraged to contact a healthcare professional should any mood changes persist for two weeks or longer and interfere with daily activities.

7.11 Mood disturbance		Grade
Identification		
a)	All patients should be screened for depression using a validated tool.	GPP
b)	Patients with suspected altered mood (e.g. depression, anxiety, emotional lability) should be assessed by trained personnel using a standardised and validated scale.	B [800, 801, 805]
c)	Diagnosis should only be made following clinical interview.	GPP
Prevention		
d)	Psychological strategies (e.g. problem solving, motivational interviewing) can be used to prevent depression after stroke.	B [806]
e)	Routine use of antidepressants to prevent post-stroke depression is NOT recommended.	B [806]
Intervention		
f)	Antidepressants can be used for stroke patients who are depressed (following due consideration of the benefit and risk profile for the individual) and for those with emotional lability.	B [807]
g)	Psychological (cognitive-behavioural) intervention can be used for stroke patients who are depressed.	B [807]

7.12 Behavioural change

Personality and behavioural changes (e.g. irritability, aggression, perseveration, adynamia/apathy, emotional lability, perseverative behaviours, disinhibition and impulsivity, lack of insight) are common after stroke and can lead to significant impediments to community participation and reintegration.[816–819] Such changes also pose difficulties for family, friends and carers, significantly contributing to carer burden and stress.[817, 819] There is limited specific research on assessment and rehabilitation of behaviour management.

Approaches to behavioural intervention are varied in rehabilitation practice. Research primarily using small numbers or single-case studies indicates the strengths of neurobehavioural approaches in decreasing the frequency, intensity and duration of problematic behaviours (e.g. functional behavioural assessment and non-aversive interventions, antecedent control, verbal feedback, establishing a therapeutic relationship, and altering staff attributions).[820–822]

Information and education for both the stroke survivor and their family/carer is important for behaviour change (see 1.9.1 Information and education).

7.12 Behavioural change		Grade
a)	The impact of chronic behavioural changes (irritability, aggression, perseveration, adynamia/apathy, emotional lability, disinhibition and impulsivity) on functional activities, participation and quality of life, including the impact on relationships, employment and leisure, should be assessed and addressed as appropriate over time.	GPP
b)	Stroke survivors and their families/carers should be given access to individually tailored interventions for personality and behavioural changes e.g. participation in anger-management therapy and rehabilitation training and support in management of complex and challenging behaviour.	GPP

7.13 Deep venous thrombosis or pulmonary embolism

DVT and the associated complication of PE are significant risks in the first few weeks post stroke with PE accounting for 5% of deaths and the third most common cause of deaths after stroke[823] Reported risk factors include reduced mobility, stroke severity, age, dehydration, increasing time between stroke and the introduction of preventive measures, haemorrhagic stroke and cryptogenic ischaemic stroke.[824] While there is often a high number of DVTs reported in studies (15–80%), many of these are asymptomatic. Clinically apparent incidence is low for both DVT (<1–10%) and PE (<1–6%).[824] National clinical guidelines for VTE prophylaxis, which also specifically address patients with stroke, were released in 2009.[825]

In high-risk populations, duplex or triplex ultrasound techniques are useful to confirm or rule out suspected DVT (sensitivity 91–92%, specificity 94%).[826] However, the most cost-effective testing strategy has been to use the D-Dimer test and the Wells Score to categorise the risk prior to ultrasound.[826]

Observational data suggests that acute stroke patients spend significant time inactive.[827] Early mobilisation is not supported by direct evidence, however, the incidence of DVT has been found to be lower in stroke unit care that encourages early mobilisation.[41] Early mobilisation has been identified as one of the most important factors contributing to better outcomes with stroke unit care (see 6.1 Amount and timing of rehabilitation).[481] Hydration has not been directly evaluated in trials but studies have found dehydration to be strongly associated with DVT.[666] Early hydration, a component of stroke unit care, could be expected to provide some protection against DVT.

Routine antiplatelet therapy using aspirin 160–300 mg daily, given orally (or by nasogastric tube or per rectum in patients who cannot swallow), and started within 48 hours of onset of presumed ischaemic stroke modestly reduces the risk of PE (OR 0.71, 95% CI 0.52–0.95, NNT 693).[828]

An updated Cochrane review (24 RCTs) found that intervention with anticoagulants significantly reduced DVT (OR 0.21, 95% CI 0.15–0.29, NNT 114), and PE (OR 0.60, 95% CI 0.44–0.81) in acute stroke, but the benefits were offset by an increase in extracranial haemorrhages (OR 2.99, 95% CI 2.24–3.99). The data did not support the routine use of any of the currently available anticoagulants in unselected acute ischaemic stroke patients as the risks outweigh the benefits.[243] The benefits of prophylactic therapy may outweigh the risks for certain subgroups, for example, those with leg paresis, a prior history of DVT or PE, or an inherited thrombophilic tendency and those who are immobile or morbidly obese.[824]

Low-molecular-weight heparin (LMWH) or heparinoid is more effective than unfractionated heparin (UFH) in preventing DVT (heparinoid OR 0.52, 95% CI 0.31–0.86; LMWH OR 0.56, 95% CI 0.44–0.73).[247, 829] However, LMWH is associated with an increase in bleeding complications and

there is insufficient evidence to determine whether LMWH differs from standard heparin for clinically important end-points such as symptomatic VTE, intracranial haemorrhage, major extracranial haemorrhage and mortality.[247, 824] LMWH may be more convenient to administer (often once-daily dosing), but dosing precautions apply (for example, for patients with renal failure) should prophylactic anticoagulant therapy be considered.

Two systematic reviews concluded that there is currently insufficient evidence on the effectiveness of physical methods for preventing DVT.[824, 830] One subsequent RCT found no significant reduction of proximal DVT after stroke but an increase in adverse effects with the use of thigh-length graduated compression stockings in patients admitted to hospital with acute stroke who were immobile.[831]

7.13 Deep venous thrombosis or pulmonary embolism		Grade
a)	Early mobilisation and adequate hydration should be encouraged in all acute stroke patients to help prevent DVT and PE.	GPP
b)	Antiplatelet therapy should be used for people with ischaemic stroke to help prevent DVT/PE.	A [240]
c)	Low molecular weight heparin or heparin in prophylactic doses can be used with caution for selected patients with acute ischaemic stroke at high risk of DVT/PE. If low molecular weight heparin is contraindicated or not available, unfractionated heparin should be used.	B [247, 829]
d)	Antithrombotic therapy is NOT recommended for the prevention of DVT/PE in haemorrhagic stroke patients.	GPP
e)	Thigh-length antithrombotic stockings are NOT recommended for the prevention of DVT/PE post-stroke.	B [831]

7.14 Pressure care

Pressure ulcers are 'areas of localised damage to the skin and underlying tissue due to pressure, shear or friction'.[832] One large multicentre trial reported 1% of patients developed pressure ulcers following acute stroke admission.[686] Age, stroke severity, immobility, incontinence, nutritional status and diabetes are contributing risk factors. The skin of those deemed at high risk should be examined on admission and reviewed as regularly as needed based on individual factors.

Pressure care policies are a common characteristic of stroke unit care.[41] Risk assessment scales, such as the Braden, Norton or Waterlow Risk Assessment scales, have only modest sensitivity and specificity but may be more useful than clinical judgement alone to identify stroke survivors at high risk of developing pressure ulcers.[833] There is no evidence that the use of risk assessment scales reduces the actual incidence of pressure ulcers.[833]

The main strategies for the treatment of pressure ulcers (not specific to stroke) are:

- local treatment of the wound using wound dressings and other topical applications
- pressure relief using beds, mattresses or cushions, or repositioning of the patient
- treatment of concurrent conditions which may delay healing, e.g. poor nutrition, infection
- use of physical therapies such as electrical stimulation, electromagnetic therapy, ultrasound, laser therapy.[834]

One Cochrane review (eight RCTs) found no firm conclusions could be drawn on the effect of enteral and parenteral nutrition on the prevention and treatment of pressure ulcers.[835] One subsequent RCT of nutritional support reported no difference in the incidence of pressure ulcers for those receiving nutritional supplementation.[686] However, supplementation was only recommended in the small number of patients with malnutrition and further large trials are needed to evaluate the benefits of nutritional support in this subgroup.

An updated Cochrane review (52 RCTs) suggested that foam alternatives to the standard hospital mattress reduced the incidence of pressure ulcers in people at risk.[832] However, the included trials varied greatly in quality and comparisons were difficult. The relative merits of alternating and constant low-pressure devices and of the different alternating pressure devices or seat cushions for pressure ulcer prevention are unclear. Medical grade sheepskins were associated with a decrease in pressure ulcer development according to two RCTs (RR 0.42, 95% CI 0.22–0.81).[832]

Another Cochrane review (three RCTs) found that there was not enough evidence to clearly determine whether physical therapies are beneficial.[834]

There is insufficient evidence to guide decisions about which dressings or topical agents are most effective in pressure ulcer management.[836]

A management plan is useful for those assessed as having an increased risk of developing pressure ulcers. Such a plan needs to be tailored to each individual situation in response to identified risk factors. Careful monitoring should be included with the frequency determined by individual factors.

7.14 Pressure care		Grade
a)	All stroke survivors at risk (e.g. stroke severity, reduced mobility, diabetes, incontinence and nutritional status) should have a pressure care risk assessment and regular evaluation completed by trained personnel.	GPP
b)	All stroke survivors assessed as high risk should be provided with appropriate pressure-relieving aids and strategies, including a pressure-relieving mattress as an alternative to a standard hospital mattress.	B [832]

7.15 Falls

Increased falling has been found after stroke in both hospital and community settings.[837–842] Seven per cent of patients were reported to have fallen in the most recent acute stroke audit [32], Seventy-nine per cent of stroke rehabilitation in-patients were assessed as 'at risk' of falls and 83% of those assessed as 'at risk' had a documented falls management plan.[39]

Assessment of falls needs to consider the specific underlying cause. Balance (e.g. using Berg Balance Scale) or mobility do not predict falls.[843, 844] Where problems are stroke-specific (e.g. difficulty standing), interventions should target these difficulties. Fear of falling (e.g. cognitive and emotional factors as well as physical factors) should also be considered.[845]

Evidence for falls intervention is primarily based on research in older people, both healthy and with a range of diagnoses, and in different settings, mainly in the community. The extent to which these findings can be generalised to stroke patients remains unclear.

A Cochrane review (111 RCTs) found that group and home-based exercises reduced the rate and risk of falling, as did Tai Chi. Assessment and multifactorial interventions reduced the rate of falls but not the risk of falling. Other interventions such as vitamin D, home safety interventions and reduction of psychotropic medications yielded more mixed results.[61] Another Cochrane review (15 RCTs) found insufficient evidence for the efficacy of other interventions, including hip protectors.[846] One subsequent Australian cluster RCT (n=3999) examined the efficacy of a targeted multifactorial fall prevention program in elderly care wards. The intervention involved a nurse and physiotherapist working 25 hours a week for three months. The program included a risk assessment of falls, staff and patient education, drug review, modification of bedside and ward environments, an exercise program and alarms for selected patients. No difference was found in fall rates during follow-up between intervention and control wards (9.26 falls vs 9.20 falls per 1000 bed-days, p=0.96).[847]

Stroke-specific studies have produced conflicting results. One RCT (n=48) found extra sit-to-stand practice did not result in fewer falls.[848] Another RCT (n=61) showed that community group exercise programs reduced rates of falls, particularly when exercises focussed on agility.[849] In another RCT (n=170), individualised physiotherapy provided to stroke survivors more than one year after their stroke did not reduce the number of falls.[850] Falls were a secondary outcome in this study and the intervention was of low intensity. Symmetrical standing training and repetitive sit-to-stand training were shown to reduce falls compared to neuromuscular facilitation techniques in one CCT (n=54).[851] A similar CCT (n=52) using visual feedback to train sit-to-stand ability found a non-significant trend in falls reduction.[852]

7.15 Falls		Grade
a)	Falls risk assessment should be undertaken using a valid tool on admission to hospital. A management plan should be initiated for all those identified as at risk of falls.	GPP
b)	Multifactorial interventions in the community, including an individually prescribed exercise program, should be provided for people who are at risk of falling.	B [61]

7.16 Sleep apnoea

Observational studies have reported incidences of obstructive sleep apnoea (OSA) between 32% and 80% following stroke.[853] There is debate as to whether OSA is a risk factor for stroke, a consequence of stroke, or both.[853]

Several Cochrane reviews of OSA in adults with mixed aetiologies were identified but few of the included studies were specific to stroke. One Cochrane review (36 RCTs) found continuous positive airway pressure (CPAP) was effective in reducing OSA.[854] Stroke-specific trials have found CPAP was a more effective intervention than postural therapy or oral devices but may not be tolerated by all people with OSA.[855, 856] A subsequent small RCT (n=30) found no benefit from CPAP treatment but compliance was poor with only 1.4 hours of use per night.[857] Another Cochrane review (16 RCTs) found oral devices improved subjective sleepiness and sleep-disordered breathing compared with controls.[858] CPAP appears to be more effective in improving sleep-disordered breathing than oral devices but people prefer oral devices.[858] The benefit of surgery for OSA is unclear according to a Cochrane review (seven RCTs).[859] Similarly, most drug interventions used for OSA were shown in a Cochrane review (26 RCTs) to be ineffective in reducing apnoea episodes or improving well-being in the long term.[860] Postural therapy had similar benefits to CPAP in people with positional OSA in one small RCT (n=13).[861]

7.16 Sleep apnoea	Grade
CPAP or oral devices should be used for stroke survivors with sleep apnoea.	B [854, 858]

CHAPTER

EIGHT

Community participation and long-term recovery

Community participation and long-term recovery

8.1 Self-management

Stroke survivors may have a decreased ability to manage aspects of their day-to-day life independently. However, they need to adapt to the impact of the stroke and any resulting disability and to be active in managing their daily lives in spite of any long-term consequences of stroke. As self-managers, stroke survivors work actively with health professionals, family members/carers and other people to optimise recovery and maximise independence from the very start of the recovery process. Self-management addresses any lifestyle interventions necessary to reduce the risk of recurrence of stroke as well as strategies to assist in adapting to changes in physical and cognitive ability, relationships, place of residence and participation in the community.

There are many models by which stroke survivors may be encouraged to manage their own recovery, but few have been comprehensively developed and tested. The most thoroughly tested model is a generic six-week self-management program in which stroke survivors (without cognitive impairment) were provided with education about communicating with health professionals, managing change and setting and achieving goals.[862–864] A systematic review (71 trials) found small to moderate positive changes in health outcomes for people participating in generic self-management education programs.[865] Other models of self-management may be based on written material only or on individual contact with health professionals and peers.

An RCT (n=100) which used an existing stroke-specific self-management program found the intervention group maintained levels of function relating to family roles, activities of daily living, self-care and work productivity while levels in the control group declined.[866] However, there were no differences after one year. There are limited stroke-specific self-management programs available. More information can be obtained from the NSF at www.strokefoundation.com.au/self-management-program.

8.1 Self-management		Grade
a)	Stroke survivors who are cognitively able should be made aware of the availability of generic self-management programs before discharge from hospital and be supported to access such programs once they have returned to the community.	C [863, 867]
b)	Stroke-specific programs for self-management should be provided for those who require more specialised programs.	GPP
c)	A collaboratively developed self-management care plan can be used to harness and optimise self-management skills.	GPP

8.2 Driving

The effects of a stroke can lead to isolation and reduced QOL as people reduce the amount of community access they had prior to the stroke.[868] The inability to return to driving in particular often has a profound impact on community participation.[869] The issue of returning to driving can be confusing and the topic is often raised by the patient or their family/carer, especially by patients with minor stroke or TIA.

Motor, sensory, visual or cognitive impairments can have a major impact on a person's ability to drive after stroke. Studies have found that the impairments most likely to predict poor on-road driving ability are visuospatial and attention deficits, reduced motor processing, homonymous hemianopia and a right cerebral hemisphere lesion.[870–873]

The current draft national guidelines describe criteria for unconditional licences and, where conditional licences exist, for private and commercial drivers.[874] For private drivers, stroke survivors are not to return to driving for a minimum of one month (three months for commercial drivers) even if there are no significant neurological, perceptual or cognitive deficits. Stroke survivors are responsible for informing the relevant licensing authority and are advised to contact their car insurance company. An unconditional licence may be granted if there is no significant impairment of any of the following: visuospatial perception, insight, judgement, attention, reaction time, sensation, muscle power, co-ordination and vision (including visual fields). A conditional licence may be considered after the non-driving period, taking into account the opinion of an appropriate specialist, the nature of the driving task and subject to at least an annual review, after consideration of the results of a practical driving assessment.

In the case of TIA, the draft national guidelines currently state that private vehicle drivers should not drive for two weeks and commercial vehicle drivers should not drive for four weeks after a TIA. A conditional licence is not required as there is no long-term impairment.

Stroke survivors who held a driving licence pre-stroke should be provided with written information about returning to drive including their legal obligations and the assessments needed including occupational therapy driver assessment. This information should be provided prior to discharge from hospital or at the first visit in the case of those not admitted to hospital after a TIA.

There is little agreement regarding the most appropriate method of assessing ability to drive. However, a three-step process is generally followed.[875, 876]

1. Medical assessment of fitness to drive.[874]
2. A comprehensive off-road driving test of motor, sensory, visual and cognitive skills that may incorporate tests such as the Dynavision Performance Assessment Battery or the Cognitive Behavioural Driver's Inventory[877, 878] or newly developed Australian tools such as Drive Safe Drive Aware[879] and Occupational Therapy Driver Off-Road Assessment Battery.[880]
3. An on-road test.[881, 882]

Evidence for interventions to improve driving ability is limited. One RCT found a visual attention retraining program was no more beneficial than traditional perceptual training in improving on-road-driving performance in stroke survivors.[539] Another RCT found simulator-based driving training in a stationary full-sized car with adaptive aids significantly improved aspects of driving compared to standard training.[883] Access to simulated driver training is very limited in Australia. A further small RCT found retraining visual processing skills (such as executing a continuous wide scan, combining motor and visual processing into a motor response) using the Dynavision apparatus did not improve any outcome related to control.[884]

8.2 Driving		Grade
a)	All patients admitted to hospital should be asked if they intend to drive again.	GPP
b)	Any patient who does wish to drive should be given information about driving after stroke and be assessed for fitness to return to driving using the national guidelines (*Assessing Fitness To Drive)* and relevant state guidelines. Patients should be informed that they are required to report their condition to the relevant driver licence authority and notify their car insurance company before returning to driving.	GPP
c)	Stroke survivors should not return to driving for at least one month post event. A follow-up assessment (normally undertaken by a GP or specialist) should be conducted prior to driving to assess suitability. Patients with TIA should be instructed not to drive for two weeks.	GPP
d)	If a person is deemed medically fit but is required to undertake further testing, they should be referred for an occupational therapy driving assessment. Relevant health professionals should discuss the results of the test and provide a written record of the decision to the patient as well as informing the GP.	GPP

8.3 Leisure

The majority of stroke survivors are over retirement age, and leisure and social activities are a significant part of their life. Many people with stroke are often unable to continue with their usual leisure activities and/or do not take up new ones, which may lead to social isolation, depressed mood and negative effects on their relationships with their families/carers.[885]

A systematic review (eight RCTs) found community OT improved participation in leisure activities if targeted interventions were used, although there was no improvement in personal or extended ADL.[603] Another RCT (n=26) evaluated a day service for younger stroke survivors and found only small gains, with no effect on depression, anxiety or QOL.[886] A subsequent RCT (n=56) compared a leisure education program run in home and/or in community with weekly visits by a recreation officer.[887] This study found positive effects in terms of depressive symptoms, leisure participation and satisfaction for the intervention group. Both groups benefited significantly from the extra contact with health professionals in terms of health-related QOL with no differences between the groups.

8.3 Leisure	Grade
Targeted occupational therapy programs can be used to increase participation in leisure activities.	A [603]

8.4 Return to work

Observational studies have reported wide-ranging estimates (most commonly~40%) of people returning to work after stroke, with a direct correlation between returning to work, age and disability.[888–890] Difficulty returning to work can significantly impact on family relationships, level of intimacy, economic situation and leisure activities.[888] If the stroke survivor wants to work but is unable to return to their previous occupation, then other vocational options within the workplace (or other areas/workplaces) should be explored (e.g. volunteer work or training in other vocational areas).

One small RCT (n=26) assessed a day service specifically for younger stroke survivors and found a positive effect on occupational performance.[886] The service offered opportunities to identify and pursue meaningful and realistic activities in the community, not specifically work-related. There is no evidence for interventions specifically targeted at assisting in return to work. Assistance with return to work can be provided by an occupational therapist and other relevant members of the stroke survivor's team, and by specialised employment agencies and services within the community.

8.4 Return to work	Grade
Stroke survivors who wish to work should be offered assessment (i.e. to establish their cognitive, language and physical abilities relative to their work demands), assistance to resume or take up work, or referral to a supported employment service.	GPP

8.5 Sexuality

Observational studies have found that sexual dissatisfaction is common post stroke (45–83%) despite no reported drop in libido, and is more common in people with communication disorders.[891–893] There are no studies that address the impact of interventions on sexual activity after stroke.

The causes of decreased sexual activity remain undefined empirically but are thought to be in part organic and in part psychosocial.[893] They may include fear, anguish, sensory and physical changes, changes in body image and self esteem, and an inability to discuss relationships and sexuality.[885, 894, 895] A fear of further stroke during sex is also common,[895] despite the lack of evidence to support this.

Possible interventions need to consider psychosocial aspects such as body image, anxiety and fear and include strategies such as counselling, providing information and effective communication. Such interventions should be provided by health professionals with appropriate experience and expertise in sexuality counselling. Interventions may also need to consider physical aspects such as positioning and timing, or the use of non-invasive interventions for erectile dysfunction.[896, 897]

A fact sheet *Sexuality after stroke* is available from the NSF (see www.strokefoundation.com.au).

8.5 Sexuality		Grade
a)	Stroke survivors and their partners should be offered:	
	• the opportunity to discuss issues relating to sexuality with an appropriate health professional	GPP
	• written information addressing issues relating to sexuality post stroke.	GPP
b)	Any interventions should address psychosocial aspects as well as physical function.	GPP

8.6 Support

Social support has been shown to correlate directly with outcomes post stroke. It is common for people with stroke to comment on a "black hole" period when returning home, as they confront the difficulty adjusting to life after stroke, especially when formal interventions have been completed. Support during this phase would seem to be particularly important.

Three important aspects of support have been reported in descriptive studies: emotional, instrumental (practical support such as home help), and informational.[898] High emotional support along with moderate levels of instrumental support was found to be most the beneficial; however, a trial of a social support intervention based on these assumptions failed to produce significant effects, highlighting the complex nature of social support after stroke.[899] Counselling services may be important during the reintegration and long-term recovery phase to provide appropriate emotional and informational support (see 1.9.3 Counselling). Services that provide support in the community include support groups, community services (e.g. Meals on Wheels, home help, and transport), primary care workers (personal care, respite support), community rehabilitation teams and voluntary services (e.g. providing social support).

8.6.1 Peer support

Peer support is a process by which stroke survivors may share their experiences with others with similar experience. Peer support may be structured via groups, online or telephone. Many stroke survivors are active in establishing and maintaining peer support groups in the community. Furthermore they report that peer support is beneficial for sharing experience, for education and for socialisation (leading to improved self-esteem and self-confidence) and is therefore critical to recovery of good QOL after stroke.[4, 900, 901] Individual peer support may also be of value, either to supplement groups or for people who do not want involvement in a group.

There are currently no RCTs regarding the effectiveness of peer support for stroke survivors. Peer support groups in Australia are supported by state stroke associations, the NSF or individual coordinators. Telephone and internet support is also being trialled. Contact the NSF for more information at www.strokefoundation.com.au/strokeconnect.

8.6.1 Peer support	Grade
Stroke survivors and family/carers should be given information about the availability and potential benefits of a local stroke support group and/or other sources of peer support before leaving hospital and when back in the community.	GPP

8.6.2 Carer support

The physical and emotional aspects of caring for someone with stroke can frequently alter the family roles and dynamics and may result in significantly higher anxiety and depression and lower perceived QOL in carers.[66, 902] Carers, along with stroke survivors, need long-term practical, emotional, social and financial support. Access and availability of carer support services is critical.

Such support includes interventions and guidelines for counselling (see 1.9.3), information and education (see 1.9.1), community rehabilitation and follow-up services (see 1.4.1), and respite care (see 1.9.4).

Interventions to support informal carers have been considered in several systematic reviews.[126, 903–907] Interventions include carer training, problem-solving, psycho-educational and social support interventions, and a combination of education and counselling. While some benefits have been reported, particularly for interventions involving counselling and/or education, the heterogeneous nature of interventions makes it hard to draw clear conclusions. One systematic review (four RCTs) assessing interventions to improve mental health for informal carers (e.g. education, particularly problem-solving approaches, or support interventions including coping skills and emotional support) pooled data and found a small but beneficial effect overall (ES 0.28, 95% CI 0.12–0.44).[908] Stroke-related personality and behavioural difficulties are known to have significant and longer term impact on individuals with stroke and their family/carers and assessment and individualised interventions should be provided (see 7.12 Behavioural change).

Different modes of delivering support to carers, for example using the telephone [909, 910] or the internet [911, 912] have been used, and have potential benefits in reducing stress. Such interventions may be particularly useful for carers in more rural and remote parts of Australia.

8.6.2 Carer support		Grade
a)	Carers should be provided with tailored information and support during all stages of the recovery process. This includes (but is not limited to) information provision and opportunities to talk with relevant health professionals about the stroke, stroke team members and their roles, test or assessment results, intervention plans, discharge planning, community services and appropriate contact details.	C [125, 903]
b)	Where it is the wish of the person with stroke, carers should be actively involved in the recovery process by assisting with goal setting, therapy sessions, discharge planning, and long-term activities.	GPP
c)	Carers should be provided with information about the availability and potential benefits of local stroke support groups and services, at or before the person's return to the community.	C [903–905, 907]
d)	Carers should be offered support services after the person's return to the community. Such services can use a problem-solving or educational-counselling approach.	C [126, 904, 906]
e)	Assistance should be provided for families/carers to manage stroke survivors who have behavioural problems.	GPP

CHAPTER

NINE

Cost and socioeconomic implications

Cost and socioeconomic implications*

Introduction

The lifetime costs of first-ever stroke have been recently estimated to be more than $2 billion in Australia (net present value 2004).[913] Therefore, providing cost-effective stroke care (prevention management and treatment) is important to avoid unnecessary costs to society. This section presents an updated review of the cost and socioeconomic implications of providing evidence-based stroke care given the recommendations within these guidelines. The EWG (including a search specialist) conducted a separate systematic review for this section. A broad search strategy was used to search the following databases: Econlit, EMBASE, Medline, Health Technology Assessment, NHS Evaluations and Australasian Medical Index (the search strategy used is available from the NSF). The search yielded 1033 abstracts which were reviewed by one member of the project team. Forty-four potential studies were selected for further consideration.

Staff at the National Stroke Research Institute, a subsidiary of Florey Neuroscience Institutes, scrutinised the 44 abstracts published between 2005 and 2009 for omissions and appropriate papers were retrieved and reviewed. As the breadth of topics was wide and the methods used quite disparate, a narrative review was deemed the most appropriate way to summarise the cost and socioeconomic evidence. There was also a preference to report evidence from studies undertaken in Australia. Therefore, if similar work had been undertaken elsewhere, this information was not included in the summary unless the results were relevant to the findings in Australia. This is because it is often difficult to extrapolate from international studies to the Australian context given differences in health services provision and funding, target populations and interventions such as drug dosages.

The discussion related to the cost-effectiveness evidence is presented to follow the structure of the guidelines document. It should be noted that these guidelines include several consensus recommendations or recommendations based on levels of evidence below Level II for a number of 'micro' clinical practice issues (e.g. physiological monitoring and oxygen therapy). As such, it is not possible to analyse the implications of these sorts of recommendations, as they in fact often form part of a larger package or program of care for which there is Level I evidence (for example, stroke units). Furthermore, there is limited cost-effectiveness evidence available for many acute stroke care interventions and often these types of studies have not been conducted. Therefore, evidence and discussion for the main (strongest) recommendations in these guidelines is provided. This review is also an extension of the summaries provided in the earlier versions of the stroke clinical guidelines.

There are two important points to keep in mind when reviewing the data presented in relation to cost-effectiveness. Firstly, an intervention can be cost-effective without being cost-saving and secondly, what constitutes a cost-effective intervention is a value judgment. In previous Australian policy decisions, $30 000–$50 000 per Disability Adjusted Life Year (DALY) recovered has been considered to represent value for money in the health sector.[914]

Evidence related to socioeconomic implications is sparser than the cost-effectiveness evidence. Where relevant references to socioeconomic implications were identified these will be highlighted. Overall, we know that there are disparities between people with different socioeconomic status. Socioeconomic status and its definition can vary depending on both the wealth of a country and of the individuals within that country. In addition, the socioeconomic status of countries and individuals does not tend to shift readily. The most disadvantaged people in society in terms of occupational status, level of education and financial resources tend to have the greatest burden of health risks, which cluster and accumulate over time.[915] Evidence suggests that socioeconomic factors appear to outweigh classic risk factors in predicting stroke trends and it has been estimated that about 68% of the variation in stroke mortality rates can be explained by differences in gross domestic product (GDP) between countries.[916]

In Australia, evidence from the North East Melbourne Stroke Incidence study (NEMESIS) indicates that stroke incidence rates increase among people with increasing levels of social disadvantage.[917] People with the highest level of disadvantage were estimated to have about a 60% increased risk of stroke compared to those with the lowest level of disadvantage. Accounting for socioeconomic status is therefore an important aspect to consider when exploring the potential expected benefits of prevention interventions, as these may be over or underestimated for different populations.

9.1 Organisation of care

The method of organising stroke services has an important impact on costs and health outcomes. This may include services within an individual hospital or a health system approach to organising services across the care continuum among acute, post-acute and community healthcare providers.[918] Understanding the economic implications of different options for providing stroke services is essential for planning and policy. However, it is important that health benefits and costs are measured appropriately, including allowing sufficient time to follow-up to ensure any benefits of upfront investments in healthcare treatment are captured.

* Prepared by T Gloede, D A Cadilhac & H M Dewey (National Stroke Research Institute as subsidiary of Florey Neuroscience Institutes, Australia).

9.1.1 Stroke unit care

Since the publication of the last guidelines (2007), two new papers from overseas have been identified, one assessing the cost-effectiveness of stroke unit care in a hospital in Germany and the other reporting a simulation model assessing the cost-effectiveness of stroke unit care coupled with early supported discharge.[919, 920] The results of these studies do not change the overall conclusions of previous economic studies which have included patient level data and longer-term (post-hospital) costs and outcomes information.

To date there has been one systematic review identified that included three studies comparing the costs and outcomes of stroke units to those of general wards.[921] All three studies were based in Europe (UK, Sweden and Germany) and included costs of community and outpatient care. All three studies found modest cost savings (3–11%) using stroke unit care, however, the figures failed to reach significance. The authors concluded that there was 'some' evidence for the costs to be at least equivalent to conventional care.

Evidence from Australia is limited to a prospective cohort study comprising 468 patients from Melbourne.[922] The investigators determined that care delivered in geographically localised units was cost-effective compared with general medical wards or mobile stroke (in-patient) teams. Moreover, the additional cost in providing stroke units compared with general medical wards was found to be justified given the greater health benefits in terms of delivering best practice processes of care and avoiding severe complications. When compared to general medical care costs ($12 251), costs for mobile teams were significantly higher ($15 903, p=0.024), but borderline for stroke units ($15 383, p=0.08). This was primarily explained by the greater use of specialist medical services. The incremental cost-effectiveness of stroke unit over general wards was $AUD9867 per patient achieving thorough adherence to clinical processes and $AUD16 372 per patient with severe complications avoided, based on costs to 28 weeks. These findings generally accord with international studies, such as that conducted by Patel et al (2004).[923] This is the first Australian study to detail the costs and cost-effectiveness of different acute care models, and it provides important information to underpin increased investment in stroke units.

Further, other work by Moodie et al (2004) has demonstrated that when modelled over the lifetime of a cohort of first-ever stroke patients, stroke units when compared to general medical care produced considerable gains in terms of health benefits with these additional benefits associated with additional costs. There was an additional lifetime cost of $1,288 per DALY recovered, or alternatively $20 172 per stroke averted or $13 487 per premature death averted (reference year: 1997). It was determined that the stroke unit intervention was cost-effective given the small additional costs per extra unit of benefit gained.[924]

9.1.2 Care pathways and clinical practice guidelines

The use of care pathways in stroke management is variable and evidence from systematic reviews suggests that use of care pathways may lead to a reduced length of hospital stay and reduced healthcare costs.[46, 925] No cost-effectiveness data for Australia has been published related to the use of care pathways. Australian authors have indicated that the benefits of using care pathways are related to greater adherence to important processes of care, such as early access to allied health, improved use of antithrombotic agents in eligible cases at discharge and estimation of blood glucose levels.[926]

To date there has only been one cost-effectiveness study for clinical guidelines in TIA and AF.[145] This UK-based study was designed to examine the cost-effectiveness of the implementation of stroke prevention guidelines for either TIA or AF patients. The study was conducted in four districts of Bradford, northern England, covering a population 400 000 people. The two guidelines were implemented in primary care practices in two districts each. The practices that were trained for TIA guidelines treated 1117 patients, while the AF practices treated 873 patients. The authors extrapolated a surrogate outcome of the adherence to the guidelines to the potential impact on quality of life. Although the increase in guideline compliance was not significant for one of the TIA districts, the authors found the implementation of both guidelines to be effective and cost-effective. The incremental costs per Quality Adjusted Life Year (QALY) gained amounted to £1540 (AF) and £1313 (TIA), respectively (reference year: 2003). There has been one study conducted in Italy that examined whether adherence to clinical practice guidelines influences the cost of acute stroke care. Non-compliance with guidelines was shown to be associated with increased costs (for every unit of non-compliance there was a 1.38% increase in hospital costs).[927] Locally, evidence published from the SCOPES study indicates that greater adherence to important clinical processes of care occurs more often in stroke units and there is also a reduction in severe complications, which, when these measures are used as proxies of health outcome, indicates that these units are more cost-effective than other care modalities.[922] In SCOPES, hospitals with stroke units that used care pathways were more likely to complete them.[106]

In most studies it is difficult to separate the specific benefits of care pathways from other aspects of organised services, such as team meetings and experienced staff. Therefore, the fundamental conclusion from this review is that organised management for stroke that provides evidence-based clinical care, with or without care pathways, should be cost-effective.

9.1.3 Early supported discharge

A systematic review identified nine randomised controlled trials of early supported discharge (ESD), seven of which were selected for inclusion in a statistical meta-analysis of outcomes.[69] All these studies compared ESD with standard care which was, in most cases, stroke unit care. The authors found the combined outcome 'death or institution', as well as 'referrals to nursing homes' significantly reduced for ESD patients. The Odds Ratios (OR) were 0.75 (95% CI 0.46–0.95) and 0.45 (95% CI 0.31–0.96), respectively. They also found a significantly reduced length of stay and statistically significant overall cost savings of US$140 per patient (reference year: 2005). However, one limitation was that four out of the seven studies, comprising 34% of all patients, found only a weak impact of ESD on the patient's functionality (<0.2). The other three studies found a strong impact (>0.8) and this may have influenced the ORs as these studies represented 66% of all patients. The authors of this review did not report any heterogeneity measures.

In addition to this meta-analysis, there have been three other relevant publications. In the UK trial-based study, outcomes and costs of early domiciliary care were assessed compared to hospital-based care.[923] A societal perspective for costs was used based on 1997/8 prices. Mean costs for healthcare and social care costs over 12 months were £6840 for domiciliary care compared to £11 450 for stroke units. QALYs were less for domiciliary care than for stroke unit care (0.221 vs 0.297). Cost-effectiveness was calculated using incremental cost-effectiveness ratios (ICERs) for avoiding an additional 1% of deaths or institutionalisation and ranged from £496 (without informal costs) to £1033 (with highest estimate of informal costs) for stroke unit care compared with domiciliary care. Based on each additional QALY gained, the costs ranged from £64 097 to £136 609. Hence in this study, health outcomes were lower using this ESD model than in-patient stroke unit care but ESD was found to be cheaper. A separate randomised controlled trial of unselected hospital cases undertaken in Norway has also provided evidence that an ESD program provided after two weeks in a stroke unit (as an alternative to in-patient rehabilitation) offered a cost-neutral or cheaper option over a 12-month period. In particular, ESD was more cost-effective in cases of moderate stroke than in very mild or severe stroke.[928]

In the most recent cost-effectiveness analysis, Saka et al (2009) looked specifically at stroke care on regular wards, stroke unit care and stroke unit care with subsequent ESD.[920] These authors found stroke unit care with ESD to be the most cost-effective strategy and calculated incremental costs of £17 721 per additional QALY gained, when compared with stroke unit care alone (reference year: 2003).

Data specific to the Australian context were included in the Larsen et al (2006) review and warrant further discussion. Australian investigators used direct and indirect data following their own meta-analysis of ESD (seven trials, n=1277, search date March 2001) to undertake a cost-minimisation analysis (since health outcomes were found to be equivalent) from the perspective of the Australian health system.[929] Hospital costs were taken from the Australian National Hospital Cost Data for 1998/1999, domiciliary rehabilitation costs were taken from a single study of domiciliary rehabilitation care (Adelaide stroke study)[930, 931] and costs related to other community services were taken from the Australian Department of Health and family Services Report, 1996/1997. Overall mean ESD costs were found to be 15% lower than standard care ($16 016 vs $18 350). Cost estimates were based over a 12-month period and did not include any indication of set-up costs. It was emphasised that the included studies were all based in urban centres confirming the view that ESD should only be considered where appropriate resources are available to provide effective domiciliary care. A small shift of costs from the hospital sector to the primary care sector was noted (more GP visits with ESD care). However, no difference was found in the cost of routine community and outpatient services. Therefore, the authors concluded that ESD should be considered for certain subgroups of people with stroke.

In summary, the above studies provide limited evidence regarding the cost-effectiveness of ESD in Australia. Nonetheless, the evidence suggests that ESD may offer an alternative to inpatient care and produces equivalent outcomes for patients at similar or potentially reduced costs, in particular for urban settings and in moderate severity strokes.

9.1.4 Community rehabilitation†

Over the past few decades there has been a global organisational shift towards greater community-based (largely home-based) health service delivery for stroke. The provision of home-based rehabilitation has become an attractive healthcare model for patients with stroke. Advocates for community rehabilitation suggest many advantages including better patient satisfaction, reduction of hospital stay and savings in direct healthcare costs. Given the increasing demand on health services for stroke among aging populations, it is important to evaluate the cost-effectiveness and efficiency of community stroke rehabilitation.

† This section was summarised from a paper provided by Paul Brown (University of Auckland, New Zealand)

Colleagues from New Zealand (Jones and Brown) have reviewed this literature and a preliminary summary of their findings is provided here. Community stroke rehabilitation was defined as care managed by a specialised team of health professionals with a personalised approach to supporting and rehabilitating stroke survivors in their communities. Home-based rehabilitation was also included. Inclusion criteria included primary studies that were economic evaluations or cost analyses, English language, full articles and studies published between 1 January 1990 and 31 December 2009. The search revealed 25 published articles, including randomised control trials, systematic reviews and intervention studies but only six met the inclusion criteria.[932–937] These investigators reported that the findings made it difficult to draw conclusions in terms of the cost-effectiveness of community stroke rehabilitation when compared with other forms of care. Therefore, the data must be viewed with caution. Community stroke rehabilitation may appear to be less costly when compared to out-patient day hospital care. This is probably due to higher staffing levels in day hospital care. Other possible explanations for the difficulty of generalising these results could be inherent differences between stroke rehabilitation services. There seems to be some degree of variation between hospitals in how rehabilitation care is organised, thus varying costs of health services and health outcomes. More research into the clinical efficacy and cost implications of home-based stroke rehabilitation is needed in order to draw sound conclusions.

9.2 Specific interventions for the management of stroke

9.2.1 Intravenous thrombolysis

The use of intravenous recombinant tissue plasminogen activator (rt-PA) for treatment of eligible patients with acute ischaemic stroke within three hours of stroke symptom onset has been consistently demonstrated to be cost-effective. These findings are independent of differences in included costs, modelling assumptions and the healthcare environments within which cost-effectiveness evaluations have been undertaken. A descriptive review of three comprehensive evaluations of rt-PA from the United States, Canada and the UK has been undertaken.[938] The authors of this review found that rt-PA was cost-effective in all three studies, with health benefits and cost savings over a 30-year time horizon.

The most current review of economic methods used to evaluate acute stroke therapies included economic models used to assess the cost-effectiveness of rt-PA. Within this review, 8 out of 13 studies presented cost-effectiveness models for rt-PA therapy compared to usual care and rt-PA was always found to be effective and cost-saving from a lifetime perspective.[939] This review included the cost-effectiveness evaluation undertaken for Australia by Moodie et al (2004). Therefore, the evidence for the cost-effectiveness of rt-PA therapy in acute stroke (< 3 hours) remains unchanged.

In these updated clinical guidelines, it has been recommended that rt-PA may be used up to 4.5 hours following stroke (see 4.1 Thrombolysis). However, so far there has only been one cost-effectiveness study for rt-PA therapy beyond the first three hours of stroke symptom onset. By using a Markov model, Sandercock et al. (2004) estimated the cost-effectiveness of rt-PA therapy up to six hours after stroke onset compared to standard care.[940] These authors calculated incremental costs of £13 581 per QALY gained within the first 12 months. The uncertainty analysis showed that the 5th and 95th percentiles for this cost increase were –£44 065 and £47 095, respectively. The corresponding percentiles for the gain in QALYs were –0.4020 and 1.8259 QALYs, respectively. An increase in QALYs occurred in 85.5% of all iterations. Over the lifetime perspective, rt-PA was found to be the dominant strategy, leading to cost savings of £96 565 per QALY gained. The 5th and 95th percentiles for the incremental cost-effectiveness ratio were –£908 153 (cost saving) and –£37 858 per QALY gained (cost saving), respectively. The probability for an increase in QALYs over the cohort lifetime was found to be 76.6%. The results were very sensitive to many of the assumptions in the model and hence the authors determined that these results may not be reliable. In another recent publication, a decision-analytic model was used to assess the cost-effectiveness of using penumbral-based MRI to select patients suitable for rt-PA and to reduce the likelihood of intracerebral haemorrhage.[941] The authors predicted that the use of penumbral-based MRI selection would be cost-effective in patients treated up to six hours after ischaemic stroke onset. These data provide some evidence that use of rt-PA beyond three hours may be worthwhile from an economic perspective; however, future research is required.

One of the major issues of using rt-PA is increasing access to the intervention. One method of increasing access is through technological solutions such as telemedicine, whereby specialist consultants can provide support to doctors in other locations. In a recent study from Denmark, the national use of thrombolysis via telemedicine was modelled using a Markov model.[942] The authors calculated incremental costs of US$50 100 per incremental QALY gained (reference year: 2007). After two years, the use of telemedicine was considered to be dominant (i.e. cost-saving), however, the authors did not perform any uncertainty analyses. Further research in this area is needed in considering the economic implications for Australia.

9.2.2 Aspirin within 48 hours of stroke

These guidelines recommend the administration of aspirin as soon as possible, i.e. within 48 hours of acute ischaemic stroke onset (see 4.3 Antithrombotic therapy).

There are, however, limited data on the cost-effectiveness of aspirin within 48 hours of stroke. Economic modelling for Australia suggests that the treatment is cost-effective and the incremental cost/DALY lifetime benefit of treating one additional first-ever case of stroke with aspirin as an acute therapy is about $1847.[943] In contrast to other Grade A recommendations in these guidelines that have been compared using the same economic model, this result was less favourable to the cost-effectiveness results of stroke units ($1390), warfarin as primary and secondary prevention, and intravenous rt-PA (these last two interventions being highly effective and cost-saving). Although not cost-saving, it should be noted that both stroke unit care and aspirin within 48 hours could be applied to many more patients than rt-PA and warfarin. Further, the stroke unit intervention represents a composite of these interventions as they are not independent and it is expected that patients treated in stroke units also receive these evidence-based therapies as required. In terms of 'value' each of these interventions would be considered highly cost-effective as they are much lower than the $30 000–$50 000 per DALY recovered threshold expressed as representing value for money in the health sector.

9.2.3 Botulinum toxin A

These guidelines recommend therapy with botulinum toxin A in conjunction with rehabilitation therapy for stroke patients with persistent moderate to severe spasticity (see 6.3.5 Upper limb activity).

Cost-effectiveness information for this intervention is very limited. Investigators have attempted to assess the cost-effectiveness of using botulinum toxin A using a decision-analytic model approach. Ward et al (2005) examined the cost-effectiveness of botulinum toxin A and oral anti-spastic drugs in post-stroke patients with spasticity where the efficacy data were obtained from an expert Delphi panel of 14 clinicians and one physiotherapist.[944] The authors considered botulinum toxin A to be cost-effective compared to oral therapy. The costs for one successfully treated month amounted to £942 for botulinum toxin A and to £1697 for oral therapy (reference year: 2008). These data provide insufficient information to reliably conclude whether botulinum toxin A is cost-effective in the Australian context, and further research is needed.

9.2.4 Imaging modalities

CT and MRI

One systematic review of economic evaluations identified three studies that assessed the cost-effectiveness of CT scanning in acute stroke patients.[945] The authors of this review concluded that immediate CT scanning (versus no CT scanning or later CT scanning) may reduce the cost of stroke care by shortening or avoiding in-patient stays. The absolute difference between scanning immediately, within 24 hours, or within 48 hours was minimal. These findings were sensitive to in-patient costs, the availability of non-hospital stroke care and the ability to effectively use saved bed-days. Although the authors' conclusions are based on the UK data by Wardlaw et al (2004), it is likely that this finding is applicable to the Australian setting.[185]

As mentioned in 9.2.1, authors of a recent cost-effectiveness analysis have indicated that the combined use of CT and MRI might lead to cost-effective patient selection for intravenous thrombolysis.[939] The authors compared CT-based selection with CT- and MRI-based selection for rt-PA therapy in acute stroke patients. Eligible patients undergoing MRI were assumed to receive rt-PA up to six hours after stroke onset. The incremental costs per additional QALY gained were estimated to be US$1004 (reference year: 2007). However, as the model did not use efficacy data for penumbral-based MRI selection from randomised controlled trials, further research is required to confirm the value of different imaging modalities to improve the selection of patients for rt-PA.

Carotid imaging

One cost-effectiveness study has provided evidence that carotid duplex ultrasound is the most efficient single examination strategy to detect high-grade carotid stenosis in symptomatic patients suitable for carotid endarterectomy.[946] This study used Markov modelling and incorporated both published data from randomised trials and data from a multicentre cohort study (n=350) performed to assess the diagnostic accuracy. The addition of MRA increased effectiveness but at disproportionately high costs. A different cost-effectiveness study of the assessment of carotid stenosis conducted in the UK provided evidence that non-invasive assessment of carotid stenosis, including use of ultrasound as the first or repeat test, could be used in place of intra-arterial angiography to select patients who are likely to benefit from carotid endarterectomy. However, the findings from the economic model were sensitive to the accuracy of non-invasive testing and to the cost and timing of surgery.[193]

In these updated guidelines there is a recommendation that there is no advantage of intra-arterial angiography over non-invasive imaging (see 3.3 Imaging). In terms of cost-effectiveness, evidence shows that if either CT-angiography (CTA) or intra-arterial conventional angiography (CA) is done in addition to carotid ultrasound, CTA is the dominant strategy.[947] By using a Markov model approach, the authors found that ultrasound and CTA led to more QALYs and lower costs than ultrasound and CA. However, the advantage of CTA was mainly driven by its lower costs as CA and CTA were almost equally effective. Hence, this study supports the recommendation in these guidelines and emphasises that there is also a cost advantage of non-invasive imaging.

These guidelines recommend further cardiac imaging in selected patients (see 3.3 Imaging). There is insufficient evidence for cost-effective use of widespread cardiac imaging. The authors of one US study compared different strategies using transthoracic echocardiography (TTE) and transoesophageal echocardiography (TEE) in patients with a first stroke or transient ischaemic attack.[948] Standard medical care was always dominant compared to TTE or TEE for all patients. When cardiac imaging was performed only in patients with an existing heart disease, the incremental costs for TEE came down to US$137 600 per additional QALY gained, whereas TTE led to incremental costs of US$159 800 per additional QALY. The underlying assumption was that patients with a cardiac history have a prevalence of intracardiac thrombus of at least 5%. Although there are limited data, routine use of cardiac imaging does not appear to be cost-effective.

9.2.5 Rapid assessment clinics and management of TIA

So far, only one study has been published that examined the cost-effectiveness of early assessment and treatment of TIA and minor stroke.[949] The authors conducted a sequential, population-based study with two phases: pre- and post- implementation of early assessment and management for TIA and minor stroke. The authors estimated a significant reduction in recurrent strokes and total days in hospital. The total mean costs for hospitalisation per patient decreased significantly from £1056 to £432 with implementation of the TIA/minor stroke clinic. These authors did not report the reference year for the cost estimates. No information was given about the impact of increased costs in the community setting. These data provide insufficient information to reliably conclude whether rapid assessment clinics would be worthwhile from an economic perspective in the Australian context, and further research is needed.

9.2.6 Carer training

The present guidelines recommend that carers be provided with tailored information and that they be involved in the recovery process if they wish. Since the last update, no further published cost-effectiveness studies could be identified.

One study was identified that assessed the economic outcome of training carers.[950] Evidence was based on one RCT conducted in the UK. Costs were based on 2001–2 prices and included health and other formal care costs as well as informal costs. Providing carer training during inpatient rehabilitation reduced total costs (mean saving of £4043), primarily reflecting savings due to earlier discharge from inpatient care, while also improving health outcomes. No difference in QALYs in carers were found; however, the authors suggested that this was likely to be influenced by the insensitivity of the outcome measure used (EuroQol five-dimensional questionnaire).

Since the burden of providing both formal and informal care after stroke in Australia is significant,[951] inpatient rehabilitation services in Australia should be encouraged to introduce formal carer training as part of their care. Further cost-effectiveness studies in this area that include appropriate assessment of the impact on carers are needed.

9.2.7 Secondary prevention

There are few economic evaluation studies available of secondary stroke prevention based on Australian data. The majority of the literature related to the cost-effectiveness of prevention interventions relates to carotid surgery and pharmacological therapies, which may include stroke outcomes but are not always stroke-specific.

Carotid endarterectomy in patients with high-grade stenosis

These guidelines recommend the use of CEA in patients with non-disabling carotid artery territory ischaemic stroke or TIA with ipsilateral carotid stenosis measured at 70–99% if surgery can be performed with low rates of perioperative mortality/morbidity. Under these conditions, CEA is also recommended for ischaemic stroke or TIA patients with symptomatic (50–69%), or in highly selected cases with asymptomatic (>60%) carotid stenosis (see 5.7 Carotid surgery).

There has been one systematic review of health economic studies that have assessed the costs and benefits of CEA and associated preoperative arterial imaging.[952] The authors of this review identified 21 studies for inclusion but only three were true cost-effectiveness studies. All three studies were set in the United States in the early 1990s and used modelling techniques incorporating data from published randomised clinical trials. Although CEA was cost-effective in these evaluations, the authors of the review pointed to significant differences in the estimated costs and benefits between these studies and in the included partial economic evaluations. An important observation is that the use of trial data on peri-operative morbidity and mortality is likely to overestimate the benefits of CEA when applied in the real world situation. Nevertheless, it is very likely that CEA in recently symptomatic patients with high-grade CEA is highly cost-effective when performed under conditions of low peri-operative morbidity and mortality.[953]

In a recent cost-effectiveness model conducted in Sweden, Henriksson et al (2008) compared best medical treatment with endarterectomy in patients with asymptomatic carotid artery stenosis.[954] Patients were assumed to have a stenosis of at least 60% and to have had no stroke, transient cerebral ischaemia or other neurological symptoms in the past six months. The results indicate that CEA in asymptomatic patients can only be assumed to be cost-effective for men aged 73 years or younger. The costs of treating men aged 65 and 73 with CEA instead of best medical treatment resulted in incremental costs per additional QALY of €34 557 and €52 100, respectively (reference year: 2006). Treating women was never cost-effective. The incremental costs per additional QALY amounted to €311 133 for women who were aged 65 years. However, the study considered only costs and outcome at five years and did not take recurrent strokes into account.

Pharmacological therapies

Moodie (2004) has investigated the cost-effectiveness of anti-thrombotic (warfarin) treatment for people with AF as a primary and secondary prevention measure.[924] This investigator determined that 1851 DALYs could be recovered with a cost/DALY saved of $480. This finding was based on the 1997 Australian population modelled using MORUCOS, an economic model with resource utilisation data derived from the North East Melbourne Stroke Incidence Study. Authors of one published systematic review[955] identified three studies[955–958] assessing the cost-effectiveness of anticoagulation for primary prevention in people with AF. Warfarin was more cost-effective than aspirin for people with two or more stroke risk factors. Warfarin was also cost-effective in stroke survivors with chronic non-valvular AF. Warfarin was also found to be cost-effective for people with only one other stroke risk factor, costing US$8000 per QALY. However, warfarin use for people with no other stroke risk factors apart from AF was not cost-effective with costs of US$370 000 per QALY. The second study confirmed these findings. The third study found anticoagulation for AF caused by mitral stenosis to be cost-effective with costs of only US$3700 per QALY. Sorensen et al. (2009) recently examined the costs of warfarin for a theoretical cohort of 1000 patients aged 70 years.[959] They compared costs and QALYs of four different scenarios from a 'perfect warfarin' situation where every patient received warfarin at the recommended dosage, to the most realistic situation where patients got lower dosages and were treated with warfarin and aspirin in combination or did not receive any treatment. The authors found potential for greater health outcomes at lower costs if more people received warfarin and if they received it within an INR of 2.0–3.0.[959] The total health gain for the model cohort amounted to 7.21 QALYs at costs of US$68 039 in the 'perfect warfarin' scenario. The most realistic scenario led to 6.67 QALYs at costs of US$87 248. The results indicate that there was potential for more health gains and cost savings if warfarin was given more often and if treatment resulted in a therapeutic INR. However, Sorensen et al (2009) had to use observational assessments for the relationship between INR distributions and stroke as there was no evidence available from any randomised trials.

These guidelines recommend blood pressure lowering therapy for all patients after stroke or TIA, irrespective of their initial blood pressure. For pharmacotherapy, ACE inhibitors alone or in combination with a diuretic are recommended (see 5.3 Blood pressure lowering).

Two studies including cost-effectiveness figures of ACE inhibitors in stroke prevention were identified. Economic benefits of a specific blood pressure medication (ramipril) for people at high risk of heart disease and stroke has been studied.[960] This Australian study reported a potential reduction of 9188 strokes over five years. The incremental cost-effectiveness result, estimated as a cost per life-year saved, was $17 214 based on a combined cardiovascular death end-point.

Authors of a UK-based study used data from the PROGRESS study to estimate the cost-effectiveness of perindopril-based blood pressure lowering for patients who had suffered a stroke or a TIA.[961, 962] Although the model only included costs that were associated with hospitalisation, the authors found perindopril to be cost-effective when compared with standard care, and calculated incremental costs of £6927 per additional QALY gained (reference year: 2005).

Nine international studies were identified that assessed the cost-effectiveness of antiplatelet therapy in secondary stroke prevention. Two studies compared a combination of dipyridamole plus aspirin to aspirin alone.[963, 964] One study compared clopidogrel to aspirin.[965] The other six studies compared all three therapy options.[966–971] The studies predicted costs in the UK, USA and France over periods of one, two and five years, or over a lifetime. The combination therapy of dipyridamole plus aspirin was found to be cost-effective compared with aspirin alone in seven studies. In one study, this strategy seemed to be more cost-effective than aspirin alone but, based on statistical considerations, the simulations were not robust enough to make a reliable conclusion. There was conflicting evidence for the cost-effectiveness of clopidogrel. In five studies, the authors reported that using clopidogrel was not cost-effective.[969, 971] In the two other studies, the authors found that clopidogrel was cost-effective and reported ICERs of US$31 200 and US$26 580 per QALY saved.[965, 970] In summary, there is mixed cost-effectiveness evidence on different antiplatelet therapy agents for secondary stroke prevention. The use of dipyridamole plus aspirin appears to have the most consistent economic evidence, but a systematic review of these data would be beneficial.

An economic model based on data obtained in the Heart Protection Study has provided evidence that cholesterol lowering using simvastatin 40 mg daily is cost-effective, not only among the population of patients enrolled in this trial (aged 40–80 years with coronary disease, other occlusive arterial disease or diabetes) but also for people with an annual risk of major vascular events of 1% or more, independent of the age of commencement of statin treatment.[972] Cost-effectiveness estimates remained favourable when proprietary (£29.69) versus generic simvastatin (£4.87) prices were assumed. Simvastatin treatment was cost-saving or cost less than £2500 per life year gained across the range of scenarios assessed.[972]

Lifestyle (non-pharmacological) prevention interventions

Cost-effectiveness studies undertaken for lifestyle changes are limited in that they have not been undertaken for stroke specifically and most consider primary prevention measures. Only two new studies have been found[973, 974] since publication of the 2007 guidelines but these were not specific to stroke nor based on Australian data. Moreover, these studies did not alter the conclusions from the information previously presented. In the available studies, smoking cessation has been reported to cost between £270–1500 per QALY saved depending on the intervention (e.g. advice from GP or nicotine replacement strategies).[975] The use of Quit Lines or telephone counselling is also cost effective.[976, 977] One large systematic review identified only five economic evaluations for lifestyle interventions (e.g. dietary modifications and/or exercise) aimed at reducing obesity in those with diabetes.[978] Such interventions were found to be cost-effective when viewed over a five-year or longer period. One study in the UK suggested the costs saved far outweighed the costs spent on exercise in those over 45 years old.[979] There have also been several studies reporting the cost-effectiveness of physical activity counselling or activities, emphasising that interventions can offer value for money over usual care for sedentary adults.[973, 974, 980–982] Clearly, stroke-specific studies are needed to assess the potential cost-effectiveness of lifestyle change interventions as well as other prevention interventions.

Several other authors have also highlighted the usefulness of multiple risk- assessment models for improving the effectiveness and/or efficiency of treatment to prevent cardiovascular disease.[983–988] This usefulness is premised on the fact that risk factors are continuous and arbitrary cut-points for treatment do not discriminate well between those who will and will not suffer an event. Murray et al (2003) showed that combination pharmacological treatment for people with a 35% risk of a cardiovascular event over 10 years was cost-effective and would result in the recovery of 63 million DALYs worldwide.[984] There has been one recent comparative evaluation of five international guidelines from English-speaking countries including Australia using the treatment recommendations within these guidelines and modelled for “best practice”. It was reported that the cost per cardiovascular event prevented was lowest in older patients and very high in those aged less than 35 years. Clinical practice guidelines that used “absolute risk” criteria as the principal determinant of treatment were more cost-effective than those recommending management for thresholds of single risk factors.[983] In consideration of risk assessment, all persons who have experienced a stroke or TIA would be considered at high risk of another vascular event. Therefore use of anti-platelet, cholesterol-lowering and BP-lowering therapies in eligible high-risk patients could be considered cost-effective.

Conclusions

In conclusion, there is good cost-effectiveness evidence for the most clinically effective stroke prevention and treatment strategies recommended in these guidelines. In particular, stroke unit care, thrombolysis, blood pressure lowering, warfarin for AF, aspirin for stroke prevention and carotid endarterectomy were all determined to be worthwhile from an economic perspective. The findings for intravenous thrombolysis with rt-PA administered within three hours of acute ischaemic stroke were consistently found to be cost-saving from a lifetime perspective. However, there is limited evidence for the cost-effectiveness of rt-PA used up to 4.5 hours and further research is needed. There is sufficient evidence for the cost-effectiveness of antithrombotic therapy with dipyridamole plus aspirin compared to aspirin alone in secondary stroke prevention. There is also sufficient evidence for blood pressure lowering with ACE inhibitors in all stroke and TIA patients, as recommended by these guidelines. This review also allowed us to identify a range of areas where additional cost-effectiveness studies would complement health outcome data, including an assessment of home-based stroke rehabilitation, rapid assessment clinics for TIA, carer training, the use of botulinum toxin A for stroke patients with persistent moderate to severe spasticity and imaging modalities for selecting patients for intravenous thrombolysis.

One major factor that may influence the economic implications of interventions found to be cost-effective is access and population coverage. In a recent modelling exercise in the Australian setting, it was found that more widely accessible, evidence-based stroke care could produce substantial economic and health-related benefits and would require only modest investment.[989] The authors suggested that if there was improved access to effective acute care (stroke units and intravenous thrombolysis) and secondary prevention (BP lowering, warfarin for AF, aspirin in ischaemic stroke and carotid endarterectomy) and improved management of BP and AF as primary prevention in the Australian population, then about $1.06 billion could be recovered as potential cost-offsets with recovery of more than 85 000 DALYs. Therefore, clinical guidelines such as these which promote improved treatment and prevention of stroke are an important contribution to achieving such increased access and cost-effective use of health resources in this country.

Appendix 1 Membership and terms of reference of working and advisory groups

The *Clinical Guidelines for Stroke Management 2010* have been developed by the NSF according to processes prescribed by the National Health and Medical Research Council (NHMRC)[6] under the direction of a multidisciplinary Expert Working Group (EWG). An independent Advisory Committee (or Governance Committee) oversaw the process of guideline development on behalf of the Department of Health and Ageing (DOHA).

Expert Working Group

The multidisciplinary EWG was established in May 2009 following an invitation from the National Stroke Foundation to previous guideline working group members and to the following professional organisations involved in the management of stroke:

- Australasian College for Emergency Medicine
- Australasian Faculty of Rehabilitation Medicine
- Australian and New Zealand Society for Geriatric Medicine
- Australian Association of Neurologists
- Australian Association of Social Workers
- Australian College of Rural and Remote Medicine
- Australian Physiotherapy Association
- Australian Psychological Society
- Council of Ambulance Authorities
- Dietitians Association of Australia
- Occupational Therapy Australia
- Royal Australian and New Zealand College of Psychiatrists
- Royal Australian and New Zealand College of Radiologists
- Royal Australian College of General Practitioners
- Royal College of Nursing Australia
- Society of Hospital Pharmacists of Australia
- Speech Pathology Australia.

The members of the EWG assisted in:

- reviewing the framework of existing guidelines
- determining the clinical questions for guidelines update
- identifying, reviewing and classifying relevant literature
- developing the draft clinical guidelines
- evaluating and responding to feedback from the consultation process
- developing a plan for communication, dissemination and implementation.

All members of the EWG completed and signed a declaration of potential conflicts of interest. Members also declared any potential conflicts at the beginning of each meeting throughout the development process. Most had no perceived conflicts. The reasons for potential conflicts primarily involved receiving money from non-commercial and commercial organisations specifically for undertaking clinical research. This was expected given the expertise of members in clinical research. Only a small number of members had received financial support from commercial companies for consultancy or lecturing. A policy of managing conflicts of interest was used during the process.

The NSF is extremely grateful to the following members of the EWG who were responsible for the development of these guidelines:

Assoc Prof Louise Ada
Physiotherapist, University of Sydney

Dr Beata Bajorek
Pharmacist, University of Sydney and Royal North Shore Hospital

Prof Alan Barber
Neurologist, Auckland City Hospital

Dr Christopher Beer
Geriatrician/clinical pharmacologist, University of Western Australia, Royal Perth and Mercy Hospitals

Assoc Prof Julie Bernhardt (co-chair)
Physiotherapist, National Stroke Research Institute

Dr Geoff Boddice
Clinical Neuropsychologist / Clinical Psychologist, University of Queensland and Ipswich Hospital

Ms Brenda Booth
Consumer, Working Aged Group with Stroke, NSW

Assoc Prof Sandy Brauer
Physiotherapist, University of Queensland

Ms Louise Corben
Occupational Therapist, Monash Medical Centre and Bruce Lefroy Centre (Murdoch Childrens Research Institute)

Prof Maria Crotty
Rehabilitation Specialist, Repatriation General Hospital

Prof Tricia Desmond
Neuroradiologist, Royal Melbourne Hospital

Ms Cindy Dilworth
Speech Pathologist, Royal Brisbane Hospital

Dr Steven Faux
Rehabilitation Physician, St Vincent's Hospital, Sydney

Prof Jonathan Golledge
Vascular Surgeon, Townsville Hospital

Dr Louise Gustafsson
Occupational Therapist, University of Queensland

Dr Hugh Grantham
Medical Director, SA Ambulance Service

Dr Deborah Hersh
Speech Pathologist, Australian Aphasia Association

Ms Sue-Ellen Hogg
Speech Pathologist, Port Kembla Hospital

Mr Kelvin Hill
Manager, Guidelines Program, National Stroke Foundation

Ms Louise-Anne Jordan
Manager Clinical Service Delivery, Hunter Stroke Service

Assoc Prof Lynette Joubert
Social Worker, The University of Melbourne

Prof Justin Kenardy
Clinical Psychologist, University of Queensland

Dr Jonathan Knott
Emergency Physician, Royal Melbourne Hospital

Dr Erin Lalor
Chief Executive Officer, National Stroke Foundation

Dr Elaine Leung
General Practitioner, Adelaide

Prof Richard Lindley (co-chair)
Geriatrician, University of Sydney

Ms Judy Martineau
Nutrition Consultant, Wesley Hospital

Prof Sandy Middleton
Director, Nursing Research Institute, St Vincent's & Mater Health Sydney, Australian Catholic University

Director, National Centre for Clinical Outcomes Research (NaCCOR), Nursing and Midwifery

Dr Ramu Nachiappan
General Practitioner, Broken Hill

Prof Mark Nelson
General Practitioner, University of Tasmania

Prof Lin Perry
Professor of Nursing Research and Practice Development, University of Technology, Prince of Wales Hospital and Sydney Eye Hospital

Ms Fiona Simpson
Dietitian and Senior Research Fellow, Royal North Shore Hospital

Ms Trish Spreadborough
Nurse Unit Manager, Rehabilitation, Redcliffe Hospital

Ms Leah Wright
Senior Project Officer, Guidelines Program, National Stroke Foundation

The EWG also collaborated with individuals and formal and informal groups from around Australia and overseas and the following are recognised:

Ms Michele Hilton Boon and Dr Roberta James
Scottish Intercollegiate Guidelines Network

Dr Patrice Lindsay
Performance and Standards Specialist, Canadian Stroke Network

The NSF is also very grateful for the expertise and input of the following people who collaboratively reviewed and developed Chapter 9: Cost and socioeconomic implications:

Dr Dominique Cadilhac
Head Public Health Division, National Stroke Research Institute

Assoc Prof Helen Dewey
Neurologist and Associate Director, National Stroke Research Institute and the Austin Hospital

Mr Tristan Gloede
Student, Health Economics, National Stroke Research Institute

Dr Paul Brown
Health Systems and Centre for Health Services Research and Policy, University of Auckland

Additional people who kindly contributed to the guideline development process included:

Assoc Prof Kirrie Ballard
Speech Pathologist, University of Sydney

Dr Rohan Grimley
Geriatrician and Stroke Unit Director, Nambour General Hospital

Dr Maree Hackett
Senior Research Fellow, George Institute for International Health

Dr Carl Hanger
Geriatrician, Princess Margaret Hospital

Dr Tammy Hoffmann
Occupational Therapist, University of Queensland

Dr Jonathan Sturm
Neurologist, Gosford Hospital

Dr David Dunbabin
Geriatrician, University of Tasmania

Mr Chris Price
Divisional Director Stroke Services, National Stroke Foundation

Advisory Committee

The role of the advisory committee was to:

- oversee the process of the development of the guidelines
- as necessary, provide general guidance on this process to the NSF over the course of the project
- provide comments on progress reports on the Guidelines Project and respond to any queries or issues raised by the project's Expert Advisory Groups and the NSF
- provide comments and information with regards to the development of the guidelines for consideration by the project's Expert Advisory Groups and the NSF.

Members of the Committee included:

Assoc Prof Mark Parsons (chair)
Neurologist, John Hunter Hospital and University of Newcastle

Prof Mark Harris
General Practice, University of New South Wales

Dr Dominique Cadilhac
Head of Public Health Division, National Stroke Research Institute

Ms Julie Luker
Physiotherapist and PhD candidate, School of Health Sciences, University of South Australia

Prof Leonard Arnolda
Cardiologist, Canberra Hospital, Chair Blood Pressure Advisory Committee, National Heart Foundation

Mr Noel Muller
Consumer Representative, Consumer's Health Forum Reference Group – Chronic Diseases

Ms Heidi Schmidt
Acting Assistant Director, Chronic Disease Decision Support Section, Department of Health and Ageing

Additional expertise and significant input was gratefully received from:

Ms Anne Parkhill
Information Manager, Aptly

Independent consultant who carried out the systematic database searches

Ms Julie Egan
Science Communicator

Independent consultant who undertook the medical editing of the guidelines

The NSF also gratefully acknowledges the support of the University of Sydney who allowed access to their database of electronic journals to source relevant articles during the development process.

Appendix 2 Guideline development process report

These guidelines were developed according to standards outlined by the National Health and Medical Council.[6]

Question formulation

Clinical questions used for previous guidelines were reviewed and duplication removed. A draft set of questions was developed by the NSF project team and circulated to the EWG. The EWG agreed on one hundred and thirty-four (134) specific clinical questions addressing interventions relevant to stroke care. The questions generally queried the effects of a specific intervention and were developed in three parts: the intervention, the outcomes and the population, for example, 'What is the effect of anticonvulsant therapy on reducing seizures in people with post-stroke seizures?' In this example, anticonvulsant therapy is the intervention, reduction of post-stroke seizures is the outcome, and the population is people with post-stroke seizures. The list of questions is available from the NSF.

Finding relevant studies

Systematic identification of relevant studies was conducted between May and August 2009. An external consultant undertook all the electronic database searches. EMBASE, Medline and Cochrane databases were used for all questions. CINAHL and Psychinfo databases were searched where relevant (e.g. questions relating to rehabilitation, discharge planning or long-term recovery). The PEDro database was used by the NSF project team to check studies related to physical therapy. A second updated search of the literature up to February 19, 2010 using Medline and EMBASE databases was conducted. Updated Cochrane reviews were also searched and included.

Where the questions were the same as those used in the previous acute management guidelines (2007), the literature was searched from the beginning of 2007. Where the questions were the same as those used in the previous rehabilitation guidelines (2005), the literature was searched from the beginning of 2005. For topics not previously addressed, searches were carried out from 1966 onwards.

Searching of EMBASE, Medline and Cochrane libraries was conducted in four broad steps:

1. Terms for the patient group were abridged from the Cochrane Collaboration's Stroke Group.
2. A second search term specific to the particular question (i.e. specific terms relevant to an intervention or assessment) was added.
3. Relevant evidence filters (Cochrane sensitive filter or Medline diagnostic filter) were applied.
4. If the search was for an update to an authoritative meta-analysis (NSF or other), it was limited to the years after the relevant document was published.

Search strategies are available from the NSF. Table A2.1 outlines the number of articles found for each of the nine broad topic areas.

TABLE A2.1
Results of database search for selected topics

TOPIC (NUMBER OF QUESTIONS)	COCHRANE LIBRARY	EMBASE	MEDLINE	CINAHL	PSYCH INFO
1. Organisation of services (22 questions)	418	5631	4059	403	
2. Pre-hospital care (6 questions)		747	594		
3. Early assessment and diagnosis (9 questions)		4702	3569		
4. Acute medical and surgical management (12 questions)		3924	1991		
5. Assessment & management of the consequences of stroke (50 questions)		6041	4623	632	340
6. Prevention & management of complications (10 questions)		905	463		
7. Secondary prevention (4 questions)	373	2013	1232		
8. Discharge planning and transfer of care (8 questions)		463	275	26	
9. Community reintegration and long-term recovery (13 questions)		2076	2013	565	

A total of 39 930 potential articles were identified up until August 2009 and an additional 7337 at February 2010. Reference lists of identified articles and other guidelines were then used to identify further studies. Existing international guidelines identified and used included those published by the Scottish Intercollegiate Guidelines Network (SIGN), the National Institute of Clinical Excellence UK, the Royal College of Physicians (London, UK), the Canadian Stroke Network and the Heart and Stroke Foundation of Canada, the American Heart/Stroke Association and the European Stroke Organisation. Correspondence with SIGN identified overlapping topics that had recently been systematically searched by SIGN and hence this information was kindly provided and used for several rehabilitation-related topics. A number of key journals were also searched by hand from October 2009 to March 2010: *Stroke, Cerebrovascular Disease, Lancet* (and *Lancet Neurology*), and *Archives of Physical Medicine and Rehabilitation*. Further, an internet search was undertaken (using the 'Google' search engine). Finally, where possible, experts in the field were contacted to review the identified studies and suggest other new studies not yet identified.

One reviewer initially scanned the titles and available abstracts of all studies identified by the searches and excluded any clearly irrelevant studies. Based on the titles and abstracts of the remaining studies, two reviewers assessed and selected potentially eligible studies using the following inclusion criteria:

- Type of study. Relevant systematic reviews were first identified. Where no systematic review was found, RCTs were searched. If there was a sparsity of Level I or Level II evidence, the search was expanded to consider lower levels of evidence.
- Type of participant. Initially only studies which included adults (>18 years) with stroke or TIA were included. Studies in other related populations (e.g. general elderly population or those with traumatic brain injury) were then included if the particular intervention was deemed to be transferable to those with stroke.
- Language. Only studies published in English were used.

Disagreements on inclusion of particular studies were resolved by consensus. If necessary a relevant member of the EWG provided a third and final vote.

In addition to the initial searches, economic literature was searched via the Australian Medical Index, Econlit, EMBASE, Medline, Health Technology Assessment, and NHS Economic Evaluation Databases. Searches were carried out from the beginning of 2005 to identify papers published after the rehabilitation guidelines (2005). A total of 1033 references were retrieved after de-duplication (Table A2.2). One person initially reviewed all references and selected 44 potentially relevant articles. These abstracts were scrutinised by two people and 35 appropriate papers were retrieved and reviewed.

TABLE A2.2
Results of database search for economic studies

ELECTRONIC DATABASE	REFERENCES RETRIEVED
Australasian Medical Index	41
Econlit	83
EMBASE	681
Health Technology Assessment database	2
Medline	337
NHS Economic Evaluation database	31

Appraising the selected studies

A standardised appraisal process was used based on forms adapted from the Guidelines International Network and SIGN. Where available, appraisals already undertaken by SIGN for the rehabilitation section were used to avoid duplication. The standardised appraisal form assesses the level of evidence (design and issues of quality), size of effect, relevance, applicability (benefits/harms) and generalisability of studies. Examples of completed checklists can be obtained from the NSF. Evidence for diagnostic and prognostic studies was also appraised using the SIGN methodology.

Summarising and synthesising the evidence

Details of relevant studies were summarised in evidence tables which form a supplement to this document and can be downloaded from the NSF website (www.strokefoundation.com.au).

To assist in the formulation of recommendations for each question, the NMHRC *Grades* process (2008–2010) was applied.[1] No pooling of data or meta-analysis was undertaken during the evidence synthesis process. For each question, the NSF project team developed a draft recommendation based on the NHMRC matrix (Table A2.3). These recommendations were subsequently discussed and agreed on by the EWG. Final decisions were made by informal group processes after open discussion facilitated by the co-chairs. The recommended grading matrix was used to guide the strength or grading of the recommendation (Table A2.4).

TABLE A2.3
NHMRC Body of evidence assessment matrix and recommendation grading [1]

COMPONENT	A EXCELLENT	B GOOD	C SATISFACTORY	D POOR
Volume of evidence	Several Level I or II studies with low risk of bias	One or two Level II studies with low risk of bias or a systematic review / multiple Level III studies with low risk of bias	Level III studies with low risk of bias, or Level I or II studies with moderate risk of bias	Level IV studies, or Level I to III studies with high risk of bias
Consistency	All studies consistent	Most studies consistent and inconsistency may be explained	Some inconsistency reflecting genuine uncertainty around clinical question	Evidence is inconsistent
Clinical impact	Very large	Substantial	Moderate	Slight or restricted
Generalisability	Population/s studied in body of evidence are the same as the target population for the guideline	Population/s studied in the body of evidence are similar to the target population for the guideline	Population/s studied in body of evidence different to target population for guideline but it is clinically sensible to apply this evidence to target population	Population/s studied in body of evidence different to target population and hard to judge whether it is sensible to generalise to target population
Applicability	Directly applicable to Australian healthcare context	Applicable to Australian healthcare context with few caveats	Probably applicable to Australian healthcare context with some caveats	Not applicable to Australian healthcare context

TABLE A2.4
NHMRC Draft grade of recommendation matrix[1]

GRADE	DESCRIPTION
A	Body of evidence can be trusted to guide practice
B	Body of evidence can be trusted to guide practice in most situations
C	Body of evidence provides some support for recommendation(s) but care should be taken in its application
D	Body of evidence is weak and recommendation must be applied with caution
Good practice point (GPP)	Recommended best practice based on clinical experience and expert opinion

Following agreement on recommendations, the NSF project team drafted the body of the guidelines which included a brief discussion of the evidence and other relevant factors such as the current gaps in practice as outlined in the most recent National Stroke Audits or considerations regarding implementation. Early drafts were circulated for comment by the EWG and amended before release for public consultation.

Consultation

Public consultation about the draft document was undertaken over one month from February to March 2010. A specific feedback form was circulated via the Australian Stroke Coalition and members of the EWG and advisory group to relevant professional bodies, stroke clinical networks, consumers and consumer organisations. A public notice was published in *The Australian* newspaper (1 February 2010) in line with NHMRC requirements. The draft document was also posted on the NSF website.

Over 460 individual comments covering a wide range of topics were received from 77 individuals, groups or organisations. Feedback received was initially considered by the NSF project team with minor amendments such as formatting or spelling reviewed and actioned. Other feedback was forwarded to relevant members of the EWG depending on topic areas and suggested responses developed. All comments and suggested responses were collated and circulated to the full EWG for consideration and discussion, with several topics being further discussed during subsequent teleconferences. Informal consensus processes were used to modify any recommendations.

A significant number of the comments received during consultation related to the structure of the document, the size of some of the chapters and the ambiguity of some the recommendations. As a result of the feedback, significant structural changes to the order of contents of the guidelines were made. Other minor rewording and reformatting was also carried out. The sequencing of the recommendations was also reviewed and modified where appropriate.

Several topics received significantly more feedback than others and the EWG's responses are listed below:

- acute blood pressure therapy: recommendation specific to ICH added
- behavioural management: further section added to expand this information
- cognitive communication deficits: further section added to expand this information
- contracture: revision of preamble regarding prolonged stretches and relevant recommendation
- loss of sensation: revision of preamble and recommendations
- neurointervention: rewording of recommendation regarding mechanical retrieval devices
- spasticity: revision of preamble
- TIA management: revision of both organisation and clinical management preambles and minor changes to recommendations.

Minor changes were also made to aphasia, cognition, incontinence, thrombolysis and dysphagia. For other topics, apart from a change in order and minor wording changes, none of the recommendations were significantly changed after feedback from consultation.

Five questions, modified from key questions included in the Guidelines Implementability Tool, were also included in the consultation feedback form to provide general feedback. This feedback was used by the NSF project team when reviewing and updating the draft document. Recommendations that were unclear or ambiguous were reworded. A medical editor also reviewed the guidelines to ensure that there was consistency in the language used and the presentation of the evidence.

A letter of reply outlining the EWG's responses was sent to all individuals and organisations who provided feedback during the public consultation period. A list of individuals, groups or organisations who provided feedback during the consultation process can be obtained from the NSF.

The updated guideline document underwent one final round of peer review by the following international experts in the field of stroke and guideline development:

Dr Sònia Abilleira Castells
Director Vascular Cerebral Stroke Programme
Catalan Agency for Health Technology Assessment and Research
Barcelona, Spain

Dr Lynn Legg
Research Fellow
Glasgow Royal Infirmary University NHS Trust, UK

Dr Tony Rudd
Clinical Director for Stroke
Healthcare for London
Chair of the Intercollegiate Stroke Working Party based at the Royal College of Physicians, London, UK

Feedback received was initially reviewed by the NSF project team and the EWG co-chairs and minor changes were made (slight wording changes to several recommendations). The final document was circulated to the EWG for sign-off and then submitted to the NHMRC for consideration of approval.

Revision of the guidelines

The NHMRC stipulates that guidelines should be reviewed or updated every five years. These guidelines will therefore be updated by 2015. The NSF will monitor the currency of the guidelines over the next five years using information collated from the National Stroke Audit, discussions with health professionals and consumers, and publication of any international stroke guidelines or major stroke trials that significantly alter the recommendations or demonstrate a change in the known safety profile of medications included in these guidelines.

Implementation

Reviewing the evidence and developing evidence-based recommendations for care are only the first steps to ensuring that evidence-based care is available. Following publication, the guidelines must be disseminated to all those involved in stroke care, who will then identify ways in which the guidelines may be taken up at a local level.

Strategies by which guidelines can be disseminated and implemented include:

1. Distribution of education materials, for example, guidelines will be emailed to stroke clinicians via existing stroke networks. Concise guidelines for the majority of disciplines including general practitioners, nurses and doctors are planned. A link to the guidelines will be available on the NSF website and will be sent to all appropriate universities, colleges, associations, societies and other professional organisations.
2. Educational meetings, for example, interdisciplinary conferences or internet-based webconferences. Resources will be developed to aid workshop facilitators identify barriers and solutions in the implementation phase.
3. Educational outreach visits. A peer support model using centres viewed as champions in aspects of acute stroke management may be used in collaboration with national audit results.
4. Key opinion leaders. Educational resources will utilise key opinion leaders. It is also planned to have local ‘champions facilitate workshops in their local areas.
5. Audit and feedback. Data from the National Stroke Audits will be fundamental to the implementation of these guidelines. A copy of relevant indicators covering organisation of care and clinical care will be available from the NSF along with key audit reports (see Appendix 4).
6. Reminders. Electronic reminders should be used once local teams have identified key areas of quality improvement activities and commenced planned strategies.

A systematic review of the above dissemination and implementation strategies found that there was difficulty in interpreting the evidence of the effectiveness of these interventions due to methodological weaknesses, poor reporting of the study setting and uncertainty about the generalisability of the results.[144] Most of the strategies appear to have modest effectiveness in implementing evidence-based care but it is unclear if single interventions are any better or worse than multiple interventions.[144] Thus all of the above strategies may be used where appropriate for implementation of the guidelines. Specific strategies will also be considered when targeting general practice in line with the RACGP Guidelines *Putting prevention into practice*.[990]

The NSF strongly recommends a systematic approach to identifying gaps in service delivery, understanding local barriers or enablers to reducing those gaps and developing a clear plan of action to improve stroke services. The NSF has developed a comprehensive QI program (known as StrokeLink) offering outreach visits by NSF staff using interactive educational formats linked to audit and feedback and local consensus processes. Implementation issues also need to consider the barriers to delivering services to ATSI people and develop models of stroke care that address local cultural and geographical needs.

Existing resources and networks can also support implementation of these stroke guidelines.

- the Acute Stroke Services Framework, which outlines how acute stroke services, and stroke units in particular, should be organised in different parts of Australia and the resources that may be needed (available at www.strokefoundation.com.au)
- the Australian Stroke Coalition (established by the NSF and Stroke Society of Australasia on 11 July 2008), which brings together representatives from groups and organisations working in the stroke field, such as clinical networks and professional associations/colleges, and works to tackle agreed priorities to improve stroke care, reduce duplication between groups and strengthen the voice for stroke care at a national and state level (see www.strokefoundation.com.au/asc)
- various activities and resources linked to the guidelines such as education workshops, health professional resources and GP education modules
- clinical networks including Stroke Services NSW, Queensland Stroke Clinical Network and other state and local networks.

Appendix 3 Priorities for research

These guidelines reflect the current evidence base and its limitations. Some interventions have higher level of evidence to support them than others . Many other interventions in current use are not discussed because there is neither good quality evidence on their effectiveness nor sufficient consensus concerning their potential benefits. The substantial gaps in the evidence base highlight the need for practitioners to build quality research studies into their clinical practice.

Since the previous guidelines published in 2005 and 2007 there has been an increase in the amount of research on different medical aspects (e.g. antiplatelet agents for secondary prevention, thrombolysis, acute blood pressure intervention, TIA management). There has also been a great amount of rehabilitation research concerning impairment and activity (e.g. strength, walking, upper limb function, contracture) and secondary complications (e.g. contracture, cardiorespiratory fitness, spasticity). Further research on participation is required as clearly this impacts on the quality of life of stroke survivors and their families/ carers.

The EWG has identified a number of areas in which research is particularly needed but where there is limited current activity. Not all these areas should be seen as a priority research area. Rather, they have been identified as areas in which current evidence is insufficient to allow a strong recommendation. Priority setting for research should consider the burden of disease for patients and families related to the research question, whether it is possible to conduct high quality research in that area, whether research findings have the potential to change practice and improve patient outcomes, and finally, the cost effectiveness implications of improving diagnosis or intervention. Further work is urgently required to establish research priorities in stroke and we aim to move towards this in time for the next revision of these guidelines. For now, we have simply listed the areas identified.

Organisation of care

- components of stroke units e.g. in-patient stroke care coordinator, organisation of nursing care
- post-discharge follow-up services
- pre-discharge needs assessment (including home visits)
- optimum organisation of care for people with TIA
- implementation of proven evidence-based rehabilitation strategies for environmental enrichment
- comparison of the cost-effectiveness of treatments for spasticity including therapy, splinting, botulinum toxin type A and multidisciplinary clinics
- further development of Aboriginal and Torres Strait Islander stroke services.

Reducing the severity of stroke

- effective neuroprotection
- thrombolysis access for rural centres.

Better diagnosis and management

- assessment/screening of people with TIA using ABCD^2 tool in the hyperacute time window
- mood disturbance (screening, prevention and management)
- behavioural change (assessment and management)
- cognitive and perceptual difficulties (screening, assessment and management).

Improving management of consequence of stroke

- bladder and bowel management (particularly in the acute phase)
- management of hyperglycaemia
- management of intracerebral haemorrhage
- recognition and management of fatigue
- management of PFO (although current trials may answer some of these questions)
- prevention and management of shoulder pain
- prevention and management of contracture
- management of central post-stroke pain
- management of agnosia
- management of apraxia (motor and speech)
- management of dysarthria
- preventing hospital (acute) falls.

Further development of rehabilitation strategies

- the optimal intensity and timing of rehabilitation (allied health and nursing interventions)
- increasing upper limb activity (particularly the application of 'robotics' or other ways to organise increased practice, bilateral interventions, repetitive transcranial magnetic stimulation and mirror therapy)
- virtual reality training for upper and lower limbs
- neuromuscular electrical stimulation for dysphagia
- repetitive transcranial magnetic stimulation for dysphagia.

Quality of life, Instrumental Activities of Daily living, support

- self-management strategies specific to stroke
- driving assessment and training
- interventions to aid returning to work
- long-term therapy needs for working age stroke survivors
- return to usual sexual activity
- peer support interventions
- respite care
- carer support.

Research priorities related to Aboriginal and Torres Straight Islander (ATSI) populations

A survey of ATSI and non-ATSI health professionals and researchers was conducted by the NSF in March 2010 to understand the priorities for research related specifically to ATSI populations. Respondents were provided with a list of broad areas related to stroke care to choose from in addition to providing specific topics. Results are shown in Table A3.1 below and these may be of use to researchers considering undertaking research in the ATSI population.

TABLE A3.1
Research priorities specifically to ATSI populations

RESEARCH TOPIC	% NOMINATING TOPIC (N=38)
Planning, leaving hospital and transfer of care to community	67
Organisation of community-based services	64
Identifying and managing risk factors for prevention	61
Secondary prevention	54
Organisation of hospital services	48
Rehabilitation	48
Information about signs of stroke and what to do if a stroke is suspected	45
Services and management of TIA	36
Monitoring the incidence and prevalence of stroke in Australia	30

Appendix 4 National stroke audit

The National Stroke Audit is an initiative of the NSF and is designed to examine how often the evidence-based recommendations made in the clinical guidelines are used in clinical practice. It also examines what resources are available to support evidence-based care and provides national benchmarks for describing the ways in which stroke care is delivered and could be improved. The inaugural acute and post-acute national stroke audits were carried out in 2007 and in 2008, respectively. The National Stroke Audit is repeated biennially with acute and post-acute services explored in alternate years to provide longitudinal data on clinical performance.

The National Stroke Audit aims to:

- characterise the nature of Australian stroke services
- identify resources available to support the delivery of evidence-based care
- identify areas where resources linked with focussed strategies may facilitate evidence-based stroke care
- monitor how closely recommendations in the national clinical guidelines are being followed
- enable hospitals to benchmark nationally against similar hospitals
- provide data to form the basis of a cycle of ongoing quality improvement
- foster a culture of audit and feedback.

The National Stroke Audit comprises two components, an organisational survey and a clinical audit.

1. An organisational survey of stroke services across Australia. The survey examines the resources required to deliver evidence-based stroke care, such as stroke units, imaging (including CT), protocols, processes and pathways, and the multidisciplinary team coordinated-care approach including team meetings. The self-reported data are provided by a nominated clinician.
2. A clinical audit involving retrospective review of up to 40 consecutive cases admitted to participating hospitals during a defined timeframe. The clinical audit examines the delivery of evidence-based processes of care, such as diagnostic imaging (CT, MRI and carotid Doppler), early acute interventions (such as rt-PA and aspirin), rehabilitation interventions, discharge planning and support for life after stroke. Timing of the delivery of aspects of care is also considered.

Each participating hospital receives a confidential individual report providing feedback on local audit results ranked against national averages so that informed decisions can be made to improve the care delivered to stroke patients. The organisational survey and clinical audit were developed in tandem and the results should be considered together. Areas of excellence and areas of need identified in the clinical audit may be better understood in association with information about the available resources from the organisational survey. Audit questions are reviewed each cycle making sure they are in line with any guidelines update. Copies of the previous guideline questions can be found in the appendix of the relevant publication, which is accessible from www.strokefoundation.com.au.

The process of audit and feedback is a crucial part of the guidelines implementation process and a core component of a cycle of continuous quality improvement. The results of the audit may also be used to inform planning at local, state and national levels with the aim of improving health outcomes associated with stroke.

Appendix 5 Thrombolysis inclusion/exclusion criteria

PATIENT SELECTION CRITERIA RT-PA
INDICATIONS
1. Onset of ischaemic stroke within the preceding 4.5 hours.
2. Measurable and clinically significant deficit on NIH Stroke Scale examination.
3. Patient's computed tomography (CT) scan does not show haemorrhage or non-vascular cause of stroke.
4. Patient's age is > 18 years.
ABSOLUTE CONTRAINDICATIONS: DO NOT ADMINISTER RT-PA IF ANY OF THESE STATEMENTS ARE TRUE.
1. Uncertainty about time of stroke onset (e.g. patients awaking from sleep).
2. Coma or severe obtundation with fixed eye deviation and complete hemiplegia.
3. Only minor stroke deficit which is rapidly improving.
4. Seizure observed or known to have occurred at onset of stroke.
5. Hypertension: systolic blood pressure ≥ 185 mmHg or diastolic blood pressure > 110 mmHg on repeated measures prior to study.
6. Clinical presentation suggestive of subarachnoid haemorrhage even if the CT scan is normal.
7. Presumed septic embolus.
8. Patient has received heparin with the last 48 hours and has elevated PTT or has a known hereditary or acquired haemorrhagic diathesis (e.g. PT or APTT greater than normal).
9. INR > 1.5.
10. Platelet count < 100,000/uL.
11. Serum glucose < 2.8 mmol/l or > 22.0 mmol/l.

RELATIVE CONTRAINDICATIONS: IF ANY OF THE FOLLOWING STATEMENTS IS TRUE, USE RT-PA WITH CAUTION. IN EACH SITUATION THE BALANCE OF THE POTENTIAL RISKS AND BENEFITS MUST BE CAREFULLY CONSIDERED.
1. Severe neurological impairment with NIH Stroke Scale score > 22.
2. Age > 80 years.
3. CT evidence of extensive middle cerebral artery (MCA) territory infarction (sulcal effacement or blurring of grey-white junction in greater than 1/3 of MCA territory).
4. Stroke or serious head trauma within the past three months where the risks of bleeding are considered to outweigh the benefits of therapy.
5. Major surgery within the last 14 days.
6. Patient has known history of intracranial haemorrhage, subarachnoid haemorrhage, known intracranial arteriovenous malformation or previously known intracranial neoplasm such that, in the opinion of the clinician, the increased risk of intracranial bleeding would outweigh the potential benefits of treatment.
7. Suspected recent (within 30 days) myocardial infarction.
8. Recent (within 30 days) biopsy of a parenchymal organ or surgery that, in the opinion of the responsible clinician, would increase the risk of unmanageable (e.g. uncontrolled by local pressure) bleeding.
9. Recent (within 30 days) trauma with internal injuries or ulcerative wounds.
10. Gastrointestinal or urinary tract haemorrhage within the last 30 days or any active or recent haemorrhage that, in the opinion of the responsible clinician, would increase the risk of unmanageable (e.g. by local pressure) bleeding.
11. Arterial puncture at non-compressible site within the last seven days.
12. Concomitant serious, advanced or terminal illness or any other condition that, in the opinion of the responsible clinician, would pose a risk to treatment.

Glossary and abbreviations

Glossary

Activities of daily living
The basic elements of personal care such as eating, washing and showering, grooming, walking, standing up from a chair and using the toilet.

Activity
The execution of a task or action by an individual. Activity limitations are difficulties an individual may have in executing activities.

Agnosia
The inability to recognise sounds, smells, objects or body parts (other people's or one's own) despite having no primary sensory deficits.

Aphasia
Impairment of language, affecting the production or comprehension of speech and the ability to read and write.

Apraxia
Impaired planning and sequencing of movement that is not due to weakness, incoordination or sensory loss.

Atrial fibrillation
Rapid, irregular beating of the heart.

Augmentative and alternative communication
Non-verbal communication, e.g. through gestures or by using computerised devices.

Cochrane review
A comprehensive systematic review and meta-analysis (where possible).

Deep vein thrombosis
Thrombosis (a clot of blood) in the deep veins of the leg, arm, or abdomen.

Disability
A defect in performing a normal activity or action (e.g. inability to dress or walk).

Drip and ship
A model of thrombolysis service provision that involves assessment of patients at a non-specialist centres with telemedicine support by stroke specialists, commencing thrombolysis (if deemed appropriate) and subsequent transfer to the stroke specialist centre.

Dysarthria
Impaired ability to produce clear speech due to the impaired function of the speech muscles.

Dysphagia
Difficulty swallowing.

Dysphasia
Reduced ability to communicate using language (spoken, written or gesture).

Dyspraxia of speech
Inability to produce clear speech due to impaired planning and sequencing of movement in the muscles used for speech.

Emotionalism
An increase in emotional behaviour—usually crying, but sometimes laughing that is outside normal control and may be unpredictable as a result of the stroke.

Enteral tube feeding
Delivery of nutrients directly into the intestine via a tube.

Executive function
Cognitive functions usually associated with the frontal lobes including planning, reasoning, time perception, complex goal-directed behaviour, decision making and working memory.

Family support/liaison worker
A person who assists stroke survivors and their families to achieve improved quality of life by providing psychosocial support, information and referrals to other stroke service providers.

Impairment
A problem in the structure of the body (e.g. loss of a limb) or the way the body or a body part functions (e.g. hemiplegia).

Infarction
Death of cells in an organ (e.g. the brain or heart) due to lack of blood supply.

Inpatient stroke care coordinator
A person who works with people with stroke and with their carers to construct care plans and discharge plans and to help coordinate the use of healthcare services during recovery in hospital.

Multidisciplinary team
The entire rehabilitation team, made up of doctors, nurses, therapists, social workers, psychologists and other health personnel.

Ischaemia
An inadequate flow of blood to part of the body due to blockage or constriction of the arteries that supply it.

Neglect
The failure to attend or respond to or make movements towards one side of the environment.

Participation
Involvement in a life situation.

Participation restrictions
Problems an individual may experience in involvement in life situations.

Penumbral-based imaging
Brain imaging that uses advanced MRI or CT angiography imaging to detect parts of the brain where the blood supply has been compromised but the tissue is still viable.

Percutaneous endoscopic gastrostomy (PEG
A form of enteral feeding in which nutrition is delivered via a tube that is surgically inserted into the stomach through the skin.

Pharmaceutical Benefits Scheme (PBS)
A scheme whereby the costs of prescription medicine are subsidised by the Australian Government to make them more affordable.

Phonological deficits
Language deficits characterised by impaired recognition and/or selection of speech sounds.

Pulmonary embolism
Blockage of the pulmonary artery (which carries blood from the heart to the lungs) with a solid material, usually a blood clot or fat, that has travelled there via the circulatory system.

Rehabilitation
Restoration of the disabled person to optimal physical and psychological functional independence.

Risk factor
A characteristic of a person (or people) that is positively associated with a particular disease or condition.

Stroke unit
A section of a hospital dedicated to comprehensive acute and/or rehabilitation programs for people with a stroke.

Stroke
Sudden and unexpected damage to brain cells that causes symptoms that last for more than 24 hours in the parts of the body controlled by those cells. Stroke happens when the blood supply to part of the brain is suddenly disrupted, either by blockage of an artery or by bleeding within the brain.

Task-specific training
Training that involves repetition of a functional task or part of the task.

Transient ischaemic attack
Stroke-like symptoms that last less than 24 hours. While TIA is not actually a stroke, it has the same cause. A TIA may be the precursor to a stroke, and people who have had a TIA require urgent assessment and intervention to prevent stroke.

Abbreviations

AAC: Augmentative and alternative communication
ACE: Angiotensin-converting enzyme
ADL: Activities of daily living
AF: Atrial fibrillation
AFO: Ankle foot orthosis
ARB: Angiotensin receptor antagonists
ATSI: Aboriginal and Torres Strait Islander
BAO: Basilar artery occlusion
BMI: Body mass index
BP: Blood pressure
CEA: Carotid endarterectomy
CEMRA: Contrast-enhanced magnetic resonance angiography
CCT: Clinical controlled trial
CI: Confidence interval
CILT: Constraint induced language therapy
CIMT: Constraint induced movement therapy
CPAP: Continuous positive airway pressure
CPSP: Central post-stroke pain
CT: Computed tomography
CTA: Computed tomography angiography
CVD: Cardiovascular disease
DALY: Disability-adjusted life years
DBP: Diastolic blood pressure
DVT: Deep vein thrombosis
DWI: Diffusion-weighted imaging
ECG: Electrocardiography
ECT: Electroconvulsive therapy
ED: Emergency department
EMG: Electromyographic feedback
EMS: Emergency medical services
ES: Effect size
ESD: Early supported discharge
EWG: Expert working group
FAST: Face, arm, speech, time
FEES: Fibre-optic endoscopic examination of swallowing
FFP: Fresh frozen plasma
FIM: Functional independence measure
GP: General practitioner
GPP: Good practice point
GSS: Gugging swallowing screen
GTN: Glyceryl trinitrate
HRT: Hormone replacement therapy
IA: Intra-arterial
ICER: Incremental cost-effectiveness ratios
ICC: Intraclass correlation coefficient
ICH: Intracranial haemorrhage

ICU: Intensive care unit
INR: International normalised ratio
IPC: Intermittent pneumatic compression
IPCS: Inpatient palliative care services
IV: Intravenous
LSVT: Lee Silverman voice treatment
LMWH: Low molecular weight heparin
LOS: Length of stay
MA: Meta-analysis
MAP: Mean arterial blood pressure
MASS: Melbourne ambulance stroke screen
MBS: Modified barium swallow
MCA: Middle cerebral artery
MD: Mean difference
MI: Myocardial infarction
MNA: Mini nutritional assessment
MR: Magnetic resonance
MRA: Magnetic resonance angiography
MRI: Magnetic resonance imaging
mRS: Modified rankin scale
MST: Malnutrition screening tool
MSSU: Mid-stream specimen of urine
MUST: Malnutrition universal screening tool
MWD: Mean weighted difference
NASCET: North American symptomatic carotid endarterectomy trial
NG: Nasogastric
NHMRC: National Health and Medical Research Council
NIHSS: National Institutes of Health Stroke Scale
NMES: Neuromuscular electrical stimulation
NNH: Numbers needed to harm
NNT: Numbers needed to treat
NPV: Negative predictive value
NSF: National Stroke Foundation
OBS: Observational study
OR: Odds ratio
OSA: Obstructive sleep apnoea
OT: Occupational therapist
PBS: Pharmaceutical benefits scheme
PE: Pulmonary embolism
PEG: Percutaneous endoscopic gastrostomy
PFO: Patent faramen ovale
pgSGA: Patient-generated subjective global assessment
PPV: Positive predictive value
QALYs: Quality-adjusted life years
QOL: Quality of life
RCT: Randomised controlled trial
rFVIIa: recombinant activated factor VII
RHS: Right hemisphere syndrome
ROC: Receiver operator curve
ROM: Range of motion
ROSIER: Recognition of stroke in the emergency room
RR: Relative risk
RRR: Relative risk reduction
rt-PA: Recombinant tissue plasminogen activator
rTMS: repetitive transcranial magnetic stimulation
SBP: Systolic blood pressure
SES: Standardised effect size
SGA: Subjective global assessment
sICH: symptomatic intracranial haemorrhage
SMD: Standardised mean difference
SSS: Scandinavian stroke scale
TEE: Transoesophageal echocardiography
TIA: Transient ischaemic attack
TOR-BSST: Toronto bedside swallowing screening test
TTE: Transthoracic echocardiography
TTS: Thermal tactile stimulation
UK: United Kingdom
UL: Upper limb
UFH: Unfractionated heparin
VMBS: Videofluoroscopic modified barium swallow
VRT: Virtual reality training
VST: Visual scanning training
VTC: Video teleconferencing
VTE: Venous thromboembolism
WMD: Weighted mean difference

References

1. National Health and Medical Research Council. Additional Levels of evidence and grades for recommendations for developers of guidelines. 2008–2010.
2. AIHW, Senes S. How we manage stroke in Australia. Australian Institute of Health and Welfare. 2006;AIHW cat. No. CVD 31.
3. White JH, Magin P, Pollack MRP. Stroke patients' experience with the Australian health system: a qualitative study. Can J Occup Ther. 2009;76(2):81–9.
4. National Stroke Foundation. Walk in our shoes: Stroke survivors and carers report on support after stroke. Melbourne; 2007.
5. Stroke Unit Trialists' Collaboration. Organised inpatient (stroke unit) care for stroke. Cochrane Database Syst Rev. 2007, Issue 4. CD000197.
6. National Health and Medical Research Council. A guide to the development and evaluation of clinical practice guidelines. Canberra: NHMRC. 1999.
7. Campbell H, Hotchkiss R, Bradshaw N, Porteous M. Integrated care pathways. Br Med J. 1998;316(7125):133–7.
8. Baker R, Camosso-Stefinovic J, Gillies C, Shaw EJ, Cheater F, Flottorp S, et al. Tailored interventions to overcome identified barriers to change: effects on professional practice and health care outcomes. Cochrane Database Syst Rev. 2010, Issue 3. CD005470.
9. Thrift AG, Hayman N. Aboriginal and Torres Strait Island peoples and the burden of stroke. Int J Stroke. 2007;2:57–9.
10. National Stroke Foundation. National Stroke Unit Program. Aboriginal Stroke Project; 2003.
11. National Stroke Foundation. National Stroke Audit Acute Services Organisational Survey Report 2009. 2009.
12. Wardlaw JM, Murray V, Berge E, Del Zoppo GJ. Thrombolysis for acute ischaemic stroke. Cochrane Database Syst Rev. 2009a, Issue 4. CD000213.
13. Kwan J, Hand P, Sandercock P. Improving the efficiency of delivery of thrombolysis for acute stroke: a systematic review. QJM. 2004;97(5):273–9.
14. Bray JE, Martin J, Cooper G, Barger B, Bernard S, Bladin C. An interventional study to improve paramedic diagnosis of stroke. Prehosp Emerg Care. 2005;9(3):297–302.
15. Belvis R, Cocho D, Marti-Fabregas J, Pagonabarraga J, Aleu A, Garcia-Bargo MD, et al. Benefits of a prehospital stroke code system: Feasibility and efficacy in the first year of clinical practice in Barcelona, Spain. Cerebrovas Dis. 2005; 19(2): 96–101.
16. Lindsberg PJ, Happola O, Kallela M, Valanne L, Kuisma M, Kaste M. Door to thrombolysis: ER reorganization and reduced delays to acute stroke treatment. Neurology. 2006; 67(2): 334–6.
17. De Luca A, Toni D, Lauria L, Sacchetti ML, Giorgi Rossi P, Ferri M, et al. An emergency clinical pathway for stroke patients-results of a cluster randomised trial. BMC Health Services Research. 2009; 9:14.
18. Quain DA, Parsons MW, Loudfoot AR, Spratt NJ, Evans MK, Russell ML, et al. Improving access to acute stroke therapies: a controlled trial of organised pre-hospital and emergency care. Med J Aust. 2008;189(8):429–33.
19. Hamidon BB, Dewey HM. Impact of acute stroke team emergency calls on in-hospital delays in acute stroke care. J Clin Neurosci. 2007; 14(9):831–4.
20. Price CI, Clement F, Gray J, Donaldson C, Ford GA. Systematic review of stroke thrombolysis service configuration. Expert Rev. 2009;9(2):211–33.
21. Kwan J, Hand P, Dennis M, Sandercock P. Effects of introducing an integrated care pathway in an acute stroke unit. Age Ageing. 2004; 33(4):362–7.
22. Asimos AW, Norton HJ, Price MF, Cheek WM. Therapeutic yield and outcomes of a community teaching hospital code stroke protocol. Acad Emerg Med. 2004;11(4):361–70.
23. Mehdiratta M, Woolfenden AR, Chapman KM, Johnston DC, Schulzer M, Beckman J, et al. Reduction in IV t-PA door to needle times using an Acute Stroke Triage Pathway. Can J Neurol Sci. 2006;33(2):214–6.
24. Sattin JA, Olson SE, Liu L, Raman R, Lyden PD. An expedited code stroke protocol is feasible and safe. Stroke. 2006;37(12):2935–9.
25. Suzuki M, Imai A, Honda M, Kobayashi K, Ohtsuka S. Role of a critical pathway for door-to-CT-completion interval in the management of acute ischemic stroke patients in the emergency room. Keio J Med. 2004;53(4):247–50.
26. Quain DA, Parsons MW. Improving access to acute stroke therapies: A controlled trial of organised pre-hospital and emergency care. Med J Aust. 2008;189(8):429–33.
27. Nazir FS, Petre I, Dewey HM. Introduction of an acute stroke team: an effective approach to hasten assessment and management of stroke in the ED. Clin Neurosci. 2009;16(1):21–5.
28. Wojner-Alexandrov AW, Alexandrov AV, Rodriguez D, Persse D, Grotta JC. Houston paramedic and emergency stroke treatment and outcomes study (HoPSTO). Stroke. 2005;36(7):1512–8.
29. Moser DK, Kimble LP, Alberts MJ, Alonzo A, Croft JB, Dracup K, et al. Reducing delay in seeking treatment by patients with acute coronary syndrome and stroke: A scientific statement from the American Heart Association Council on Cardiovascular Nursing and Stroke Council. Circulation. 2006;114(2):168–82.
30. Kwan J, Hand P, Sandercock P. A systematic review of barriers to delivery of thrombolysis for acute stroke. Age Ageing. 2004;33(2):116–21.
31. Bray JE, Martin J, Cooper G, Barger B, Bernard S, Bladin C. Paramedic identification of stroke: community validation of the melbourne ambulance stroke screen. Cerebrovasc Dis. 2005;20(1):28–33.
32. National Stroke Foundation. National Stroke Audit Acute Services Clinical Audit Report 2009. Melbourne, Australia.
33. Govan L, Langhorne P, Weir CJ. Does the prevention of complications explain the survival benefit of organized inpatient (stroke unit) care? Further analysis of a systematic review. Stroke. 2007;38(9):2536–40.
34. Seenan P, Long M, Langhorne. Stroke Units in their natural habitat. Systematic review of observational studies. Stroke. 2007;38:1886–92.
35. Muller R, Pfefferkorn T. Admission facility is associated with outcome of basilar artery occlusion. Stroke. 2007;38(4):1380–3.
36. Perez de La Ossa N, Sanchez-Ojanguren J, Palomeras E, Millan M, Arenillas JF, Dorado L, et al. Influence of the stroke code activation source on the outcome of acute ischemic stroke patients. Neurology. 2008;70(15):1238–43.
37. Silvestrelli G, Parnetti L, Paciaroni, Caso, Corea, Vitali, et al. Early admission to stroke unit influences clinical outcome. Eur J Neurol. 2006;13:250–5.
38. Foley N, Salter K, Teasell R. Specialized stroke services: A meta-analysis comparing three models of care. Cerebrovasc Dis. 2007;23 (2–3):194–202.
39. National Stroke Foundation. Acute Stroke Services Framework. Melbourne; 2008.
40. National Stroke Foundation. National Stroke Audit Acute Services Organisational Survey Report 2009. Melbourne, Australia.
41. Langhorne P, Pollock A. What are the components of effective stroke unit care? Age Ageing. 2002;31(5):365–71.
42. van der Walt A, Gilligan AK, Cadilhac DA, Brodtmann AG, Pearce DC, Donnan GA. Quality of stroke care within a hospital: Effects of a mobile stroke service. Med J Aust. 2005;182(4):160–3.
43. Langhorne P, Dey P, Woodman M, Kalra L, Wood-Dauphinee S, Patel N, et al. Is stroke unit care portable? A systematic review of the clinical trials. Age Ageing. 2005;34(4):324–30.
44. Langhorne P, Dennis MS, Kalra L, Shepperd S, Wade DT, Wolfe CDA. Services for helping acute stroke patients avoid hospital admission. Cochrane Database Syst Rev. 1999, Issue 3. CD000444.
45. Kalra L, Evans A, Perez I, Knapp M, Donaldson N, Swift CG. Alternative strategies for stroke care: a prospective randomised controlled trial. Lancet. 2000;356(9233):894–9.
46. Kwan J, Sandercock P. In-hospital care pathways for stroke. Cochrane Database Syst Rev. 2004, Issue 4. CD002924.
47. Perednia DA, Allen A. Telemedicine technology and clinical applications. JAMA. 1995;273(6):483–8.

48. Schwamm LH, Holloway RG, Amarenco P, Audebert HJ, Bakas T, Chumbler NR, et al. A review of the evidence for the use of telemedicine within stroke systems of care: a scientific statement from the American Heart Association/American Stroke Association. Stroke. 2009;40(7):2616–34.
49. Audebert HJ, Schwamm L. Telestroke: scientific results. Cerebrovasc Dis. 2009;27 (Suppl 4):15–20.
50. Meyer BC, Raman R, Hemmen T, Obler R, Zivin JA, Rao R, et al. Efficacy of site-independent telemedicine in the STRokE DOC trial: a randomised, blinded, prospective study. Lancet neurol. 2008;7(9):787–95.
51. Price CI, Clement F, Gray J, Donaldson C, Ford GA. Systematic review of stroke thrombolysis service configuration. Expert Rev. 2009;9(2):211–33.
52. Audebert HJ, Kukla C, Clarmann von Claranau S, Kuhn J, Vatankhah B, Schenkel J, et al. Telemedicine for safe and extended use of thrombolysis in stroke: the Telemedic Pilot Project for Integrative Stroke Care (TEMPiS) in Bavaria. Stroke. 2005;36(2):287–91.
53. Audebert HJ, Kukla C, Vatankhah B, Gotzler B, Schenkel J, Hofer S, et al. Comparison of tissue plasminogen activator administration management between Telestroke Network hospitals and academic stroke centers: the Telemedical Pilot Project for Integrative Stroke Care in Bavaria/Germany. Stroke. 2006;37(7):1822–7.
54. Schwab S, Vatankhah B, Kukla C, Hauchwitz M, Bogdahn U, Furst A, et al. Long-term outcome after thrombolysis in telemedical stroke care. Neurology. 2007;69(9):898–903.
55. Tatlisumak T, Soinila S, Kaste M. Telestroke networking offers multiple benefits beyond thrombolysis. Cerebrovasc Dis. 2009;27(SUPPL. 4):21–7.
56. Lai JC, Woo J, Hui E, Chan WM. Telerabilitation: a new model for community-based stroke rehabilitation. J Telemed Telecare. 2004;10:199–205.
57. Piron L, Turolla A, Agostini M, Zucconi C, Cortese F, Zampolini M, et al. Exercises for paretic upper limb after stroke: A combined virtual-reality and telemedicine approach. J Rehabil Med. 2009;41(12):1016–20.
58. Winkler D, Farnworth L, Sloan S. People under 60 living in aged care facilities in Victoria. Aust Health Rev. 2006;30(1):100–8.
59. Barras S. A systematic and critical review of the literature: the effectiveness of occupational therapy home assessment on a range of outcome measures. Aust Occup Ther J. 2005;52(4):326–36.
60. Grasel E, Schmidt R, Biehler J. Long-term effects of the intensification of the transition between inpatient neurological rehabilitation and home care of stroke patients. Clin Rehabil. 2006;20:577–83.
61. Gillespie LD, Robertson MC, Gillespie WJ, Lamb SE, Gates S, Cumming RG, et al. Interventions for preventing falls in older people living in the community. Cochrane Database Syst Rev. 2009, Issue 2. CD007146.
62. Mitchell GK, Brown RM, Erikssen L, Tieman JJ. Multidisciplinary care planning in the primary care management of completed stroke: A systematic review. BMC Family Practice. 2008;9(44).
63. Shepperd S, Parkes J, McClaran J, Phillips C. Discharge planning from hospital to home. Cochrane Database Syst Rev. 2004, Issue 1. CD000313.
64. Preyde M, Macaulay C, Dingwall T. Discharge planning from hospital to home for elderly patients: a meta-analysis. J Evid Based Soc Work. 2009;6(2):198–216.
65. Schedlbauer A, Schroeder K, Peters TJ, Fahey T. Interventions to improve adherence to lipid lowering medication. Cochrane Database Syst Rev. 2004, Issue 2. CD004371.
66. Greenwood N, Mackenzie A, Cloud GC, Wilson N. Informal primary carers of stroke survivors living at home-challenges, satisfactions and coping: a systematic review of qualitative studies. Disabil Rehabil. 2009;31(5):337–51.
67. Kalra L, Evans A, Perez I, Melbourn A, Patel A, Knapp M, et al. Training carers of stroke patients: randomised controlled trial. Br Med J. 2004;328(7448):1099.
68. Early Supported Discharge Trialists. Services for reducing duration of hospital care for acute stroke patients. Cochrane Database Syst Rev 2005, Issue 2. CD000443.
69. Larsen T, Olsen TS, Sorensen J. Early home-supported discharge of stroke patients: a health technology assessment. Int J Technol Assess Health Care. 2006;22(3):313–20.
70. Tyson S, Turner G. Discharge and follow-up for people with stroke: what happens and why. Clin Rehabil. 2000;14(4):381–92.
71. Outpatient Service Trialists. Therapy-based rehabilitation services for stroke patients at home. Cochrane Database Syst Rev. 2002, Issue 2. CD002925.
72. Britton M, Andersson A. Home rehabilitation after stroke: reviewing the scientific evidence on effects and costs. Int J Technol Assess Health Care. 2000;16(3):842–8.
73. Hillier S, Gakeemah I. Rehabilitation for community-dwelling people with stroke: home or centre based? A systematic review. Int J Stroke. 2010;5(3):Published online May 5.
74. Crotty M, Giles LC, Halbert J, Harding J, Miller M. Home versus day rehabilitation: a randomised controlled trial. Age Ageing. 2008;37(6):628–33.
75. Christie D, Weigall D. Social work effectiveness in two-year stroke survivors: a randomised controlled trial. Community Health Stud. 1984;8(1):26–32.
76. Towle D, Lincoln NB, Mayfield LM. Evaluation of social work on depression after stroke. Clin Rehabil. 1989(2):89–96.
77. Boter H. Multicenter randomized controlled trial of an outreach nursing support program for recently discharged stroke patients. Stroke. 2004;35(12):2867–72.
78. Burton C, Gibbon B. Expanding the role of the stroke nurse: a pragmatic clinical trial. J Adv Nurs. 2005;52(6):640–50.
79. Larson J, Franzén Dahlin A, Billing E, Arbin M, Murray V, Wredling R. The impact of a nurse-led support and education programme for spouses of stroke patients: a randomized controlled trial. J Clin Nurs. 2005;14(8):995–1003.
80. Nir Z, Weisel-Eichler A. Improving knowledge and skills for use of medication by patients after stroke: evaluation of a nursing intervention. Am J Phys Med Rehabil. 2006;85(7):582–92.
81. Middleton S, Donnelly N, Harris J, Ward J. Nursing intervention after carotid endarterectomy: a randomized trial of Co-ordinated Care Post-Discharge (CCPD). J Adv Nurs. 2005;52(3):250–61.
82. Forster A, Young J. Specialist nurse support for patients with stroke in the community: a randomised controlled trial. Br Med J. 1996;312(7047):1642–6.
83. Goldberg G, Segal ME, Berk SN, Schall RR, Gershkoff AM. Stroke transition after inpatient rehabilitation. Top Stroke Rehabil. 1997(1):64–79.
84. Dennis M, O'Rourke S, Slattery J, Staniforth T, Warlow C. Evaluation of a stroke family care worker: results of a randomised controlled trial. Br Med J. 1997;314(7087):1071–6.
85. Glass TA, Berkman LF, Hiltunen EF, Furie K, Glymour MM, Fay ME, et al. The families in recovery from stroke trial (FIRST): Primary study results. Psychosom Med. 2004;66(6):889–97.
86. Johnston M, Bonetti D, Joice S, Pollard B, Morrison V, Francis JJ, et al. Recovery from disability after stroke as a target for a behavioural intervention: Results of a randomized controlled trial. Dis Rehabil. 2007;29(14):1117–27.
87. Harrington R, Taylor G, Hollinghurst S, Reed M, Kay H, Wood VA. A community-based exercise and education scheme for stroke survivors: a randomized controlled trial and economic evaluation. Clin Rehabil. 2010;24(1):3–15.
88. Andersen HE, Eriksen K, Brown A, Schultz-Larsen K, Forchhammer BH. Follow-up services for stroke survivors after hospital discharge-a randomized control study. Clin Rehabil. 2002;16(6):593–603.
89. Joubert J, Reid C, Joubert L, Barton D, Ruth D, Jackson D, et al. Risk factor management and depression post-stroke: the value of an integrated model of care. J Clin Neurosci. 2006;13(1):84–90.

90. Claiborne N. Effectiveness of a care coordination model for stroke survivors: a randomized study. Health & Social Work. 2006;31(2):87–96.
91. Mayo NE, Nadeau L, Ahmed S, White C, Grad R, Huang A, et al. Bridging the gap: the effectiveness of teaming a stroke coordinator with patient's personal physician on the outcome of stroke. Age Ageing. 2008;37(1):32–8.
92. Allen K, Hazelett S, Jarjoura D, Hua K, Wright K, Weinhardt J, et al. A Randomized Trial Testing the Superiority of a Postdischarge Care Management Model for Stroke Survivors. J Stroke Cerebrovasc Dis. 2009;18(6):443–52.
93. Lincoln NB, Francis VM, Lilley SA, Sharma JC, Summerfield M. Evaluation of a stroke family support organiser: a randomized controlled trial. Stroke. 2003;34(1):116–21.
94. Mant J, Carter J, Wade DT, Winner S. Family support for stroke: a randomised controlled trial. Lancet. 2000;356(9232):808–13.
95. Tilling K, Coshall C, McKevitt C, Daneski K, Wolfe C. A family support organiser for stroke patients and their carers: a randomised controlled trial. Cerebrovasc Dis. 2005;20(2):85–91.
96. Mistiaen P, Poot E. Telephone follow-up, initiated by a hospital-based health professional, for postdischarge problems in patients discharged from hospital to home. Cochrane Database Syst Rev. 2006, Issue 4. CD004510.
97. Forster A, Young J, Green J, Patterson C, Wanklyn P, Smith J, et al. Structured re-assessment system at 6 months after a disabling stroke: a randomised controlled trial with resource use and cost study. Age Ageing. 2009;38(5):576–83.
98. Legg LA, Drummond AE, Langhorne P. Occupational therapy for patients with problems in activities of daily living after stroke. Cochrane Database Syst Rev. 2006, Issue 4. CD003585.
99. Sackley C, Wade DT, Mant D, Atkinson JC, Yudkin P, Cardoso K, et al. Cluster randomized pilot controlled trial of an occupational therapy intervention for residents with stroke in UK care homes. Stroke. 2006;37(9):2336–41.
100. Aziz Noor A, Leonardi BJ, Phillips MF, Gladman J, Legg LA, Walker M. Therapy-based rehabilitation services for patients living at home more than one year after stroke. Cochrane Database Syst Rev. 2008, Issue 2. CD005952.
101. States RA, Pappas E, Salem Y. Overground physical therapy gait training for chronic stroke patients with mobility deficits. Cochrane Database Syst Rev. 2009, Issue 3. CD006075.
102. Boysen G, Krarup L-H, Zeng X, Oskedra A, Korv J, Andersen G, et al. ExStroke Pilot Trial of the effect of repeated instructions to improve physical activity after ischaemic stroke: a multinational randomised controlled clinical trial. Br Med J. 2009;339:b2810.
103. Langhammer B, Lindmark B, Stanghelle JK. Stroke patients and long-term training: Is it worthwhile? A randomized comparison of two different training strategies after rehabilitation. Clin Rehabil. 2007;21(6):495–510.
104. Outpatient Service Trialists. Therapy-based rehabilitation services for stroke patients at home. Cochrane Database Syst Rev. 2002, Issue 2. CD002925.
105. Legg L, Drummond A, Leonardi-Bee J, Gladman JRF, Corr S, Donkervoort M, et al. Occupational therapy for patients with problems in personal activities of daily living after stroke: Systematic review of randomised trials. Br Med J. 2007;335(7626):922–5.
106. Cadilhac DA, Ibrahim J, Pearce DC, Ogden KJ, McNeill J, Davis SM, et al. Multicenter comparison of processes of care between stroke units and conventional care wards in Australia. Stroke. 2004;35(5):1035–40.
107. Kehdi EE, Cordato DJ. Outcomes of patients with transient ischaemic attack after hospital admission or discharge from the ED. Med J Aust. 2008;189(1):9–12.
108. Wu CM, Manns BJ, Hill MD, Ghali WA, Donaldson C, Buchan AM. Rapid evaluation after high-risk TIA is associated with lower stroke risk. Can J Neurol Sci. 2009 01;36(4):450–5.
109. Rothwell PM, Giles MF, Chandratheva A, Geraghty MO, Redgrave J, Lovelock C, et al. Effect of urgent treatment of transient ischaemic attack and minor stroke on early recurrent stroke (EXPRESS study): a prospective population-based sequential comparison. Lancet. 2007;370(9596):1432–42.
110. Lavallee PC, Meseguer E, Abboud H, Cabrejo L, Olivot J, Simon OM, M., et al. A transient ischaemic attack clinic with round-the-clock access (SOS-TIA): feasibility and effects. Lancet Neurology 2007;6(11):953–60.
111. Ross MA, Compton S, Medado P, Fitzgerald M, Kilanowski P, O'Neil B. An ED diagnostic protocol for patients with transient ischemic attack: a randomized controlled trial. Ann Emerg Med. 2007;50(2):109–19.
112. Johnston SC, Easton JD. Are patients with acutely recovered cerebral ischemia more unstable? Stroke. 2003;34(10):2446–50.
113. Smith EE, Abdullah AR, Petkovska I, Rosenthal E, Koroshetz WJ, Schwamm LH. Poor outcomes in patients who do not receive intravenous tissue plasminogen activator because of mild or improving ischemic stroke. Stroke. 2005;36(11):2497–9.
114. Aslanyan S, Weir CJ, Johnston CS, Krams M, Grieve AP, Lees KR. The association of post-stroke neurological improvement with risk of subsequent deterioration due to stroke events. Eur J Neurol. 2007;14(1):1–6.
115. Nguyen-Huynh MN, Johnston SC. Is hospitalization after TIA cost-effective on the basis of treatment with tPA? Neurology. 2005;65(11):1799–801.
116. Blight A, Pereira AC, Brown MM. A single consultation cerebrovascular disease clinic is cost effective in the management of transient ischaemic attack and minor stroke. J R Coll Physicians Lond. 2000;34(5):452–5.
117. Widjaja E, Salam SN, Griffiths PD, Kamara C, Doyle C, Venables GS. Is the rapid assessment stroke clinic rapid enough in assessing transient ischaemic attack and minor stroke? J Neurol Neurosurg Psychiatry. 2005;76:145–6.
118. Royal College of Physicians of London. National Sentinel Audit of Stroke 2006. Organisational Audit Report 2006.
119. Senes S, Britt H. A general practice view of cardiovascular disease and diabetes in Australia. Canberra: Australian Institute of Health and Welfare and University of Sydney. 2001.
120. Giles MF, Rothwell PM. Risk of stroke early after transient ischaemic attack: a systematic review and meta-analysis. Lancet neurol. 2007;6(12):1063–72.
121. Giles MF, Rothwell PM. Systematic Review and Pooled Analysis of Published and Unpublished Validations of the ABCD and ABCD2 Transient Ischemic Attack Risk Scores. Stroke. 2010;41(4):667–73.
122. Levack WMM, Taylor K, Siegert RJ, Dean SG. Is goal planning in rehabilitation effective? A systematic review. Clin Rehabil. 2006(20):739–55.
123. Playford ED, Siegert R, Levack W, Freeman J. Areas of consensus and controversy about goal setting in rehabilitation: a conference report. Clin Rehabil. 2009;23(4):334–44.
124. Hoffmann T, McKenna K. Analysis of stroke patients' and carers' reading ability and the content and design of written materials: Recommendations for improving written stroke information. Patient Educ Couns. 2006;60(3):286–93.
125. Smith J, Forster A, House A, Knapp P, Wright J, Young J. Information provision for stroke patients and their caregivers. Cochrane Database Syst Rev. 2008, Issue 2. CD001919.
126. Bhogal SK, Teasell RW, Foley NC, Speechley MR. Community reintegration after stroke. Top Stroke Rehabil. 2003;10(2):107–29.
127. Evans RL, Bishop DS, Matlock AL, Stranahan S, Smith GG, Halar EM. Family interaction and treatment adherence after stroke. Arch Phys Med Rehabil. 1987;68(8):513–7.
128. Evans RL, Bishop DS, Matlock AL, Stranahan S, Halar EM, Noonan WC. Prestroke family interaction as a predictor of stroke outcome. Arch Phys Med Rehabil. 1987;68(8):508–12.

129. Clark MS, Rubenach S, Winsor A. A randomized controlled trial of an education and counselling intervention for families after stroke. Clin Rehabil. 2003;17(7):703–12.

130. Evans R L, Matlock A L, Bishop D S, Stranahan S, C. P. Family intervention after stroke: does counseling or education help? Stroke. 1988;19(10):1243–9.

131. Lee H, Cameron M. Respite care for people with dementia and their carers. Cochrane Database Syst Rev. 2004, Issue 1. CD004396.

132. Thrift AG, Dewey HM, Macdonell RA, McNeil JJ, Donnan GA. Stroke incidence on the east coast of Australia: the North East Melbourne Stroke Incidence Study (NEMESIS). Stroke. 2000;31(9):2087–92.

133. Stevens T, Payne SA, Burton C, Addington-Hall J. Palliative care in stroke: a critical review of the literature. Palliat Med. 2007;21:323–31.

134. Jack C, Jones L, Jack BA, Gambles M, Murphy D, Ellershaw JE. Towards a good death: The impact of the care of the dying pathway in an acute stroke unit. Age Ageing. 2004;33(6):625–6.

135. Goodwin DM, Higginson IJ, Edwards AG, Finlay IG, Cook AM, Hood K, et al. An evaluation of systematic reviews of palliative care services. J Palliat Care. 2002;18(2):77–83.

136. Forte AL, Hill M, Pazder R, Feudtner C. Bereavement care interventions: a systematic review. BMC Palliative Care. 2004; 36; 3(1):3.

137. Gade G, Venohr I, Conner D, Mcgrady K, Beane J, Richardson, et al. Impact of an Inpatient Palliative Care Team: A Randomized Controlled Trial. J Palliat Med. 2008;11(2):180–90.

138. Fellowes D, Wilkinson S, Moore P. Communication skills training for health care professionals working with cancer patients, their families and/or carers. Cochrane Database Syst Rev. 2004, Issue 2. CD003751.

139. Gysels M, Richardson A, Higginson IJ. Communication training for health professionals who care for patients with cancer: a systematic review of effectiveness. Support Care Cancer. 2004;12(10):692–700.

140. Palliative Care Australia. Standards for Providing Quality Palliative Care for all Australians. 2005 [cited; Available from: http://www.pallcare.org.au/Portals/9/docs/Standards%20Palliative%20Care.pdf

141. Jamtvedt G, Young JM, Kristoffersen DT, O'Brien MA, Oxman AD. Audit and feedback: effects on professional practice and health care outcomes. Cochrane Database Syst Rev. 2006, Issue 2. CD000259.

142. Cadilhac DA, Pearce DC, Levi CR, Donnan GA. Improvements in the quality of care and health outcomes with new stroke care units following implementation of a clinician-led, health system redesign programme in New South Wales, Australia. Qual Saf Health Care. 2008;17(5):329–33.

143. Irwin P, Hoffman A, Lowe D, Pearson M, Rudd AG. Improving clinical practice in stroke through audit: Results of three rounds of National Stroke Audit. J Eval Clin Pract. 2005;11(4):306–14.

144. Grimshaw G, Eccles M, Thomas R, MacLennan G, Ramsay C, Fraser C, et al. Toward Evidence-Based Quality Improvement Evidence (and its Limitations) of the Effectiveness of Guideline Dissemination and Implementation Strategies 1966–1998. J Gen Intern Med. 2006;21:S14–20.

145. Wright J, Bibby J, Eastham J, Harrison S, McGeorge M, Patterson C, et al. Multifaceted implementation of stroke prevention guidelines in primary care: cluster-randomised evaluation of clinical and cost effectiveness. Qual Saf Health Care. 2007;16(1):51–9.

146. Strasser D, Falconer J, Stevens A, Uomoto J, Herrin J, Bowen S, et al. Team Training and Stroke Rehabilitation Outcomes: A Cluster Randomized Trial. Arch Phys Med Rehabil. 2008;89(1):10–5.

147. Schwamm LH, Fonarow GC, Reeves MJ, Pan W, Frankel MR, Smith EE. Get With the Guidelines-Stroke is associated with sustained improvement in care for patients hospitalized with acute stroke or transient ischemic attack. Circulation 2009;119(1):107–15.

148. Sprigg N, Machili C, Otter ME, Wilson A, Robinson TG. A systematic review of delays in seeking medical attention after transient ischaemic attack. J Neurol Neurosurg Psychiatry. 2009;80(8):871–5.

149. Muller-Nordhorn J, Wegscheider K, Nolte CH, Jungehulsing GJ, Rossnagel K, Reich A, et al. Population-based intervention to reduce prehospital delays in patients with cerebrovascular events. Arch Intern Med. 2009 14;169(16):1484–90.

150. Davis SM, Martinelli D, Braxton B, Kutrovac K, Crocco T. The impact of the extended parallel process model on stroke awareness: pilot results from a novel study. Stroke. 2009;40(12):3857–63.

151. Jones SP, Jenkinson AJ, Leathley MJ, Watkins CL. Stroke knowledge and awareness: an integrative review of the evidence. Age Ageing. 2010;39(1):11–22.

152. Fogle CC, Oser CS, Troutman TP, McNamara M, Williamson AP, Keller M, et al. Public education strategies to increase awareness of stroke warning signs and the need to call 911. J Public Health Manag Pract. 2008;14(3):e17–22.

153. Marx JJ, Nedelmann M, Haertle B, Dieterich M, Eicke BM. An educational multimedia campaign has differential effects on public stroke knowledge and care-seeking behavior. J Neurol. 2008;255(3):378–84.

154. Chan YF, Lavery R, Fox N, Kwon R, Zinzuwadia S, Massone R, et al. Effect of an educational video on emergency department patient stroke knowledge. J Emerg Med. 2008;34(2):215–20.

155. Kleindorfer DO, Miller R, Moomaw CJ, Alwell K, Broderick JP, Khoury J, et al. Designing a message for public education regarding stroke: does FAST capture enough stroke? Stroke. 2007;38(10):2864–8.

156. Leifeld T, Rau R, Mensing M. Community stroke knowledge: A new information strategy using a joint project of the public health service and the hairdressers' guild of the Wesel district. J Public Health. 2009;17(6):371–6.

157. Bell M, Lommel T, Fischer JG, Lee JS, Reddy S, Johnson MA. Improved recognition of heart attack and stroke symptoms after a community-based intervention for older adults, Georgia, 2006–2007. Prev Chronic Dis 2009;6(2):A41.

158. Alberts MJ, Perry A, Dawson DV, Bertels C. Effects of public and professional education on reducing the delay in presentation and referral of stroke patients. Stroke. 1992;23:352–6.

159. Barsan WG, Brott TG, Broderick JP, Haley ECJ, Levy DE, Marler JR. Urgent therapy for acute stroke: effects of a stroke trial on untreated patients. Stroke. 1994;25:2132–7.

160. Hodgson CP, Lindsay P, Rubini F. Can mass media influence emergency department visits for stroke? Stroke. 2007;38(7):2115–22.

161. Kleindorfer DO, Miller R, Moomaw CJ, Alwell K, Broderick JP, Khoury J, et al. Designing a message for public education regarding stroke: Does FAST capture enough stroke? Stroke. 2007;38(10):2864–8.

162. Mosley I, Nicol M, Donnan G, Patrick I, Kerr F, Dewey H. The impact of ambulance practice on acute stroke care. Stroke. 2007;38(10):2765–70.

163. Kidwell CS, Starkman S, Eckstein M, Weems K, Saver JL. Identifying stroke in the field: Prospective validation of the Los Angeles Prehospital Stroke Screen (LAPSS). Stroke. 2000;31(1):71–6.

164. Nor AM, McAllister C, Louw SJ, Dyker AG, Davis M, Jenkinson D, et al. Agreement between ambulance paramedic- and physician-recorded neurological signs with Face Arm Speech Test (FAST) in acute stroke patients. Stroke. 2004;35(6):1355–9.

165. Kothari RU, Pancioli A, Liu T, Brott T, Broderick J. Cincinnati Prehospital Stroke Scale: reproducibility and validity. Ann Emerg Med. 1999;33(4):373–8.

166. Silverman IE, Beland DK, Chhabra J, McCullough LD. The "drip-and-ship" approach: starting IV t-PA for acute ischemic stroke at outside hospitals prior to transfer to a regional stroke center. Conn Med. 2005;69(10):613–20.

167. Rymer MM, Thurtchley D, Summers D, America Brain and Stroke Institute Stroke T. Expanded modes of tissue plasminogen activator delivery in a comprehensive stroke center increases regional acute stroke interventions. Stroke. 2003;34(6):e58–60.

168. Albers GW, Caplan LR, Easton JD, Fayad PB, Mohr JP, Saver JL, et al. Transient ischemic attack – Proposal for a new definition. N ENGL J MED. 2002;347(21):1713–6.

169. Wu CM, McLaughlin K, Lorenzetti DL, Hill MD, Manns BJ, Ghali WA. Early risk of stroke after transient ischemic attack: A systematic review and meta-analysis. Arch Intern Med. 2007;167(22):2417–22.

170. Johnston SC, Rothwell PM, Nguyen-Huynh MN, Giles MF, Elkins JS, Bernstein AL, et al. Validation and refinement of scores to predict very early stroke risk after transient ischaemic attack. Lancet. 2007;369(9558):283–92.

171. Bray JE, Coughlan K, Bladin C. Can the ABCD Score be dichotomised to identify high-risk patients with transient ischaemic attack in the emergency department? Emerg Med J. 2007;24(2):92–5.

172. Weimar C, Benemann J, Huber R, Mieck T, Kaendler S, Grieshammer S, et al. Long-term mortality and risk of stroke after transient ischemic attack: a hospital-based cohort study. J Neurol. 2009;256(4):639–44.

173. Amarenco P, Labreuche J, Lavallée PC, Meseguer E, Cabrejo L, Slaoui T, et al. Does ABCD2 score below 4 allow more time to evaluate patients with a transient ischemic attack? Stroke. 2009;40(9):3091–5.

174. Sheehan OC, Merwick A, Kelly LA, Hannon N, Marnane M, Kyne L, et al. Diagnostic usefulness of the ABCD2 score to distinguish transient ischemic attack and minor ischemic stroke from noncerebrovascular events: the North Dublin TIA Study. Stroke. 2009;40(11):3449–54.

175. Ong MEH, Chan YH, Lin WP, Chung WL. Validating the ABCD2 Score for predicting stroke risk after transient ischemic attack in the ED. Am J Emerg Med. 2010;28(1):44–8.

176. Koton S, Rothwell PM. Performance of the ABCD and ABCD2 scores in TIA patients with carotid stenosis and atrial fibrillation. Cerebrovasc Dis. 2007;24(2):231–5.

177. Quinn TJ, Cameron AC, Dawson J, Lees KR, Walters MR. ABCD2 scores and prediction of noncerebrovascular diagnoses in an outpatient population: a case-control study. Stroke. 2009;40(4): 749–53.

178. Calvet D, Touzé E, Oppenheim C, Turc G, Meder JF, Mas JL. DWI lesions and TIA etiology improve the prediction of stroke after TIA. Stroke. 2009 Jan;40(1):187–92.

179. Purroy F, Begue R, Quilez A, Pinol-Ripoll G, Sanahuja J, Brieva L, et al. The california, abcd, and unified abcd2 risk scores and the presence of acute ischemic lesions on diffusion-weighted imaging in tia patients. Stroke. 2009;40(6):2229–32.

180. Eliasziw M, Kennedy J, Hill MD, Buchan AM, Barnett HJM. Early risk of stroke after a transient ischemic attack in patients with internal carotid artery disease. Can Med Assoc J. 2004;170(7):1105–9.

181. Ois A, Gomis M, Rodríguez-Campello A, J. C-GE, Pont-Sunyer C. Factors associated with a high risk of recurrence in patients with transient ischemic attack or minor stroke. Stroke. 2008;39(6):1717–21.

182. Calvet D, Touze E, Oppenheim C, Turc G, Meder JF, Mas JL. DWI lesions and TIA etiology improve the prediction of stroke after TIA. Stroke. 2009;40(1):187–92.

183. Cucchiara BL, Messe SR, Sansing L, MacKenzie L, Taylor RA, Pacelli J, et al. D-dimer, magnetic resonance imaging diffusion-weighted imaging, and ABCD2 score for transient ischemic attack risk stratification. J Stroke Cerebrovasc Dis. 2009;18(5):367–73.

184. Douglas VC, Johnston CM, Elkins J, Sidney S, Gress DR, Johnston SC. Head Computed Tomography Findings Predict Short-Term Stroke Risk after Transient Ischemic Attack. Stroke. 2003;34(12):2894–8.

185. Wardlaw JM, Keir SL, Seymour J, Lewis S, Sandercock PA, Dennis MS, et al. What is the best imaging strategy for acute stroke? Health Technology Assessment. 2004;8(1):iii, ix-x, 1–180.

186. Redgrave JNE, Coutts SB, Schulz UG, Briley D, Rothwell PM. Systematic review of associations between the presence of acute ischemic lesions on diffusion-weighted imaging and clinical predictors of early stroke risk after transient ischemic attack. Stroke. 2007;38(5):1482–8.

187. Coutts SB, Hill MD, Campos CR, Choi YB, Subramaniam S, Kosior JC, et al. Recurrent events in transient ischemic attack and minor stroke: What events are happening and to which patients? Stroke. 2008;39(9):2461–6.

188. Ay H, Arsava EM, Johnston SC, Vangel M, Schwamm LH, Furie KL, et al. Clinical- and imaging-based prediction of stroke risk after transient ischemic attack: The CIP model. Stroke. 2009;40(1):181–6.

189. Asimos AW, Rosamond WD, Johnson AM, Price MF, Rose KM, Murphy CV, et al. Early diffusion weighted MRI as a negative predictor for disabling stroke after ABCD2 score risk categorization in transient ischemic attack patients. Stroke. 2009;40(10):3252–7.

190. Price CJ, Blacker DJ, Grimley RS, Dewey HM, Gerraty RP, Koblar SA, et al. National survey of management of transient ischaemic attack in Australia: take immediate action. Med J Aust. 2009;191(1):17–20.

191. Cucchiara B, Kasner SE, Tanne D, Levine SR, Demchuk A, Messe SR, et al. Factors associated with intracerebral hemorrhage after thrombolytic therapy for ischemic stroke: pooled analysis of placebo data from the Stroke-Acute Ischemic NXY Treatment (SAINT) I and SAINT II Trials. Stroke. 2009;40(9):3067–72.

192. Cucchiara BL, Messe SR, Sansing L, MacKenzie L, Taylor RA, Pacelli J, et al. Lipoprotein-associated phospholipase A2 and C-reactive protein for risk-stratification of patients with TIA. Stroke. 2009;40(7):2332–6.

193. Wardlaw JM, Chappell FM, Stevenson M, De Nigris E, Thomas S, Gillard J, et al. Accurate, practical and cost-effective assessment of carotid stenosis in the UK. Health Technology Assessment. 2006;10(30):1–200.

194. Wardlaw JM, Stevenson MD, Chappell F, Rothwell PM, Gillard J, Young G, et al. Carotid artery imaging for secondary stroke prevention: Both imaging modality and rapid access to imaging are important. Stroke. 2009b November;40(11):3511–7.

195. Hand PJ, Haisma JA, Kwan J, Lindley RI, Lamont B, Dennis MS, et al. Interobserver agreement for the bedside clinical assessment of suspected stroke. Stroke. 2006;37(3):776–80.

196. Goldstein LB, Simel DL. Is this patient having a stroke? JAMA. 2005;293(19):2391–402.

197. Kothari R, Barsan W, Brott T, et al. Frequency and accuracy of prehospital diagnosis of stroke. Stroke. 1995;26(937–41):937–41.

198. Ferro JM, Pinto AN, Falcao I, et al. Diagnosis of stroke by the non-neurologist: a validation study. Stroke. 1998;29:1106–9.

199. Morgenstern LB, Lisabeth LD, Mecozzi AC, Smith MA, Longwell PJ, McFarling DA, et al. A population-based study of acute stroke and TIA diagnosis. Neurology. 2004;62(6):895–900.

200. Martin PJ, Young G, Enevoldson TP, Humphrey PR. Overdiagnosis of TIA and minor stroke: experience at a regional neurovascular clinic. QJM. 1997;90(12):759–63.

201. Muir KW, Weir CJ, Murray GD, Povey C, Lees KR. Comparison of neurological scales and scoring systems for acute stroke prognosis. Stroke. 1996;27(10):1817–20.

202. Weimar C, Goertler M, Röther J, Ringelstein EB, Darius H, Nabavi DG. Systemic Risk Score Evaluation in Ischemic Stroke Patients (SCALA): A prospective cross sectional study in 85 German stroke units. J Neurol. 2007;254(11):1562–8.

203. Christensen H, Boysen G, Truelsen T. The Scandinavian stroke scale predicts outcome in patients with mild ischemic stroke. Cerebrovasc Dis. 2005;20(1):46–8.

204. Nor AM, Davis J, Sen B, Shipsey D, Louw SJ, Dyker AG, et al. The Recognition of Stroke in the Emergency Room (ROSIER) scale: development and validation of a stroke recognition instrument. Lancet neurol. 2005;4(11):727–34.

205. Jackson A, Deasy C, Geary UM, Plunkett PK, Harbison J. Validation of the use of the ROSIER stroke recognition instrument in an Irish emergency department. Irish Journal of Medical Science. 2008 Sep;177(3):189–92.

206. Weimar C, König IR, Kraywinkel K, Ziegler A, Diener HC, German Stroke Study Collaboration. Age and National Institutes of Health Stroke Scale Score within 6 hours after onset are accurate predictors of outcome after cerebral ischemia: development and external validation of prognostic models. Stroke. 2004;35(1):158–62.

207. Brazzelli M, Sandercock PA, Chappell FM, Celani MG, Righetti E, Arestis N, et al. Magnetic resonance imaging versus computed tomography for detection of acute vascular lesions in patients presenting with stroke symptoms. Cochrane Database Syst Rev. 2009, Issue 4. CD007424.

208. Debrey SM, Yu H, Lynch JK, Lövblad KO, Wright VL, Janket SJ, et al. Diagnostic accuracy of magnetic resonance angiography for internal carotid artery disease: a systematic review and meta-analysis. Stroke. 2008;39(8):2237–48.

209. Chappell FM, Wardlaw JM, Young GR, Gillard JH, Roditi GH, Yip B. Carotid artery stenosis: accuracy of noninvasive tests – individual patient data meta-analysis. Radiology. 2009;251(2):493–502.

210. Agency for Healthcare Research and Q. Effectiveness and cost-effectiveness of echocardiography and carotid imaging in the management of stroke. 2002. Available from http://www.ahrq.gov/clinic/tp/strokemantp.htm

211. Kapral MK, Silver FL, Feightner JW, Goldbloom R, Wayne Elford R, Labrecque M, et al. Preventive health care, 1999 update: 2. Echocardiography for the detection of a cardiac source of embolus in patients with stroke. Can Med Assoc J. 1999;161(8):989–95.

212. De Bruijn SFTM, Agema WRP, Lammers GJ, Van Der Wall EE, Wolterbeek R, Holman ER, et al. Transesophageal echocardiography is superior to transthoracic echocardiography in management of patients of any age with transient ischemic attack or stroke. Stroke. 2006;37(10):2531–4.

213. Debrey SM, Yu H, Lynch JK, Lovblad KO, Wright VL, Janket SJ, et al. Diagnostic accuracy of magnetic resonance angiography for internal carotid artery disease: a systematic review and meta-analysis. Stroke. 2008;38(8):2237–48.

214. Liao J, Khalid Z, Scallan C, Morillo C, O'Donnell M. Noninvasive cardiac monitoring for detecting paroxysmal atrial fibrillation or flutter after acute ischemic stroke: A systematic review. Stroke. 2007;38(11):2935–40.

215. Whiteley W, Chong WL, Sengupta A, Sandercock P. Blood markers for the prognosis of ischemic stroke: a systematic review. Stroke. 2009;40(5):e380–9.

216. Haapaniemi E, Tatlisumak T. Is D-dimer helpful in evaluating stroke patients? A systematic review. Acta Neurol Scand. 2009;119(3):141–50.

217. Laskowitz DT, Kasner SE, Saver J, Remmel KS, Jauch EC. Clinical usefulness of a biomarker-based diagnostic test for acute stroke: The Biomarker Rapid Assessment in Ischemic Injury (BRAIN) study. Stroke. 2009;40(1):77–85.

218. Vanni S, Polidori G, Pepe G, Chiarlone M, Albani A, Pagnanelli A, et al. Use of Biomarkers in Triage of Patients with Suspected Stroke. J Emerg Med. 2009;Feb 12.

219. Sibon I, Rouanet F, Meissner W, Orgogozo JM. Use of the Triage Stroke Panel in a neurologic emergency service. Am J Emerg Med. 2009;27(5):558–62.

220. The ATLANTIS ECASS and NINDS rt-PA Study Group Investigators. Association of outcome with early stroke treatment: Pooled analysis of ATLANTIS, ECASS, and NINDS rt-PA stroke trials. Lancet. 2004;363(9411):768–74.

221. Lansberg MG, Schrooten M, Bluhmki E, Thijs VN, Saver JL. Treatment time-specific number needed to treat estimates for tissue plasminogen activator therapy in acute stroke based on shifts over the entire range of the modified rankin Scale. Stroke. 2009;40(6):2079–84.

222. Hacke W, Kaste M, Bluhmki E, Brozman M, Davalos A, Guidetti D, et al. Thrombolysis with alteplase 3 to 4.5 hours after acute ischemic stroke. New England Journal of Medicine. 2008;359(13):1317–29.

223. Lansberg MG, Bluhmki E, Thijs VN, Saver JL. Efficacy and safety of tissue plasminogen activator 3 to 4.5 hours after acute ischemic stroke:A metaanalysis. Stroke. 2009;40(7):2438–41.

224. Graham GD. Tissue plasminogen activator for acute ischemic stroke in clinical practice: a meta-analysis of safety data. Stroke. 2003;34(12):2847–50.

225. Wahlgren N, Ahmed N, Davalos A, Ford GA, Grond M, Hacke W, et al. Thrombolysis with alteplase for acute ischaemic stroke in the Safe Implementation of Thrombolysis in Stroke-Monitoring Study (SITS-MOST): an observational study. Lancet. 2007;369(9558):275–82.

226. Wahlgren N, Ahmed N, Dávalos A, Hacke W, Millán M, Muir K, et al. SITS investigators.Thrombolysis with alteplase 3-4.5 h after acute ischaemic stroke (SITS-ISTR): an observational study. Lancet. 2008;372(9646):1303–9.

227. Ahmed N, Wahlgren N, Brainin M, Castillo J, Ford GA, Kaste M, et al. Relationship of blood pressure, antihypertensive therapy, and outcome in ischemic stroke treated with intravenous thrombolysis: retrospective analysis from Safe Implementation of Thrombolysis in Stroke-International Stroke Thrombolysis Register (SITS-ISTR). Stroke. 2009;40(7):2442–9.

228. Butcher K, Christensen S, Parsons M, De Silva DA, Ebinger M, Levi C, et al. Postthrombolysis blood pressure elevation is associated with hemorrhagic transformation. Stroke. 2010;41(1):72–7.

229. Levi C, Lindley R, Smith B, Bladin C, Parsons M, Read S, et al. The implementation of intravenous tissue plasminogen activator in acute ischaemic stroke – a scientific position statement from the National Stroke Foundation and the Stroke Society of Australasia. Intern Med J. 2009;39:317–24.

230. Davis SM, Donnan GA, Parsons MW, Levi C, Butcher KS, Peeters A, et al. Effects of alteplase beyond 3 h after stroke in the Echoplanar Imaging Thrombolytic Evaluation Trial (EPITHET): a placebo-controlled randomised trial. Lancet Neurol. 2008;7(4):299–309.

231. Mishra NK, Albers GW, Davis SM, Donnan GA, Furlan AJ, Hacke W, et al. Mismatch-based delayed thrombolysis: A meta-analysis. Stroke. 2010;41(1):e25–e33.

232. Schellinger PD, Thomalla G, Fiehler J, Köhrmann M, Molina CA, Neumann-Haefelin T. MRI-based and CT-based thrombolytic therapy in acute stroke within and beyond established time windows: an analysis of 1210 patients. Stroke. 2007;38(10):2640–5.

233. Tsivgoulis G, Eggers J, Ribo M, Perren F, Saqqur M, Rubiera M, et al. Safety and efficacy of ultrasound-enhanced thrombolysis: a comprehensive review and meta-analysis of randomized and nonrandomized studies. Stroke. 2010 Feb;41(2):280–7.

234. Butcher K, Christensen S, Parsons M, De Silva DA, Ebinger M, Levi C, et al. Postthrombolysis blood pressure elevation is associated with hemorrhagic transformation. Stroke. 2010;41(1):72–7.

235. Furlan A, Higashida R, Weschler L, Gent M, Rowley H, Kase C, et al. Intraarterial Pro-Urokinase for acute ischaemic stroke. The PROACT II Study: A randomised controlledd trial. JAMA. 1999;282:2003–11.

236. Lindsberg PJ, Mattle HP. Therapy of basilar artery occlusion: a systematic analysis comparing intra-arterial and intravenous thrombolysis. Stroke. 2006;37(3):922–8.

237. Macleod MR, Davis SM, Mitchell PJ, Gerraty RP, Fitt G, Hankey GJ, et al. Results of a multicentre, randomised controlled trial of intra-arterial urokinase in the treatment of acute posterior circulation Ischaemic stroke. Cerebrovasc Dis. 2005;20(1):12–7.

238. Schonewille WJ, Wijman CA, Michel P, Rueckert CM, Weimar C, Mattle HP. Treatment and outcomes of acute basilar artery occlusion in the Basilar Artery International Cooperation Study (BASICS): a prospective registry study. Lancet Neurol. 2009 Aug;8(8):724–30.

239. Stead LG, Gilmore RM, Bellolio MF, Rabinstein AA, Decker WW. Percutaneous clot removal devices in acute ischemic stroke: A systematic review and meta-analysis. Arch Neurol. 2008;65(8):1024–30.

240. Sandercock PAG, Counsell C, Gubitz GJ, Tseng MC. Antiplatelet therapy for acute ischaemic stroke. Cochrane Database Syst Rev. 2008, Issue 3. CD000029.

241. Kennedy J, Hill MD, Ryckborst KJ, Eliasziw M, Demchuk AM, Buchan AM. Fast assessment of stroke and transient ischaemic attack to prevent early recurrence (FASTER): a randomised controlled pilot trial. Lancet Neurol. 2007;6(11):961–9.

242. Dengler R, Diener H-C, Schwartz A, Grond M, Schumacher H, Machnig T, et al. Early treatment with aspirin plus extended-release dipyridamole for transient ischaemic attack or ischaemic stroke within 24 h of symptom onset (EARLY trial): a randomised, open-label, blinded-endpoint trial. Lancet neurol. 2010;9(2):159–66.
243. Sandercock PAG, Counsell C, Kamal AK. Anticoagulants for acute ischaemic stroke. Cochrane Database Syst Rev. 2008, Issue 4. CD000024.
244. Paciaroni M, Agnelli G, Micheli S, Caso V. Efficacy and safety of anticoagulant treatment in acute cardioembolic stroke: A meta-analysis of randomized controlled trials. Stroke. 2007;38(2):423–30.
245. Lyrer P, Engelter S. Antithrombotic drugs for carotid artery dissection. Cochrane Database Syst Rev. 2003, Issue 3. CD000255.
246. Sandercock PAG CC, Gubitz GJ, Tseng MC. Antiplatelet therapy for acute ischaemic stroke. Cochrane Database Syst Rev. 2008, Issue 3. CD000029.
247. Sandercock PAG, Counsell C, Tseng MC. Low-molecular-weight heparins or heparinoids versus standard unfractionated heparin for acute ischaemic stroke. Cochrane Database Syst Rev. 2008, Issue 3. CD000119.
248. Mistri AK, Robinson TG, Potter JF. Pressor therapy in acute ischemic stroke: systematic review. Stroke. 2006;37(6):1565–71.
249. Willmot M, Leonardi-Bee J, Bath P. High Blood Pressure in Acute Stroke and Subsequent Outcome: A Systematic review. Hypertension. 2004;43:18–24.
250. Geeganage CM, Bath PMW. Relationship between therapeutic changes in blood pressure and outcomes in acute stroke: A metaregression. Hypertension. 2009;54(4):775–81.
251. Perez MI, Musini VM, Wright JM. Effect of early treatment with anti-hypertensive drugs on short and long-term mortality in patients with an acute cardiovascular event. Cochrane Database Syst Rev. 2009, Issue 4. CD006743.
252. Geeganage C, Bath PM, Geeganage C, Bath PMW. Interventions for deliberately altering blood pressure in acute stroke. Cochrane Database Syst Rev. 2008, Issue 4. CD000039.
253. Potter JF, Robinson TG, Ford GA, Mistri A, James M, Chernova J, et al. Controlling hypertension and hypotension immediately post-stroke (CHHIPS): a randomised, placebo-controlled, double-blind pilot trial. Lancet Neurol. 2009;8(1):48–56.
254. Anderson CS, Huang Y, Wang JG, Arima H, Neal B, Peng B, et al. Intensive blood pressure reduction in acute cerebral haemorrhage trial (INTERACT): a randomised pilot trial. Lancet neurol. 2008;7(5):391–9.
255. Morley NCD, Berge E, Cruz Flores S, Whittle IR. Surgical decompression for cerebral oedema in acute ischaemic stroke. Cochrane Database Syst Rev. 2002, Issue 3. CD003435.
256. Vahedi K, Hofmeijer J, Juettler E, Vicaut E, George B, Algra A, et al. Early decompressive surgery in malignant infarction of the middle cerebral artery: a pooled analysis of three randomised controlled trials. Lancet neurol. 2007;6(3):215–22.
257. Cruz-Flores S, Diamond AL. Angioplasty for intracranial artery stenosis. Cochrane Database Syst Rev. 2006, Issue 3. CD004133.
258. Qizilbash N, Lewington SL, Lopez-Arrieta JM. Corticosteroids for acute ischaemic stroke. Cochrane Database Syst Rev. 2002, Issue 4. CD000064.
259. Righetti E, Celani MG, Cantisani T, Sterzi R, Boysen G, Ricci S. Glycerol for acute stroke. Cochrane Database Syst Rev. 2004, Issue 2. CD000096.
260. Bereczki D, Fekete I, Prado GF, Liu M. Mannitol for acute stroke. Cochrane Database Syst Rev. 2007, Issue 3. CD001153.
261. Hofmeijer J, Van Der Worp HB, Kappelle LJ. Treatment of space-occupying cerebral infarction. Crit Care Med. 2003;31(2):617–25.
262. Davis SM, Broderick J, Hennerici M, Brun NC, Diringer MN, Mayer SA, et al. Hematoma growth is a determinant of mortality and poor outcome after intracerebral hemorrhage. Neurology. 2006;66(8): 1175–81.
263. Al-Shahi Salman R. Haemostatic drug therapies for acute spontaneous intracerebral haemorrhage. Cochrane Database Syst Rev. 2009, Issue 4. CD005951.
264. You H, Al-Shahi R. Haemostatic drug therapies for acute primary intracerebral haemorrhage. Cochrane Database Syst Rev. 2006, Issue 3. CD005951.
265. Haley EC, Thompson JL, Levin B, Davis S, Lees KR, Pittman JG, et al. Gavestinel does not improve outcome after acute intracerebral hemorrhage: an analysis from the GAIN International and GAIN Americas studies. Stroke. 2005;36(5):1006–10.
266. Secades JJ, Alvarez-Sabin J, Rubio F, Lozano R, Davalos A, Castillo J, et al. Citicoline in intracerebral haemorrhage: a double-blind, randomized, placebo-controlled, multi-centre pilot study. Cerebrovasc Dis. 2006;21(5–6):380–5.
267. Misra UK, Kalita J, Ranjan P, Mandal SK. Mannitol in intracerebral hemorrhage: A randomized controlled study. J Neurol Sci. 2005;234(1–2):41–5.
268. Aguilar MI, Hart RG, Kase CS, Freeman WD, Hoeben BJ, Garcia RC, et al. Treatment of warfarin-associated intracerebral hemorrhage: Literature review and expert opinion. Mayo Clinic Proceedings. 2007;82(1):82–92.
269. Steiner T, Rosand J, Diringer M. Intracerebral hemorrhage associated with oral anticoagulant therapy: Current practices and unresolved questions. Stroke. 2006;37(1):256–62.
270. Freeman WD, Brott TG, Barrett KM, Castillo PR, Deen Jr HG, Czervionke LF, et al. Recombinant factor VIIa for rapid reversal of warfarin anticoagulation in acute intracranial hemorrhage. Mayo Clinic Proceedings. 2004;79(12):1495–500.
271. Brody DL, Aiyagari V, Shackleford AM, Diringer MN. Use of recombinant factor VIIa in patients with warfarin-associated intracranial hemorrhage. Neurocrit Care. 2005;2(3):263–7.
272. Prasad K, Mendelow AD, Gregson B. Surgery for primary supratentorial intracerebral haemorrhage. Cochrane Database Syst Rev. 2008, Issue 4. CD000200.
273. Mendelow AD, Gregson BA, Fernandes HM, Murray GD, Teasdale GM, Terence Hope D, et al. Early surgery versus initial conservative treatment in patients with spontaneous supratentorial intracerebral haematomas in the International Surgical Trial in Intracerebral Haemorrhage (STICH): A randomised trial. Lancet. 2005;365(9457):387–97.
274. Teernstra OP, Evers SM, Kessels AH. Meta analyses in treatment of spontaneous supratentorial intracerebral haematoma. Acta Neurochir. 2006;148(5):521–8.
275. The European Stroke Initiative Writing Committee and the Writing Committee for the EUSI Executive Committee. Recommendations for the Management of Intracranial Haemorrhage – Part I: Spontaneous Intracerebral Haemorrhage. Cerebrovasc Dis. 2006;22:294–316.
276. Sulter G, Elting JW, Langedijk M, Maurits NM, De Keyser J. Admitting acute ischemic stroke patients to a stroke care monitoring unit versus a conventional stroke unit: a randomized pilot study. Stroke. 2003;34(1):101–4.
277. Silva Y, Puigdemont M, Castellanos M, Serena J, Suner RM, Garcia MM, et al. Semi-intensive monitoring in acute stroke and long-term outcome. Cerebrovasc Dis. 2005;19(1):23–30.
278. Cavallini A, Micieli G, Marcheselli S, Quaglini S. Role of monitoring in management of acute ischemic stroke patients. Stroke. 2003;34(11):2599–603.
279. Roquer J, Rodriguez-Campello A, Gomis M, Jimenez-Conde J, Cuadrado-Godia E, Vivanco R, et al. Acute stroke unit care and early neurological deterioration in ischemic stroke. J Neurol. 2008;255(7):1012–7.
280. Sulter G, Elting JW, Langedijk M, Maurits NM, De Keyser J. Admitting acute ischemic stroke patients to a stroke care monitoring unit versus a conventional stroke unit: a randomized pilot study. Stroke. 2003;34(1):101–4.

281. Bennett MH, Wasiak J, Schnabel A, Kranke P, French C. Hyperbaric oxygen therapy for acute ischaemic stroke. . Cochrane Database Syst Rev. 2009, Issue 4. CD004954.
282. Ronning OM, Guldvog B. Should stroke victims routinely receive supplemented oxygen? A quasi-randomised controlled trial. Stroke. 1999;30:2033–7.
283. Singhal AB, Banner T, Roccatagliata L, Koroshetz WJ, Schaefer PW, Lo EH, et al. A pilot study of normobaric oxygen therapy in acute ischemic stroke. Stroke. 2005;36(4):797–802.
284. Roffe C, Sills S, Pountain SJ, Allen M. A Randomized Controlled Trial of the Effect of Fixed-dose Routine Nocturnal Oxygen Supplementation on Oxygen Saturation in Patients with Acute Stroke. J Stroke Cerebrovasc Dis. 2010;19(1):29–35.
285. Capes SE, Hunt D, Malmberg K, Pathak P, Gerstein HC. Stress hyperglycemia and prognosis of stroke in nondiabetic and diabetic patients: a systematic overview. Stroke. 2001;32(10):2426–32.
286. Gray CS, Scott JF, French JM, Alberti KG, O'Connell JE. Prevalence and prediction of unrecognised diabetes mellitus and impaired glucose tolerance following acute stroke. Age Ageing. 2004;33(1):71–7.
287. Kernan WN, Viscoli CM, Inzucchi SE, Brass LM, Bravata DM, Shulman GI, et al. Prevalence of abnormal glucose tolerance following a transient ischemic attack or ischemic stroke. Arch Intern Med. 2005;165(2):227–33.
288. Allport L, Baird T, Butcher K, Macgregor L, Prosser J, Colman P, et al. Frequency and temporal profile of poststroke hyperglycemia using continuous glucose monitoring. Diabetes Care. 2006;29(8):1839–44.
289. Matz K, Keresztes K, Tatschl C, Nowotny M, Dachenhausenm A, Brainin M, et al. Disorders of glucose metabolism in acute stroke patients: an underrecognized problem. Diabetes Care. 2006;29(4):792–7.
290. Vermeer SE, Sandee W, Algra A, Koudstaal PJ, Kappelle LJ, Dippel DW, et al. Impaired glucose tolerance increases stroke risk in nondiabetic patients with transient ischemic attack or minor ischemic stroke. Stroke. 2006;37(6):1413–7.
291. Walters MR, Weir CJ, Lees KR. A randomised, controlled pilot study to investigate the potential benefit of intervention with insulin in hyperglycaemic acute ischaemic stroke patients. Cerebrovasc Dis. 2006;22(2–3):116–22.
292. Scott JF, Robinson GM, French JM, O'Connell JE, Alberti KGMM, Gray CS. Glucose potassium insulin infusions in the treatment of acute stroke patients with mild to moderate hyperglycemia: The glucose insulin in stroke trial (GIST). Stroke. 1999;30(4):793–9.
293. Bruno A, Kent TA, Coull BM, Shankar RR, Saha C, Becker KJ, et al. Treatment of hyperglycemia in ischemic stroke (THIS): A randomized pilot trial. Stroke. 2008;39(2):384–9.
294. Kreisel SH, Berschin UM, Hammes HP, Leweling H, Bertsch T, Hennerici MG, et al. Pragmatic management of hyperglycaemia in acute ischaemic stroke: Safety and feasibility of intensive intravenous insulin treatment. Cerebrovasc Dis. 2009;27(2):167–75.
295. Johnston KC, Hall CE, Kissela BM, Bleck TP, Conaway MR, Investigators G. Glucose Regulation in Acute Stroke Patients (GRASP) trial: a randomized pilot trial. Stroke. 2009;40(12):3804–9.
296. Gray CS, Hildreth AJ, Sandercock PA, O'Connell JE, Johnston DE, Cartlidge NE, et al. Glucose-potassium-insulin infusions in the management of post-stroke hyperglycaemia: the UK Glucose Insulin in Stroke Trial (GIST-UK). Lancet neurol. 2007;6(5):397–406.
297. Wiener RS, Wiener DC, Larson RJ. Benefits and risks of tight glucose control in critically ill adults: a meta-analysis. JAMA. 2008;300(8):933–44.
298. Ladurner G, Kalvach P, Moessler H. Neuroprotective treatment with Cerebrolysin in patients with acute stroke: A randomised controlled trial. J Neural Transm. 2005;112(3):415–28.
299. Lees KR, Muir KW, Ford I, Reid L, Mendelow AD, Sandercock PAG, et al. Magnesium for acute stroke (Intravenous Magnesium Efficacy in Stroke trial): Randomised controlled trial. Lancet. 2004;363(9407):439–45.
300. Krams M, Lees KR, Hacke W, Grieve AP, Orgogozo JM, Ford GA. Acute Stroke Therapy by Inhibition of Neutrophils (ASTIN): An Adaptive Dose-Response Study of UK-279,276 in Acute Ischemic Stroke. Stroke. 2003;34(11):2543–8.
301. Muir KW, Lees KR. Excitatory amino acid antagonists for acute stroke. Cochrane Database Syst Rev. 2003, Issue 3. CD001244.
302. Diener HC, Lees KR, Lyden P, Grotta J, Davalos A, Davis SM, et al. NXY-059 for the treatment of acute stroke: pooled analysis of the SAINT I and II Trials. Stroke. 2008;39(6):1751–8.
303. Lyden PD, Shuaib A. Safety and tolerability of NXY-059 for acute intracerebral hemorrhage: The CHANT trial. Stroke. 2007;38(8):2262–9.
304. Diener HC, Schneider D, Lampl Y, Bornstein NM, Kozak A, Rosenberg G, et al. DP-b99, a membrane-activated metal ion chelator, as neuroprotective therapy in ischemic stroke. Stroke. 2008;39(6):1774–8.
305. Bath PMW. Theophylline, aminophylline, caffeine and analogues for acute ischaemic stroke. Cochrane Database Syst Rev. 2004, Issue 3. CD000211.
306. Palesch YY, Hill MD, Ryckborst KJ, Tamariz D, Ginsberg MD. The ALIAS Pilot Trial: a dose-escalation and safety study of albumin therapy for acute ischemic stroke–II: neurologic outcome and efficacy analysis. Stroke. 2006;37(8):2107–14.
307. Otomo E, Tohgi H, Kogure K, Hirai S, Takakura K, Terashi A, et al. Effect of a novel free radical scavenger, edaravone (MCI-186), on acute brain infarction: Randomized, placebo-controlled, double-blind study at multicenters. Cerebrovasc Dis. 2003;15(3):222–9.
308. Lampl Y, Boaz M. Minocycline treatment in acute stroke: an open-label, evaluator-blinded study. Neurology. 2007;69(14):1404–10.
309. Pettigrew LC, Kasner SE, Albers GW, Gorman M, Grotta JC, Sherman DG, et al. Safety and tolerability of arundic acid in acute ischemic stroke. J Neurol Sci. 2006;251(1-2):50–6.
310. Dávalos A, Castillo J, Alvarez-Sabín J, Secades JJ, Mercadal J, López S. Oral citicoline in acute ischemic stroke: an individual patient data pooling analysis of clinical trials. Stroke. 2002;33(12):2850–7.
311. De Georgia MA, Krieger DW, Abou-Chebl A, Devlin TG, Jauss M, Davis SM, et al. Cooling for acute ischemic brain damage (COOL AID): A feasibility trial of endovascular cooling. Neurology. 2004;63(2):312–7.
312. Dippel DWJ, van Breda EJ, van der Worp HB, van Gemert HMA, Meijer RJ, Kappelle LJ, et al. Effect of paracetamol (acetaminophen) and ibuprofen on body temperature in a cute ischemic stroke PISA, a phase II double-blind, randomized, placebo-controlled trial. BMC Cardiovasc Disord. 2003;3:2.
313. Kasner SE, Wein T, Piriyawat P, Villar Cordova CE, Chalela JA, Krieger DW, et al. Acetaminophen for altering body temperature in acute stroke: a randomized clinical trial. Stroke. 2002;33(1):130–4.
314. Wang H, Olivero W, Lanzino G, Elkins W, Rose J, Honings D, et al. Rapid and selective cerebral hypothermia achieved using a cooling helmet. J Neurosurg. 2004;100(2):272–7.
315. den Hertog HM, van der Worp HB, van Gemert HMA, Algra A, Kappelle LJ, van Gijn J, et al. The Paracetamol (Acetaminophen) In Stroke (PAIS) trial: a multicentre, randomised, placebo-controlled, phase III trial. Lancet Neurol. 2009;8(5):434–40.
316. den Hertog HM, van der Worp HB, van Gemert HM, Algra A, Kappelle LJ, van Gijn J. The Paracetamol (Acetaminophen) In Stroke (PAIS) trial: a multicentre, randomised, placebo-controlled, phase III trial. Lancet Neurol. 2009;8(5):434–40.
317. Blanco M, Nombela F, Castellanos M. Statin treatment withdrawal in ischemic stroke: a controlled randomized study. Neurology. 2007;69(9):904–10.
318. Montaner J, Perea-Gainza M, Delgado P, Ribó M, Chacón P, Rosell A, et al. Etiologic diagnosis of ischemic stroke subtypes with plasma biomarkers. Stroke. 2008;39(8):2280–7.
319. Montaner J, Chacon P. Simvastatin in the acute phase of ischemic stroke: a safety and efficacy pilot trial. Eur J Neurol. 2008;15(1):82–90.

320. Doesborgh SJ, van de Sandt-Koenderman MW, Dippel DW, van Harskamp F, Koudstaal PJ, Visch-Brink EG. Effects of semantic treatment on verbal communication and linguistic processing in aphasia after stroke: a randomized controlled trial. Stroke. 2004;35(1):141–6.

321. Rose M, Douglas J, Matyas T. The comparative effectiveness of gesture and verval treatments for a specific phonologic naming impairment. Aphasiology. 2002;16(10/11):1001–30.

322. Greer DM, Funk SE, Reaven NL, Ouzounelli M, Uman GC. Impact of fever on outcome in patients with stroke and neurologic injury: A comprehensive meta-analysis. Stroke. 2008;39(11):3029–35.

323. Langhorne P, Waganaar R, Partridge C. Medical complications in hospitalised stroke patients: a multicentre study. Stroke. 2000;31:1223–9.

324. Mayer SA, Kowalski RG, Presciutti M, Osiapkovich ND, McGann E, Fitzsimmons BF, et al. Clinical trial of a novel surface cooling system for fever control in neurocritical care patients. Crit Care Med. 2004;32(12):2508–15.

325. Schwarz S, Al-Shajlawi F, Sick C, Meairs S, Hennerici MG. Effects of prophylactic antibiotic therapy with mezlocillin plus sulbactam on the incidence and height of fever after severe acute ischemic stroke: The Mannheim Infection in Stroke Study (MISS). Stroke. 2008;39(4): 1220–7.

326. Camilo O, Goldstein LB. Seizures and epilepsy after ischaemic stroke. Stroke 2004;35(6):1769–75.

327. Tudur Smith C, Marson AG, Clough HE, Williamson PR. Carbamazepine versus phenytoin monotherapy for epilepsy. Cochrane Database Syst Rev. 2002, Issue 2. CD001911.

328. Tudur Smith C, Marson AG, Williamson PR. Carbamazepine versus phenobarbitone monotherapy for epilepsy. Cochrane Database Syst Rev. 2003, Issue 1. CD001904.

329. Gamble C, Williamson PR, Chadwick DW, Marson AG. A meta-analysis of individual patient responses to lamotrigine or carbamazepine monotherapy. Neurology. 2006;66:1310–17.

330. Kwan J, Wood E. Antiepileptic drugs for the primary and secondary prevention of seizures after stroke. Cochrane Database Syst Rev. 2009, Issue 1. CD005398.

331. Gilad R, Sadeh M, Rapoport A, Dabby R, Boaz M, Lampl Y. Monotherapy of lamotrigine versus carbamazepine in patients with poststroke seizure. Clin Neuropharmacol. 2007;30:189–95.

332. Rowan AJ, Ramsay RE, Collins JF, Pryor F, Boardman KD, Uthman BM, et al. New onset geriatric epilepsy: a randomized study of gabapentin, lamotrigine and carbamazepine. Neurology 2005;64:1868–73.

333. Marson AG, Al-Kharusi AM, Alwaidh M, Appleton R, Baker GA, Chadwick DW, et al. The SANAD study of effectiveness of carbamazepine, gabapentin, lamotrigine, oxcarbazepine, or topiramate for treatment of partial epilepsy: an unblinded randomised controlled trial. Lancet. 2007;369:1000–15.

334. Zhang SH, Liu M, Asplund K, Li L. Acupuncture for acute stroke. Cochrane Database Syst Rev. 2005, Issue 2. CD003317.

335. Li W, Liu M, Feng S, Wu B, Zhang S, Yang W, et al. Acanthopanax for acute ischaemic stroke. Cochrane Database Syst Rev. 2009, Issue 3. CD007032.

336. Yan T, Hui-Chan CW. Transcutaneous electrical stimulation on acupuncture points improves muscle function in subjects after acute stroke: a randomized controlled trial. J Rehabil Med. 2009;41(5).

337. Cao W, Liu W, Wu T, Zhong D, Liu G. Dengzhanhua preparations for acute cerebral infarction. Cochrane Database Syst Rev. 2008, Issue 4. CD005568.

338. Tan Y, Liu M, Wu B. Puerarin for acute ischaemic stroke. Cochrane Database Syst Rev. 2008, Issue 1. CD004955.

339. Zeng X, Liu M, Yang Y, Li Y, Asplund K. Ginkgo biloba for acute ischaemic stroke. Cochrane Database Syst Rev. 2005, Issue 4. CD003691.

340. Wu HM, Tang JL, Lin XP, Lau J, Leung PC, Woo J, et al. Acupuncture for stroke rehabilitation. Cochrane Database Syst Rev. 2006, Issue 3. CD004131.

341. Wu B, Liu M, Zhang S. Dan Shen agents for acute ischaemic stroke. Cochrane Database Syst Rev. 2007, Issue 2. CD004295.

342. Chen X, Zhou M, Li Q, Yang J, Zhang Y, Zhang D, et al. Sanchi for acute ischaemic stroke. Cochrane Database Syst Rev. 2008, Issue 4. CD006305.

343. Zhuo Q, Yang X, Wu T, Liu G, Zhou L. Tongxinluo capsule for acute stroke. Cochrane Database Syst Rev. 2008, Issue 4. CD004584.

344. Yan T, Hui-Chan CWY. Transcutaneous electrical stimulation on acupuncture points improves muscle function in subjects after acute stroke: A randomized controlled trial. J Rehabil Med. 2009;41(5):312–6.

345. Hardie K, Hankey GJ, Jamrozik K, Broadhurst RJ, Anderson C. Ten-year risk of first recurrent stroke and disability after first-ever stroke in the Perth Community Stroke Study. Stroke. 2004;35(3):731–5.

346. Paul SL, Thrift AG, Donnan GAJ-. Smoking as a crucial independent determinant of stroke. Tob Induc Dis. 2004;2(2):67–80.

347. Kurth T, Kase CS, Berger K, Gaziano JM, Cook NR, Buring JE. Smoking and risk of hemorrhagic stroke in women. Stroke. 2003;34(12):2792–5.

348. Kurth T, Kase CS, Berger K, Schaeffner ES, Buring JE, Gaziano JM. Smoking and the risk of hemorrhagic stroke in men. Stroke. 2003;34(5):1151–5.

349. Shinton R, Beevers G. Meta-analysis of relation between cigarette smoking and stroke. Br Med J. 1989;298(6676):789–94.

350. Ariesen MJ, Claus SP, Rinkel GJ, Algra A. Risk factors for intracerebral hemorrhage in the general population: a systematic review. Stroke. 2003;34(8):2060–5.

351. Wannamethee SG, Shaper AG, Whincup PH, Walker M. Smoking cessation and the risk of stroke in middle-aged men. JAMA. 1995;274(2):155–60.

352. Kawachi I, Colditz GA, Stampfer MJ, Willett WC, Manson JE, Rosner B, et al. Smoking cessation and decreased risk of stroke in women. JAMA. 1992;269(2):232–6.

353. Silagy C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev. 2004, Issue 3. CD000146.

354. Hughes JR, Stead LF, Lancaster T. Antidepressants for smoking cessation. Cochrane Database Syst Rev. 2007, Issue 1. CD000031.

355. Cahill K, Stead LF, Lancaster T. Nicotine receptor partial agonists for smoking cessation. Cochrane Database Syst Rev. 2007, Issue 1. CD006103.

356. Stead LF, Lancaster T, . Group behaviour therapy programmes for smoking cessation. Cochrane Database Syst Rev. 2005, Issue 2. CD001007.

357. Sinclair HK, Bond CM, Stead LF. Community pharmacy personnel interventions for smoking cessation. Cochrane Database Syst Rev. 2004, Issue 1. CD003698.

358. Rice VH, Stead LF. Nursing interventions for smoking cessation. Cochrane Database Syst Rev. 2004, Issue 1. CD001188.

359. Lancaster T, Stead LF. Individual behavioural counselling for smoking cessation. Cochrane Database Syst Rev. 2005, Issue 2. CD001292.

360. Stead LF, Perera R, Lancaster T. Telephone counselling for smoking cessation. Cochrane Database Syst Rev. 2006, Issue 3. CD002850.

361. He FJ, MacGregor GA. Effect of longer-term modest salt reduction on blood pressure. Cochrane Database Syst Rev. 2004, Issue 1. CD004937.

362. Hooper L, Bartlett C, Davey Smith G, Ebrahim S. Advice to reduce dietary salt for prevention of cardiovascular disease. Cochrane Database Syst Rev. 2004, Issue 1. CD003656.

363. He FJ, Nowson CA, MacGregor GA. Fruit and vegetable consumption and stroke: Meta-analysis of cohort studies. Lancet. 2006;367(9507):320–6.

364. Dauchet L, Amouyel P, Dallongeville J. Fruit and vegetable consumption and risk of stroke: a meta-analysis of cohort studies. Neurology. 2005;65(8):1193–7.

365. Hooper L, Summerbell CD, Higgins JP, Thompson RL, Capps NE, Smith GD, et al. Dietary fat intake and prevention of cardiovascular disease: systematic review. Br Med J. 2001;322(7289):757–63.

366. Sacks FM, Svetkey LP, Vollmer WM, Appel LJ, Bray GA, Harsha D, et al. Effects on blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet. DASH-Sodium Collaborative Research Group. N Engl J Med. 2001;344(1):3–10.

367. Appel LJ, Moore TJ, Obarzanek E, Vollmer WM, Svetkey LP, Sacks FM, et al. A clinical trial of the effects of dietary patterns on blood pressure. DASH Collaborative Research Group. N Engl J Med. 1997;336(16):1117–24.

368. Barzi F, Woodward M, Marfisi RM, Tavazzi L, Valagussa F, Marchioli R. Mediterranean diet and all-causes mortality after myocardial infarction: results from the GISSI-Prevenzione trial. Eur J Clin Nutr. 2003;57(4):604–11.

369. de Lorgeril M, Salen P, Martin JL, Monjaud I, Delaye J, Mamelle N. Mediterranean diet, traditional risk factors, and the rate of cardiovascular complications after myocardial infarction: final report of the Lyon Diet Heart Study. Circulation. 1999;99(6):779–85.

370. Hooper L. Dietetic guidelines: diet in secondary prevention of cardiovascular disease. J Hum Nutr Diet. 2001;14(4):297–305.

371. Jula A, Marniemi J, Huupponen R, Virtanen A, Rastas M, Ronnemaa T. Effects of diet and simvastatin on serum lipids, insulin, and antioxidants in hypercholesterolemic men: a randomized controlled trial. JAMA. 2002;287(5):598–605.

372. Sdringola S, Nakagawa K, Nakagawa Y, Yusuf SW, Boccalandro F, Mullani N, et al. Combined intense lifestyle and pharmacologic lipid treatment further reduce coronary events and myocardial perfusion abnormalities compared with usual-care cholesterol-lowering drugs in coronary artery disease. J Am Coll Cardiol. 2003;41(2):263–72.

373. Mulrow CD, Chiquette E, Angel L, Cornell J, Summerbell C, Anagnostelis B, et al. Dieting to reduce body weight for controlling hypertension in adults. Cochrane Database Syst Rev. 1998, Issue 4. CD000484.

374. Toole JF, Malinow MR, Chambless LE, Spence JD, Pettigrew LC, Howard VJ, et al. Lowering homocysteine in patients with ischemic stroke to prevent recurrent stroke, myocardial infarction, and death: the Vitamin Intervention for Stroke Prevention (VISP) randomized controlled trial. JAMA. 2004;291(5):565–75.

375. Heart Protection Study Collaborative G. Effects of cholesterol-lowering with simvastatin on stroke and other major vascular events in 20536 people with cerebrovascular disease or other high-risk conditions. Lancet. 2004;363:757–67.

376. National Health and Medical Research Council. Dietary Guidelines for Australian Adults. Canberra: National Health and Medical Research Council 2003.

377. Lee CD, Folsom AR, Blair SN. Physical activity and stroke risk: a meta-analysis. Stroke. 2003;34(10):2475–81.

378. Wendel-Vos GC, Schuit AJ, Feskens EJ, Boshuizen HC, Verschuren WM, Saris WH, et al. Physical activity and stroke. A meta-analysis of observational data. Int J Epidemiol. 2004;33(4):787–98.

379. Pang MYC, Eng JJ, Dawson AS, Gylfadottir S. The use of aerobic exercise training in improving aerobic capacity in individuals with stroke: a meta-analysis. Clin Rehabil. 2006;20(2):97–111.

380. Mead GE, Greig CA, Cunningham I, Lewis SJ, Dinan S, Saunders DH, et al. Stroke: A randomized trial of exercise or relaxation. J Am Geriatr Soc. 2007;55(6):892–9.

381. Whelton SP, Chin A, Xin X, He J. Effect of aerobic exercise on blood pressure: A meta-analysis of randomized, controlled trials. Ann Intern Med. 2002;136(7):493–503.

382. Thomas DE, Elliott EJ, Naughton GA. Exercise for type 2 diabetes mellitus. Cochrane Database Syst Rev. 2006, Issue 3. CD002968.

383. Sims J, Hill K, Hunt S, Haralambous B, Brown A, Engel L, et al. National physical activity recommendations for older Australians: Discussion document. Canberra: Australian Government Department of Health and Ageing; 2006.

384. Department of Health and Aged Care. National Physical Activity Guidelines for Adults. Canberra; 1999.

385. Winter Y, Rohrmann S, Linseisen J, Lanczik O, Ringleb PA, Hebebrand J, et al. Contribution of obesity and abdominal fat mass to risk of stroke and transient ischemic attacks. Stroke. 2008;39(12):3145–51.

386. Curioni C, André C, Veras R. Weight reduction for primary prevention of stroke in adults with overweight or obesity. Cochrane Database Syst Rev. 2006, Issue 4. CD006062.

387. Reynolds K, Lewis B, Nolen JD, Kinney GL, Sathya B, He J, et al. Alcohol consumption and risk of stroke: a meta-analysis. JAMA. 2003;289(5):579–88.

388. National Health and Medical Research Council. Australian guidelines to reduce health risks from drinking alcohol. Canberra: Commonwealth of Australia 2009.

389. Ovbiagele B, Saver JL, Fredieu A, Suzuki S, Selco S, Rajajee V, et al. In-hospital initiation of secondary stroke prevention therapies yields high rates of adherence at follow-up. Stroke. 2004;35(12):2879–83.

390. Touze E, Coste J, Voicu M, Kansao J, Masmoudi R, Doumenc B, et al. Importance of in-hospital initiation of therapies and therapeutic inertia in secondary stroke prevention: IMplementation of prevention after a cerebrovascular evenT (IMPACT) study. Stroke. 2008;39(6):1834–43.

391. Rubak S, Sandbaek A, Lauritzen T, Christensen B. Motivational interviewing: a systematic review and meta-analysis. Br J Gen Pract. 2005;55(513):305–12.

392. Pignone M, Mulrow CD. Evidence based management of hypertension: Using cardiovascular risk profiles to individualise hypertensive treatment. Br Med J. 2001;322(7295):1164–6.

393. Brunner E, Rees K, Ward K, Burke M, Thorogood M. Dietary advice for reducing cardiovascular risk. Cochrane Database Syst Rev. 2007, Issue 4. CD002128.

394. Glader EL, Sjölander M, Eriksson M, Lundberg M. Persistent Use of Secondary Preventive Drugs Declines Rapidly During the First 2 Years After Stroke. Stroke. 2010;41:397–401.

395. Haynes RB, Ackloo E, Sahota N, McDonald Heather P, Yao X. Interventions for enhancing medication adherence. Cochrane Database Syst Rev. 2008, Issue 2. CD000011.

396. Heneghan CJ, Glasziou P, Perera R. Reminder packaging for improving adherence to self-administered long-term medications. Cochrane Database Syst Rev. 2006, Issue 1. CD005025.

397. Chiu CC, Wu SS, Lee PY, Huang YC, Tan TY, Chang KC. Control of modifiable risk factors in ischemic stroke outpatients by pharmacist intervention: An equal allocation stratified randomized study. J Clin Pharm Ther. 2008;33(5):529–35.

398. McManus JA, Craig A, McAlpine C, Langhorne P, Ellis G. Does behaviour modification affect post-stroke risk factor control? Three-year follow-up of a randomized controlled trial. Clin Rehabil. 2009;23(2):99–105.

399. Lakhan SE, Sapko MT. Blood pressure lowering treatment for preventing stroke recurrence: a systematic review and meta-analysis. Int Arch Med. 2009;2(1):30.

400. Rashid P, Leonardi-Bee J, Bath P. Blood pressure reduction and secondary prevention of stroke and other vascular events: a systematic review. Stroke. 2003;34(11):2741–8.

401. Yusuf S, Diener HC, Sacco RL, Cotton D, Ounpuu S, Lawton WA, et al. Telmisartan to prevent recurrent stroke and cardiovascular events. N Eng J Med. 2008;359(12):1225–37.

402. Nazir FS, Overell JR, Bolster A, Hilditch TE, Reid JL, Lees KR. The effect of losartan on global and focal cerebral perfusion and on renal function in hypertensives in mild early ischaemic stroke. Journal of hypertension. 2004;22(5):989–95.

403. Nazir FS, Overell JR, Bolster A, Hilditch TE, Lees KR. Effect of perindopril on cerebral and renal perfusion on normotensives in mild early ischaemic stroke: a randomized controlled trial. Cerebrovascular Diseases. 2005;19(2):77–83.

404. Antithrombotic Trialists Collaboration. Collaborative meta-analysis of randomised trials of antiplatelet therapy for prevention of death, myocardial infarction, and stroke in high risk patients. Br Med J. 2002;324:71–86.

405. Serebruany VL, Malinin AI, Eisert RM, Sane DC. Risk of bleeding complications with antiplatelet agents: meta-analysis of 338,191 patients enrolled in 50 randomized controlled trials. Am J Hematol. 2004;75(1):40–7.

406. Reid C, Nelson MR, Shiel L, Chew D, Connor G, F. D. Australians at Risk: Management of Cardiovascular Risk Factors in the REACH Registry. Heart Lung Circ. 2008;17:114–8.

407. Algra A, Van Gijn J. Aspirin at any dose above 30 mg offers only modest protection after cerebral ischaemia. J Neurol Neurosurg Psychiatry. 1996;60(2):197–9.

408. Halkes PHA, Gray LJ, Bath PMW, Diener HC, Guiraud-Chaumeil B, Yatsu FM, et al. Dipyridamole plus aspirin versus aspirin alone in secondary prevention after TIA or stroke: a meta-analysis by risk. J Neurol Neurosurg Psychiatry. 2008;79(11):1218–23.

409. De Schryver ELLM, Algra A, van Gijn J. Dipyridamole for preventing stroke and other vascular events in patients with vascular disease. Cochrane Database Syst Rev. 2007, Issue 3. CD001820.

410. Sudlow CL, Mason G, Maurice JB, Wedderburn CJ, Hankey GJ. Thienopyridine derivatives versus aspirin for preventing stroke and other serious vascular events in high vascular risk patients. Cochrane Database Syst Rev. 2009, Issue 4. CD001246.

411. Sacco RL, Diener HC, Yusuf S, Cotton D, Ounpuu S, Lawton WA, et al. Aspirin and extended-release dipyridamole versus clopidogrel for recurrent stroke. N Engl J Med. 2008;359(12):1238–51.

412. Diener HC, Bogousslavsky J, Brass LM, Cimminiello C, Csiba L, Kaste M, et al. Aspirin and clopidogrel compared with clopidogrel alone after recent ischaemic stroke or transient ischaemic attack in high-risk patients (MATCH): randomised, double-blind, placebo-controlled trial. Lancet. 2004;364(9431):331–7.

413. Bhatt DL, Fox KAA, Hacke W, Berger PB, Black HR, Boden WE, et al. Clopidogrel and aspirin versus aspirin alone for the prevention of atherothrombotic events. N Engl J Med. 2006;354(16):1706–17.

414. Active Investigators, Connolly SJ, Pogue J, Hart RG, Hohnloser SH, Pfeffer M. Effect of Clopidogrel Added to Aspirin in Patients with Atrial Fibrillation. N Engl J Med. 2009;360(20):2066–78.

415. Sandercock PAG, Gibson LM, Liu M. Anticoagulants for preventing recurrence following presumed non-cardioembolic ischaemic stroke or transient ischaemic attack. Cochrane Database Syst Rev. 2009, Issue 2. CD000248.

416. Saxena R, Koudstaal P. Anticoagulants versus antiplatelet therapy for preventing stroke in patients with nonrheumatic atrial fibrillation and a history of stroke or transient ischemic attack. Cochrane Database Syst Rev. 2004, Issue 4. CD000187.

417. Saxena R, Koudstaal PJ. Anticoagulants for preventing stroke in patients with nonrheumatic atrial fibrillation and a history of stroke or transient ischaemic attack. Cochrane Database Syst Rev. 2004, Issue 1. CD000185.

418. Mant J, Hobbs FD, Fletcher K, Roalfe A, Fitzmaurice D, Lip GY, et al. Warfarin versus aspirin for stroke prevention in an elderly community population with atrial fibrillation (the Birmingham Atrial Fibrillation Treatment of the Aged Study, BAFTA): a randomised controlled trial. Lancet. 2007;370(9586):493–503.

419. Connolly SJ, Ezekowitz MD, Yusuf S, Eikelboom J, Oldgren J, Parekh A, et al. Dabigatran versus warfarin in patients with atrial fibrillation. N Engl J Med. 2009;361(12):1139–51.

420. Reynolds MW, Fahrbach K, Hauch O, Wygant G, Estok R, Cella C, et al. Warfarin anticoagulation and outcomes in patients with atrial fibrillation: a systematic review and metaanalysis. Chest. 2004;126(6):1938–45.

421. Connolly SJ, Pogue J, Eikelboom J, Flaker G, Commerford P, Franzosi MG, et al. Benefit of oral anticoagulant over antiplatelet therapy in atrial fibrillation depends on the quality of international normalized ratio control achieved by centers and countries as measured by time in therapeutic range. Circulation. 2008;118(20):2029–37.

422. Dolan G, Smith LA, Collins S, Plumb JM. Effect of setting, monitoring intensity and patient experience on anticoagulation control: a systematic review and meta-analysis of the literature. Curr Med Res Opin. 2008;24(5):1459–72.

423. Gattellari M, Worthington JM, Zwar NA, Middleton S. The management of non-valvular atrial fibrillation (NVAF) in Australian general practice: bridging the evidence-practice gap. A national, representative postal survey. BMC Fam Pract. 2008;9:62.

424. Hankey GJ. Role of lipid-modifying therapy in the prevention of initial and recurrent stroke. Curr Opin Lipidol. 2002;13(6):645–51.

425. Cholesterol Treatment Trialists' Collaborators. Efficacy and safety of cholesterol-lowering treatment:prospective meta-analysis of data from 90,056 participants in 14 randomised trials of statins. Lancet. 2005;366:1267–78.

426. Law M, Rudnicka AR. Statin Safety: A Systematic Review. Am J Cardioly. 2006;97(8 SUPPL. 1):S52–S60.

427. De Denus S, Spinler SA, Miller K, Peterson AM. Statins and Liver Toxicity: A Meta-Analysis. Pharmacotherapy. 2004;24(5):584–91.

428. The Stroke Prevention by Aggressive Reduction in Cholesterol Levels (SPARCL) Investigators. High-Dose Atorvastatin after Stroke or Transient Ischemic Attack. N Engl J Med. 2006;355(6):549–559.

429. Vergouwen MD, de Haan RJ, Vermeulen M, Roos YB. Statin treatment and the occurrence of hemorrhagic stroke in patients with a history of cerebrovascular disease. Stroke. 2008;39(2):497–502.

430. Amarenco P, Labreuche J. Lipid management in the prevention of stroke: review and updated meta-analysis of statins for stroke prevention. Lancet neurol. 2009;8(5):453–63.

431. Manktelow BN, Potter JF. Interventions in the management of serum lipids for preventing stroke recurrence. Cochrane Database Syst Rev. 2009, Issue 3. CD002091.

432. Sanossian N, Saver JL, Liebeskind DS, Kim D, Razinia T, Ovbiagele B. Achieving target cholesterol goals after stroke: Is in-hospital statin initiation the key? Arch Neurol. 2006;63(8):1081–3.

433. Rothwell PM, Eliasziw M, Gutnikov SA, Fox AJ, Taylor DW, Mayberg MR, et al. Analysis of pooled data from the randomised controlled trials of endarterectomy for symptomatic carotid stenosis. Lancet. 2003;361(9352):107–16.

434. Ringleb PA, Chatellier G, Hacke W, Favre J-P, Bartoli J-M, Eckstein HH, et al. Safety of endovascular treatment of carotid artery stenosis compared with surgical treatment: a meta-analysis. J Vasc Surg. 2008;47(2):350–5.

435. Ederle J, Featherstone R, Brown M. Percutaneous transluminal angioplasty and stenting for carotid artery stenosis. Cochrane Database Syst Rev. 2007, Issue 4. CD000515.

436. Eckstein HH, Ringleb P, Allenberg JR, Berger J, Fraedrich G, Hacke W, et al. Results of the Stent-Protected Angioplasty versus Carotid Endarterectomy (SPACE) study to treat symptomatic stenoses at 2 years: a multinational, prospective, randomised trial. Lancet neurol. 2008;7(10):893–902.

437. Rothwell PM, Eliasziw M, Gutnikov SA, Warlow CP, Barnett HJM. Endarterectomy for symptomatic carotid stenosis in relation to clinical subgroups and timing of surgery. Lancet. 2004;363(9413):915–24.

438. Cina CS, Clase CM, Haynes RB. Carotid endarterectomy for symptomatic carotid stenosis. Cochrane Database Syst Rev. 1999, Issue 3. CD001081.

439. Rerkasem K, Rothwell PM. Systematic review of the operative risks of carotid endarterectomy for recently symptomatic stenosis in relation to the timing of surgery. Stroke. 2009;40(10):e564–72

440. Chambers BR, Donnan GA. Carotid endarterectomy for asymptomatic carotid stenosis. Cochrane Database Syst Rev. 2005, Issue 4. CD001923.

441. Abbott AL. Medical (nonsurgical) intervention alone is now best for prevention of stroke associated with asymptomatic severe carotid stenosis: results of a systematic review and analysis. Stroke. 2009;40(10):e573–83.

442. Marquardt L, Geraghty OC, Mehta Z, Rothwell PM. Low risk of ipsilateral stroke in patients with asymptomatic carotid stenosis on best medical treatment: a prospective, population-based study. Stroke. 2010;41(1):11–7.

443. Rothwell PM, Slattery J, Warlow CP. A systematic review of the risks of stroke and death due to endarterectomy for symptomatic carotid stenosis. Stroke. 1996;27(2):260–5.

444. Engelter S, Lyrer P. Antiplatelet therapy for preventing stroke and other vascular events after carotid endarterectomy. Cochrane Database Syst Rev. 2003, Issue 3. CD001458.

445. Payne DA, Jones CI, Hayes PD, Thompson MM, London NJ, Bell PR, et al. Beneficial Effects of Clopidogrel Combined with Aspirin in Reducing Cerebral Emboli in Patients Undergoing Carotid Endarterectomy. Circulation. 2004;109(12):1476–81.

446. Markus HS, Droste DW, Kaps M, Larrue V, Lees KR, Siebler M, et al. Dual antiplatelet therapy with clopidogrel and aspirin in symptomatic carotid stenosis evaluated using doppler embolic signal detection: The clopidogrel and aspirin for reduction of emboli in symptomatic carotid stenosis (CARESS) trial. Circulation. 2005;111(17):2233–40.

447. Petty GW, Brown RD, Whisnant JP, Sicks JD, O'Fallon WM, Wiebers DO. Survival and recurrence after first cerebral infarction: a population-based study in Rochester, Minnesota, 1975 through 1989. Neurology. 1998;50(1):208–16.

448. Hillen T, Coshall C, Tilling K, Rudd AG, McGovern R, Wolfe CD. Cause of stroke recurrence is multifactorial: patterns, risk factors, and outcomes of stroke recurrence in the South London Stroke Register. Stroke. 2003;34(6):1457–63.

449. Messe SR, Silverman IE, Kizer JR, Homma S, Zahn C, Gronseth G, et al. Practice Parameter: Recurrent stroke with patent foramen ovale and atrial septal aneurysm. Report of the Quality Standards Subcommittee of the American Academy of Neurology. Neurology. 2004;62(7):1042–50.

450. Di Tullio MR, Sacco RL, Sciacca RR, Jin Z, Homma S. Patent Foramen Ovale and the Risk of Ischemic Stroke in a Multiethnic Population. J Am Coll Cardiol. 2007 20;49(7):797–802.

451. Almekhlafi MA, Wilton SB, Rabi DM, Ghali WA, Lorenzetti DL, Hill MD. Recurrent cerebral ischemia in medically treated patent foramen ovale: a meta-analysis. Neurology. 2009 Jul 14;73(2):89–97.

452. Khairy P, O'Donnell CP, Landzberg MJ. Transcatheter Closure versus Medical Therapy of Patent Foramen Ovale and Presumed Paradoxical Thromboemboli: A Systematic Review. Ann Intern Med. 2003;139(9):753–60.

453. Homma S, Sacco RL, Di Tullio MR, Sciacca RR, Mohr JP. Effect of medical treatment in stroke patients with patent foramen ovale: Patent foramen ovale in Cryptogenic Stroke Study. Circulation. 2002;105(22):2625–31.

454. Harrer JU, Wessels T, Franke A, Lucas S, Berlit P, Klotzsch C. Stroke recurrence and its prevention in patients with patent foramen ovale. Can J Neurol Sci. 2006;33(1):39–47.

455. Schuchlenz HW, Weihs W, Berghold A, Lechner A, Schmidt R. Secondary prevention after cryptogenic cerebrovascular events in patients with patent foramen ovale. Int J Cardiol. 2005;101(1):77–82.

456. Windecker S, Wahl A, Nedeltchev K, Arnold M, Schwerzmann M, Seiler C, et al. Comparison of medical treatment with percutaneous closure of patent foramen ovale in patients with cryptogenic stroke. J Am Coll Cardiol. 2004;44(4):750–8.

457. Hu FB, Grodstein F. Postmenopausal hormone therapy and the risk of cardiovascular disease: the epidemiologic evidence. Am J Cardiol. 2002;90(1A):26F–9F.

458. Gabriel Sanchez R, Sanchez Gomez Luis M, Carmona L, Roqué i Figuls M, Bonfill Cosp X. Hormone replacement therapy for preventing cardiovascular disease in post-menopausal women. 2005, Issue 2. CD002229.

459. Sare GM, Gray LJ, Bath PM. Association between hormone replacement therapy and subsequent arterial and venous vascular events: a meta-analysis. Evid Based Med. 2008;29(16):2031–41.

460. Magliano DJ, Sophie J. Hormone therapy and cardiovascular disease: a systematic review and meta-analysis. BJOG. 2006;113(1):5–14.

461. Bath PM, Gray LJ. Association between hormone replacement therapy and subsequent stroke: a meta-analysis. Br Med J. 2005;330(7487):342.

462. Baillargeon J, McClish D, Essah P, Nestler J. Association between the current use of low-dose oral contraceptives and cardiovascular arterial disease: a meta-analysis. J Clin Endocrinol Metab. 2005;90(7): 3863–70.

463. Chan W, Ray J, Wai E, Ginsburg S, Hannah M, Corey P, et al. Risk of stroke in women exposed to low-dose oral contraceptives: a critical evaluation of the evidence. Arch Intern Med. 2004;164(7):741–7.

464. Siritho S, Thrift A, McNeil J, You R, Davis S, Donnan G, et al. Risk of ischemic stroke among users of the oral contraceptive pill: The Melbourne Risk Factor Study (MERFS) Group. Stroke. 2003;34(7):1575–80.

465. Chakhtoura Z, Canonico M, Gompel A, Thalabard JC, Scarabin PY, Plu-Bureau G. Progestogen-only contraceptives and the risk of stroke: A meta-analysis. Stroke. 2009;40(4):1059–62.

466. Schurks M, Rist PM, Bigal ME, Buring JE, Lipton RB, Kurth T. Migraine and cardiovascular disease: systematic review and meta-analysis. Br Med J. 2009;339:b3914.

467. Bernhart. Inactive and alone: physical activity within the first 14 days of acute stroke unit care. Stroke. 2004;35(4):1005–9.

468. Lincoln NB, Parry RH, Vass CD. Randomized, controlled trial to evaluate increased intensity of physiotherapy treatment of arm function after stroke. Stroke. 1999;30(3):573–9.

469. Royal College of Physicians. National clinical guideline for stroke. The Intercollegiate Stroke Working Party. 3rd ed. London 2008.

470. Kwakkel G, van Peppen R, Wagenaar RC, Wood Dauphinee S, Richards C, Ashburn A, et al. Effects of augmented exercise therapy time after stroke: a meta-analysis. Stroke. 2004;35(11):2529–39.

471. Wevers L, van de Port I, Vermue M, Mead G, Kwakkel G. Effects of task-oriented circuit class training on walking competency after stroke: a systematic review. Stroke. 2009;40(7):2450–9.

472. McClellan R, Ada L. A six-week, resource-efficient mobility program after discharge from rehabilitation improves standing in people affected by stroke: placebo-controlled, randomised trial. Aust J Physiother. 2004;50(3):163–7.

473. French B, Leathley M, Sutton C, McAdam J, Thomas L, Forster A, et al. A systematic review of repetitive functional task practice with modelling of resource use, costs and effectiveness. Health Technology Assessment. 2008;12(30):1–140.

474. Dromerick AW, Lang CE, Birkenmeier RL, Wagner JM, Miller JP, Videen TO, et al. Very early constraint-induced movement during stroke rehabilitation (VECTORS): a single-center RCT. Neurology. 2009;73(3):195–201.

475. Bhogal SK, Teasell R, Speechley M. Intensity of aphasia therapy, impact on recovery. Stroke. 2003;34(4):987–93.

476. Cherney LR, Patterson JP, Raymer A, Frymark T, Schooling T. Evidence-based systematic review: effects of intensity of treatment and constraint-induced language therapy for individuals with stroke-induced aphasia. J Speech Lang Hear Res. 2008;51(5):1282–99.

477. Bakheit AMO, Shaw S, Carrington S, Griffiths S. The rate and extent of improvement with therapy from the different types of aphasia in the first year after stroke. Clin Rehabil. 2007;21(10):941–9.

478. Godecke E. Efficacy of aphasia therapy in the acute setting. Perth: Curtin University of Technology; 2009.

479. Carnaby G, Hankey GJ, Pizzi J. Behavioural intervention for dysphagia in acute stroke: a randomised controlled trial. Lancet neurol. 2006;5(1):31–7.

480. Bernhardt J, Chitravas N, Meslo IL, Thrift AG, Indredavik B. Not all stroke units are the same: a comparison of physical activity patterns in Melbourne, Australia, and Trondheim, Norway. Stroke. 2008;39(7):2059–65.

481. Indredavik B, Bakke F, Slordahl SA, Rokseth R, Haheim LL. Treatment in a combined acute and rehabilitation stroke unit: Which aspects are most important? Stroke. 1999;30(5):917–23.

482. Bernhardt J, Thuy MNT, Collier JM, Legg LA. Very early versus delayed mobilisation after stroke. Cochrane Database Syst Rev. 2009, Issue 1. CD006187.

483. Cumming TB, Collier J, Thrift AG, Bernhardt J. The effect of very early mobilisation after stroke on psychological well-being. J Rehabil Med. 2008;40(8):609–14.

484. Tay-Teo K, Moodie M, Bernhardt J, Thrift AG, Collier J, Donnan G, et al. Economic evaluation alongside a phase II, multi-centre, randomised controlled trial of very early rehabilitation after stroke (AVERT). Cerebrovasc Dis. 2008;26(5):475–81.

485. Langhorne P, Stott D, Knight A, Bernhardt J, Barer D, Watkins C. Very early rehabilitation or intensive telemetry after stroke: a pilot randomised trial. Cerebrovasc Dis. 2010;29(4):352–60.

486. Sirtori V, Corbetta D, Moja L, Gatti R. Constraint-induced movement therapy for upper extremities in stroke patients. Cochrane Database Syst Rev. 2009, Issue 4. CD004433.

487. French B, Thomas LH, Leathley MJ, Sutton CJ, McAdam J, Forster A, et al. Repetitive task training for improving functional ability after stroke. Cochrane Database Syst Rev. 2007, Issue 4. CD006073.

488. Kwakkel G, Kollen BJ, Krebs HI. Effects of robot-assisted therapy on upper limb recovery after stroke: A systematic review. . Neurorehabilitation and Neural Repair. 2008;22:11–21.

489. Foley NC, Martin RE, Salter KL, Teasell RW. A review of the relationship between dysphagia and malnutrition following stroke. J Rehabil Med. 2009;41(9):707–13.

490. National Institute for Clinical Excellence. Stroke: national clinical guideline for diagnosis and initial management of acute stroke and transient ischaemic attack (TIA). London: NICE; 2008.

491. Hinchey JA, Shephard T, Furie K, Smith D, Wang D, Tonn S. Formal dysphagia screening protocols prevent pneumonia. Stroke. 2005;36(9):1972–6.

492. Odderson IR, Keaton JC, McKenna BS. Swallow management in patients on an acute stroke pathway: quality is cost effective. Arch Phys Med Rehabil. 1995;76:1130–3.

493. Perry L, McLaren S. Nutritional support in acute stroke: the impact of evidence-based guidelines. Clinical Nutrition. 2003;22(3):283–93.

494. Westergren A. Detection of eating difficulties after stroke: a systematic review. Int Nurs Rev. 2006;53(2):143–9.

495. Ramsey DJ, Smithard DG, Kalra L. Early assessments of dysphagia and aspiration risk in acute stroke patients. Stroke. 2003;34(5): 1252–7.

496. Perry L, Love CP. Screening for dysphagia and aspiration in acute stroke: A systematic review. Dysphagia. 2001;16(1):7–18.

497. Martino R, Pron G, Diamant N. Screening for oropharyngeal dysphagia in stroke: Insufficient evidence for guidelines. Dysphagia. 2000;15(1):19–30.

498. Lim SHB, Lieu PK, Phua SY, Seshadri R, Venketasubramanian N, Lee SH, et al. Accuracy of bedside clinical methods compared with fiberoptic endoscopic examination of swallowing (FEES) in determining the risk of aspiration in acute stroke patients. Dysphagia. 2001;16(1):1–6.

499. Leder SB, Espinosa JF. Aspiration risk after acute stroke: Comparison of clinical examination and fiberoptic endoscopic evaluation of swallowing. Dysphagia. 2002;17(3):214–8.

500. Chong MS, Lieu PK, Sitoh YY, Meng YY, Leow LP. Bedside Clinical Methods Useful as Screening Test for Aspiration in Elderly Patients with Recent and Previous Strokes. Ann Acad Med Singapore. 2003;32(6):790–4.

501. Wu MC, Chang YC, Wang TG, Lin LC. Evaluating Swallowing Dysfunction Using a 100-ml Water Swallowing Test. Dysphagia. 2004;19(1):43–7.

502. Trapl M, Enderle P, Nowotny M, Teuschl Y, Matz K, Dachenhausen A, et al. Dysphagia bedside screening for acute-stroke patients: the Gugging Swallowing Screen. Stroke. 2007;38(11):2948–52.

503. Martino RF, Silver F, Teasell R, Bayley M, Nicholson G, Streiner DL, et al. The toronto bedside swallowing screening test (TOR-BSST) development and validation of a dysphagia screening tool for patients with stroke. Stroke. 2009;40(2):555–61.

504. Diniz PB, Vanin G, Xavier R, Parente MA. Reduced incidence of aspiration with spoon-thick consistency in stroke patients. Nutr Clin Pract. 2009;24(3):414–8.

505. Smith HA, Lee SH, O'Neill PA, Connolly MJ. The combination of bedside swallowing assessment and oxygen saturation monitoring of swallowing in acute stroke: A safe and humane screening tool. Age Ageing. 2000;29(6):495–9.

506. Langmore SE, Schatz K, Olson N. Endoscopic and videofluoroscopic evaluations of swallowing and aspiration. Ann Otol Rhinol Laryngol. 1991;100(8):678–81.

507. Warnecke T, Teismann I, Oelenberg S, Hamacher C, Ringelstein EB, Schabitz WR, et al. The safety of fiberoptic endoscopic evaluation of swallowing in acute stroke patients. Stroke. 2009;40(2):482–6.

508. Bath PMW, Bath FJ, Smithard DG. Interventions for dysphagia in acute stroke. Cochrane Database Syst Rev. 1999, Issue 3. CD000323.

509. Foley N, Teasell R, Salter K, Kruger E, Martino R. Dysphagia treatment post stroke: a systematic review of randomised controlled trials. Age Ageing. 2008;37(3):258–64.

510. Xie Y, Wang L, He J, Wu T. Acupuncture for dysphagia in acute stroke. Cochrane Database Syst Rev. 2008, Issue 3. CD006076.

511. Rosenbek JC, Robbins J, Willford WO, Kirk G, Schiltz A, Sowell TW, et al. Comparing treatment intensities of tactile-thermal application. Dysphagia. 1998;13(1):1–9.

512. Freed M, Christian MO, Beytas EM, Tucker H, Kotton B. Electrical stimulation of the neck: a new effective treatment for dysphagia. Respiratory Care. 2001;46:466–74.

513. Leelamanit V, Limsakul C, Geater A. Synchronized electrical stimulation in treating pharyngeal dysphagia. Laryngoscope. 2002;112(12):2204–10.

514. Bulow M, Speyer R, Baijens L, Woisard V, Ekberg O. Neuromuscular electrical stimulation (NMES) in stroke patients with oral and pharyngeal dysfunction. Dysphagia. 2008;23(3):302–9.

515. Lim K-B, Lee H-J, Lim S-S, Choi Y-I. Neuromuscular electrical and thermal-tactile stimulation for dysphagia caused by stroke: a randomized controlled trial. J Rehabil Med. 2009;41(3):174–8.

516. Shaker R, Easterling C, Kern M, Nitschke T, Massey B, Daniels S, et al. Rehabilitation of swallowing by exercise in tube-fed patients with pharyngeal dysphagia secondary to abnormal UES opening. Gastroenterology. 2002;122(5):1314–21.

517. Logemann JA, Rademaker A, Pauloski BR, Kelly A, Stangl-McBreen C, Antinoja J, et al. A Randomized Study Comparing the Shaker Exercise with Traditional Therapy: A Preliminary Study. Dysphagia. 2009;24(4):403–11.

518. Khedr EM, Etraby AE, Hemeda M, Nasef AM, Razek AAE. Long-term effect of repetitive transcranial magnetic stimulation on motor function recovery after acute ischemic stroke. Acta Neurologica Scandinavica. 2010;121(1):30–7.

519. Ada L, Dorsch S, Canning C. Strengthening interventions increase strength and improve activity after stroke: a systematic review. J Physiother. 2006;52(4):241–8.

520. Harris JE, Eng JJ. Strength training improves upper-limb function in individuals with stroke: a meta-analysis. Stroke. 2010;41(1):136–40.

521. Glinsky J, Harvey L, Van Es P. Efficacy of electrical stimulation to increase muscle strength in people with neurological conditions: a systematic review. Physiother Res Int. 2007;12(3):175–94.

522. Pak S, Patten C. Strengthening to promote functional recovery poststroke: an evidence-based review. Top Stroke Rehabil. 2008;15(3):177–99.

523. Schabrun SM, Hillier S. Evidence for the retraining of sensation after stroke: a systematic review. Clin Rehabil. 2009;23(1):27–39.

524. Carey LM, Matyas TA, Oke LE. Sensory loss in stroke patients: effective training of tactile and proprioceptive discrimination. Arch Phys Med Rehabil. 1993;74(6):602–11.

525. Yekutiel M, Guttman E. A controlled trial of the retraining of the sensory function of the hand in stroke patients. J Neurol Neurosurg Psychiatry. 1993;56(3):241–4.

526. Byl N, Roderick J, Mohamed O, Hanny M, Kotler J, Smith A, et al. Effectiveness of sensory and motor rehabilitation of the upper limb following the principles of neuroplasticity: patients stable poststroke. Neurorehabil Neural Repair. 2003;17(3):176–91.

527. Hillier S, Dunsford A. A pilot study of sensory retraining for the hemiparetic foot post-stroke. Int J Rehabil Res. 2006;29(3):237–42.

528. Lynch EA, Hillier SL, Stiller K, Campanella RR, Fisher PH. Sensory retraining of the lower limb after acute stroke: a randomized controlled pilot trial. Arch Phys Med Rehabil. 2007;88(9):1101–7.

529. Smania N, Montagnana B, Faccioli S, Fiaschi A, Aglioti SM. Rehabilitation of somatic sensation and related deficit of motor control in patients with pure sensory stroke. Arch Phys Med Rehabil. 2003;84(11):1692–702.

530. Carey LM, Matyas TA. Training of somatosensory discrimination after stroke: facilitation of stimulus generalization. Am J Phys Med Rehabil. 2005;84(6):428–42.

531. Carey LM. Loss of somatic sensation. In: Selzer M, Clarke S, Cohen L, Duncan P, Gage FH, eds. Textbook of Neural Repair and Rehabilitation Cambridge: Cambridge University Press 2006:Chapter II.16, pp 231–47.

532. Van Deusen-Fox J. Cutaneous stimulation: Effects on selected tests of perception. Am J Occup Ther. 1964(2):53–5.

533. Peurala SH, Pitkanen K, Sivenius J, Tarkka IM. Cutaneous electrical stimulation may enhance sensorimotor recovery in chronic stroke. Clin Rehabil. 2002;16(7):709–16.

534. Kerkhoff G. Restorative and compensatory therapy approaches in cerebral blindness – a review. Restor Neurol Neurosci. 1999;15(2–3):255–71.

535. Bouwmeester L, Heutink J, Lucas C. The effect of visual training for patients with visual field defects due to brain damage: a systematic review. J Neurol Neurosurg Psychiatry. 2007;78(6):555–64.

536. Riggs RV, Andrews K, Roberts P, Gilewski M. Visual deficit interventions in adult stroke and brain injury: a systematic review. Am J Phys Med Rehabil. 2007;86:853–60.

537. Rossi PW, Kheyfets S, Reding MJ. Fresnel prisms improve visual perception in stroke patients with homonymous hemianopia or unilateral visual neglect. Neurology. 1990;40(10):1597–9.

538. Kasten E, Wust S, Behrens-Baumann W, Sabel BA. Computer-based training for the treatment of partial blindness. Nat Med. 1998;4(9):1083–7.

539. Mazer BL, Sofer S, Korner-Bitensky N, Gelinas I, Hanley J, Wood-Dauphinee S. Effectiveness of a visual attention retraining program on the driving performance of clients with stroke. Arch Phys Med Rehabil. 2003;84(4):541–50.

540. Poggel DA, Kasten E, Muller-Oehring EM, Sabel BA, Brandt SA. Unusual spontaneous and training induced visual field recovery in a patient with a gunshot lesion. J Neurol Neurosurg Psychiatry. 2001;70(2):236–9.

541. Barrett AM, Crucian GP, Heilman KM. Eye patching biases spatial attention after thalamic hemorrhage in a patient without spatial neglect: a case report. Arch Phys Med Rehabil. 2004;85:1017–20.

542. Dean CM, Shepherd RB. Task-related training improves performance of seated reaching tasks after stroke. A randomized controlled trial. Stroke. 1997 May;28(4):722–8.

543. Dean CM, Channon EF. Sitting training early after stroke improves sitting ability and quality and carries over to standing up but not to walking: a randomised trial. Aust J Physiother. 2007;53(2):97–102.

544. Howe TE, Taylor I, Finn P, Jones H. Lateral weight transference exercises following acute stroke: a preliminary study of clinical effectiveness. Clin Rehabil. 2005;19(1):45–53.

545. Verheyden G, Vereeck L, Truijen S, Troch M, Lafosse C, Saeys W, et al. Additional exercises improve trunk performance after stroke: a pilot randomized controlled trial. Neurorehabilitation & Neural Repair. 2009;23(3):281–6.

546. Van Nes IJ, Latour WH. Long-term effects of 6-week whole-body vibration on balance recovery and activities of daily living in the postacute phase of stroke: A randomized, controlled trial. Stroke. 2006;37(9):2331–5.

547. Bagley P, Hudson M. A randomized trial evaluation of the Oswestry Standing Frame for patients after stroke. Clin Rehabil. 2005;19(4):354–64.

548. Langhorne P, Coupar F, Pollock A. Motor recovery after stroke: a systematic review. Lancet neurol. 2009;8(8):741–54.

549. van Peppen RPS, Kortsmit M, Lindeman E, Kwakkel G. Effects of visual feedback therapy on postural control in bilateral standing after stroke: a systematic review. J Rehabil Med. 2006;38(1):3–9.

550. Barclay-Goddard R, Stevenson T, Poluha W, Moffatt MEK, Taback SP. Force platform feedback for standing balance training after stroke. Cochrane Database Syst Rev. 2004, Issue 3. CD004129.

551. Pollock AG, Baer G, Pomeroy VM, Langhorne P. Physiotherapy treatment approaches for the recovery of postural control and lower limb function following stroke. Cochrane Database Syst Rev. 2007, Issue 1. CD001920.

552. Woodford HJ, Price CIM. EMG biofeedback for the recovery of motor function after stroke. Cochrane Database Syst Rev. 2007, Issue 2. CD004585.

553. Mehrholz J, Werner C, Kugler J, Pohl M. Electromechanical-assisted training for walking after stroke. Cochrane Database Syst Rev. 2007, Issue 4. CD006185.

554. Moseley AM, Stark A, Cameron ID, Pollock A. Treadmill training and body weight support for walking after stroke. Cochrane Database Syst Rev. 2005, Issue 4. CD002840.

555. Macko RF, Ivey FM, Forrester LW, Hanley D, Sorkin JD, Katzel LI, et al. Treadmill exercise rehabilitation improves ambulatory function and cardiovascular fitness in patients with chronic stroke: A randomized, controlled trial. Stroke. 2005;36(10):2206–11.

556. Luft AR, Macko RF, Forrester LW, Villagra F, Ivey F, Sorkin JD. Treadmill exercise activates subcortical neural networks and improves walking after stroke: a randomized controlled trial. Stroke. 2008;39(12): 3341–50.

557. Yen CL, Wang RY, Liao KK, Huang CC, Yang YR. Gait training induced change in corticomotor excitability in patients with chronic stroke. Neurorehabilitation and Neural Repair. 2008;22(1):22–30.

558. Sullivan KJ, Brown DA, Klassen T, Mulroy S, Ge T, Azen SP, et al. Physical Therapy Clinical Research Network (PTClinResNet). Effects of task-specific locomotor and strength training in adults who were ambulatory after stroke: results of the STEPS randomized clinical trial. Phys Ther. 2007;87(12):1580–602.

559. Franceschini M, Carda S, Agosti M, Antenucci R, Malgrati D, Cisari C, et al. Walking after stroke: what does treadmill training with body weight support add to overground gait training in patients early after stroke?: a single-blind, randomized, controlled trial. Stroke. 2009;40(9):3079–85.

560. Leung J, Moseley AM. The impact of ankle-foot-orthosis on walking gait and muscle activity in adult hemiplegia. Physiotherapy. 2003;89:29–55.

561. Bleyenheuft C, Caty G, Lejeune T, Detrembleur C. Assessment of the Chignon dynamic ankle-foot orthosis using instrumented gait analysis in hemiparetic adults. Ann Readapt Med Phys. 2008;51(3):154–60.

562. de Wit DC, Buurke JH, Nijlant JM, Ijzerman MJ, Hermens HJ. The effect of an ankle-foot orthosis on walking ability in chronic stroke patients: a randomized controlled trial. Clin Rehabil. 2004;18(5):550–7.

563. Wang RY, Lin PY, Lee CC, Yang YR. Gait and balance performance improvements attributable to ankle-foot orthosis in subjects with hemiparesis. Am J Phys Med Rehabil. 2007;86(7):556–62.

564. Wang RY, Yen L, Lee CC, Lin PY, Wang MF, Yang YR. Effects of an ankle-foot orthosis on balance performance in patients with hemiparesis of different durations. Clin Rehabil. 2005;19(1):37–44.

565. Pohl M, Mehrholz J. Immediate effects of an individually designed functional ankle-foot orthosis on stance and gait in hemiparetic patients. Clin Rehabil. 2006;20(4):324–30.

566. Sheffler LR, Hennessey MT, Naples GG, Chae J. Peroneal nerve stimulation versus an ankle foot orthosis for correction of footdrop in stroke: impact on functional ambulation. Neurorehabil Neural Repair. 2006;20(3):355–60.

567. Tyson SF, Rogerson L. Assistive Walking Devices in Nonambulant Patients Undergoing Rehabilitation After Stroke: The Effects on Functional Mobility, Walking Impairments, and Patients' Opinion. Arch Phys Med Rehabil. 2009;90(3):475–9.

568. Chen CL, Yeung KT, Wang CH, Chu HT, Yeh CY. Anterior ankle-foot orthosis effects on postural stability in hemiplegic patients. Arch Phys Med Rehabil. 1999;80(12):1587–92.

569. You SH, Jang SH, Kim YH, Hallett M, Ahn SH, Kwon YH, et al. Virtual reality-induced cortical reorganization and associated locomotor recovery in chronic stroke: an experimenter-blind randomized study. Stroke. 2005;36(6):1166–71.

570. Mirelman A, Bonato P, Deutsch JE. Effects of training with a robot-virtual reality system compared with a robot alone on the gait of individuals after stroke. Stroke. 2009;40(1):169–74.

571. Kim JH, Jang SH, Kim CS, Jung JH, You JH. Use of virtual reality to enhance balance and ambulation in chronic stroke: a double-blind, randomized controlled study. Am J Phys Med Rehabil. 2009;88(9):693–701.

572. Yang H, Liu T, Wang Y, Ying S, Zheng C, Kuai L, et al. Acupoint electrogymnastics therapy in stroke hemiplegia. Neural Regeneration Research. 2008;3(10):1145–51.

573. Jaffe DL, Brown DA, Pierson-Carey CD, Bucklet EL, Lew HL. Stepping over obstacles to improve walking in individuals with post-stroke hemiplegia. J Rehabil Res Develop. 2004;41:283–92.

574. Barker RN, Brauer SG, Carson RG. Training of reaching in stroke survivors with severe and chronic upper limb paresis using a novel nonrobotic device: A randomized clinical trial. Stroke. 2008;39(6):1800–7.

575. Woodbury ML, Howland DR, McGuirk TE, Davis SB, Senesac CR, Kautz S, et al. Effects of trunk restraint combined with intensive task practice on poststroke upper extremity reach and function: a pilot study. Eurorehabil Neural Repair. 2009;23(1):78–91.

576. Michaelsen SM, Dannenbaum R, Levin MF. Task-specific training with trunk restraint on arm recovery in stroke: randomized control trial. Stroke. 2006;37(1):186–92.

577. Michaelsen SM, Levin MF. Short-term effects of practice with trunk restraint on reaching movements in patients with chronic stroke: a controlled trial. Stroke. 2004;35(8):1914–9.

578. Stewart KC, Cauraugh JH, Summers JJ. Bilateral movement training and stroke rehabilitation: A systematic review and meta-analysis. J Neurol Sci. 2006;244:89–95.

579. Summers JJ, Kagerer FA, Garry MI, Hiraga CY, Loftus A, Cauraugh JH. Bilateral and unilateral movement training on upper limb function in chronic stroke patients: a TMS study. . J Neurol Sci. 2007;252(1): 76–82.

580. Cauraugh JH, Coombes SA, Lodha N, Naik SK, Summers JJ. Upper extremity improvements in chronic stroke: coupled bilateral load training. Restor Neurol Neurosci. 2009;27(1):17–25.

581. Lin K-c, Chang Y-f, Wu C-y, Chen Y-a. Effects of constraint-induced therapy versus bilateral arm training on motor performance, daily functions, and quality of life in stroke survivors. Neurorehabil Neural Repair. 2009;23(5):441–8.

582. Desrosiers J, Bourbonnais D, Corriveau H, Gosselin S, Bravo G. Effectiveness of unilateral and symmetrical bilateral task training for arm during the subacute phase after stroke: a randomized controlled trial. Clin Rehabil. 2005;19(6):581–93.

583. Morris JH, van Wijck F, Joice S, Ogston SA, Cole I, MacWalter RS. A comparison of bilateral and unilateral upper-limb task training in early poststroke rehabilitation: a randomized controlled trial. Arch Phys Med Rehabil. 2008;89(7):1237–45.

584. Meilink A, Hemmen B, Seelen HAM, Kwakkel G. Impact of EMG-triggered neuromuscular stimulation of the wrist and finger extensors of the paretic hand after stroke: a systematic review of the literature. Clin Rehabil. 2008;22(4):291–305.

585. van Dijk H, Jannink MJ, Hermens HJ. Effect of augmented feedback on motor function of the affected upper extremity in rehabilitation patients: a systematic review of randomized controlled trials. J Rehabil Med. 2005;37(4):202–11.

586. Mehrholz J, Platz T, Kugler J, Pohl M. Electromechanical and robot-assisted arm training for improving arm function and activities of daily living after stroke. Cochrane Database Syst Rev. 2008, Issue 4. CD006876.

587. Yavuzer G, Selles R, Sezer N, Sutbeyaz S, Bussmann JB, Koseoglu F, et al. Mirror Therapy Improves Hand Function in Subacute Stroke: A Randomized Controlled Trial. Arch Phys Med Rehabil. 2008;89(3): 393–8.

588. Dohle C, Pullen J, Nakaten A, Kust J, Rietz C, Karbe H. Mirror therapy promotes recovery from severe hemiparesis: a randomized controlled trial. Neurorehabil Neural Repair. 2009;23(3):209–17.

589. Altschuler EL, Wisdom SB, Stone L, Foster C, Galasko D, Llewellyn DM, et al. Rehabilitation of hemiparesis after stroke with a mirror. Lancet. 1999;353(9169):2035–6.

590. Takeuchi N, Chuma T, Matsuo Y, Watanabe I, Ikoma K. Repetitive Transcranial Magnetic Stimulation of Contralesional Primary motor Cortex Improves Hand Function after Stroke. Stroke. 2005;26:2681–6.

591. Takeuchi N, Tada T, Toshima M, Chuma T, Matsuo Y, Ikoma K. Inhibition of the unaffected motor cortex by 1 Hz repetitive transcranical magnetic stimulation enhances motor performance and training effect of the paretic hand in patients with chronic stroke. J Rehabil Med. 2008;40(4):298–303.

592. Liepert J, Zittel S, Weiller C. Improvement of dexterity by single session low-frequency repetitive transcranial magnetic stimulation over the contralesional motor cortex in acute stroke: a double-blind placebo-controlled crossover trial. Restor Neurol Neurosci. 2007;25(5–6):461–5.

593. Mansur CG, Fregni F, Boggio PS, Riberto M, Gallucci-Neto J, Santos CM, et al. A sham stimulation controlled-trial of rTMS of the unaffected hemisphere in stroke patients. Neurology. 2005;64:1802–4.

594. Kim YH, You SH, Ko MH, Park JW, Lee KH, Jang SH, et al. Repetitive transcranial magnetic stimulation induced corticomotor excitability and associated motor skill acquisition in chronic stroke. Stroke. 2006;37:1471–6.

595. Malcolm MP, Triggs WJ, Light KE, Gonzalez RLJ, Wu S, Reid K, et al. Repetitive transcranial magnetic stimulation as an adjunct to constraint-induced therapy: an exploratory randomized controlled trial. Am J Phys Med Rehabil. 2007;86(9):707–15.

596. Khedr EM, Ahmed MA, Fathy N, Rothwell JC. Therapeutic trial of repetitive transcranial magnetic stimulation after acute ischemic stroke. Neurology. 2005;65(3):466–468.

597. Pomeroy VM, Cloud G, Tallis RC, Donaldson C, Nayak V, Miller S. Transcranial magnetic stimulation and muscle contraction to enhance stroke recovery: a randomized proof-of-principle and feasibility investigation. Neurorehabil Neural Repair. 2007;21(6):509–17.

598. Henderson A, Korner-Bitensky N, Levin M. Virtual reality in stroke rehabilitation: A systematic review of its effectiveness for upper limb motor recovery. Top Stroke Rehabil. 2007;14:52–61.

599. Crosbie JH, Lennon S, Basford JR, McDonough SM. Virtual reality in stroke rehabilitation: Still more virtual than real. Disabil Rehabil. 2007;29:1139–46.

600. Broeren J, Claesson L, Goude D, Rydmark M, Sunnerhagen KS. Virtual rehabilitation in an activity centre for community-dwelling persons with stroke: The possibilities of 3-dimensional computer games. Cerebrovasc Dis. 2008;26(3):289–96.

601. Housman SJ, Scott KM, Reinkensmeyer DJ. A randomized controlled trial of gravity-supported, computer-enhanced arm exercise for individuals with severe hemiparesis. Neurorehabil Neural Repair. 2009;23(5):505–14.

602. Outpatient Service Trialists. Therapy-based rehabilitation services for stroke patients at home. Cochrane Database Syst Rev. 2002, Issue 2. CD002925

603. Walker MF, Leonardi-Bee J, Bath P, Langhorne P, Dewey M, Corr S, et al. Individual Patient Data Meta-Analysis of Randomized Controlled Trials of Community Occupational Therapy for Stroke Patients. Stroke. 2004;35(9):2226–32.

604. Logan P, Gladman J, Avery A, Walker M, Dyas J, Groom L. Randomised controlled trial of an occupational therapy intervention to increase outdoor mobility after stroke. Br Med J. 2004;329:1372–7.

605. Martinsson L, Wahlgren NG, Hårdemark HG. Amphetamines for improving recovery after stroke. Cochrane Database Syst Rev. 2007, Issue 3. CD002090.

606. Sprigg N, Bath PMW. Speeding stroke recovery? A systematic review of amphetamine after stroke. J Neurol Sci. 2009;285(1–2):3–9.

607. Junhua Z, Menniti-Ippolito F, Xiumei G, Firenzuoli F, Boli Z, Massari M, et al. Complex traditional Chinese medicine for poststroke motor dysfunction: a systematic review. Stroke. 2009;40(8):2797–804.

608. Salter K, Jutai J, Foley N, Hellings C, Teasell R. Identification of aphasia post stroke: A review of screening assessment tools. Brain Injury. 2006;20(6):559–68.

609. Greener J, Enderby P, Whurr R. Speech and language therapy for aphasia following stroke. Cochrane Database Syst Rev. 1999, Issue 4. CD000425.

610. Walker-Batson D, Curtis S, Natarajan R, et al. A double-blind, placebo controlled study of the use of amphetamine in the treatment of aphasia. Stroke. 2001;32:2093–8.

611. Berthier ML, Green C, Lara JP, Higueras C, Barbancho MA, Davila G, et al. Memantine and constraint-induced aphasia therapy in chronic poststroke aphasia. Ann Neurol. 2009;65(5):577–85.

612. Katz RC, Wertz RT. The efficacy of computer-provided reading treatment for chronic aphasic adults. J Speech Lang Hear Res. 1997;40(3):493–507.

613. Crerar MA, Ellis AW, Dean EC. Remediation of sentence processing deficits in aphasia using a computer-based microworld. Brain Lang. 1996;52(1):229–75.

614. Aftonomos LB, Steele RD, Wertz RT. Promoting recovery in chronic aphasia with an interactive technology. Arch Phys Med Rehabil. 1997;78(8):841–6.

615. Brennan AD, Worrall LE, McKenna KT. The relationship between specific features of aphasia-friendly written material and comprehension of written material for people with aphasia: An exploratory study. Aphasiology. 2005;19(8):693–711.

616. Rose TA, Worrall LE, McKenna KT. The effectiveness of aphasia-friendly principles for printed health education materials for people with aphasia following stroke. Aphasiology. 2003;17(10):947–63.

617. Wertz RT, Weiss DG, Aten JL, et al. Comparison of clinic, home and deferred language treatment for aphasia. Arch Neurol. 1986;43:653–8.

618. Kagan A, Black SE, Duchan FJ, Simmons-Mackie N, Square P. Training volunteers as conversation partners using "Supported Conversation for Adults with Aphasia" (SCA): a controlled trial. J Speech Lang Hear Res. 2001;44(3):624–38.

619. Elman RJ, Bernstein-Ellis E. The efficacy of group communication treatment in adults with chronic aphasia. J Speech Lang Hear Res. 1999;42(2):411–9.

620. Jacobs B, Drew R, Ogletree B, Pierce K. Augmentative and Alternative Communication (AAC) for adults with severe aphasia: where we stand and how we can go further. Disabil Rehabil. 2004;26(21–22):1231–40.

621. Greener J, Enderby P, Whurr R. Pharmacological treatment for aphasia following stroke. Cochrane Database Syst Rev. 2001, Issue 4. CD000424.

622. West C, Bowen A, Hesketh A, Vail A. Interventions for motor apraxia following stroke. Cochrane Database Syst Rev. 2008, Issue 1. CD004132.

623. Wambaugh J, Duffy, J., McNeil, M., Robin, D., Rogers, M. Treatment Guidelines for Acquired Apraxia of Speech: A Synthesis and Evaluation of the Evidence. J Med Speech Lang Pathol. 2006;14(2):xv–xxxiii.

624. Maas E, Robin DA, Austermann Hula SN, Freedman SE, Wulf G, Ballard KJ, et al. Principles of motor learning in treatment of motor speech disorders. Am J Speech Lang Pathol. 2008;17(3):277–98.

625. Austermann Hula SN, Robin DA, Maas E, Ballard KJ, Schmidt RA. Effects of feedback frequency and timing on acquisition, retention, and transfer of speech skills in acquired apraxia of speech. J Speech Lang Hear Res. 2008;51(5):1088–113.

626. Ballard K, Maas E, Robin D. Treating control of voicing in apraxia of speech with variable practice. Aphasiology. 2007;21(12):1195–217.

627. Sellars C, Hughes T, Langhorne P. Speech and language therapy for dysarthria due to non-progressive brain damage. Cochrane Database Syst Rev. 2005, Issue 3.:CD002088.

628. Simpson MB, Till JA, Goff AM. Longterm treatment of severe dysarthria: A single case study. J Speech Hear Disord. 1988; 53:433–40.

629. Cariski D, Rosenbek J. The effectiveness of the Speech Enhancer. J Med Speech Lang Pathol. 1999;7(4):315–22.

630. Wenke RJ, Theodoros D, Cornwell P. The short- and long-term effectiveness of the LSVT for dysarthria following TBI and stroke. Brain Injury. 2008;22(4):339–52.

631. Mackenzie C, Lowit A. Behavioural intervention effects in dysarthria following stroke: Communication effectiveness, intelligibility and dysarthria impact. Int J Lang Commun Disord. 2007;42(2):131–53.

632. Palmer R, Enderby P, Hawley M. Addressing the needs of speakers with longstanding dysarthria: computerized and traditional therapy compared. Int J Lang Commun Disord. 2007;42(Suppl 1):61–79.

633. Bedwinek AP, O'Brien RL. A patient selection profile for the use of speech prostheses in adult dysarthria. J Commun Disord. 1985;18:169–82.

634. Kerman PC, Singer LS, Davidoff A. Palatal lift and speech therapy for velopharyngeal incompetence. Arch Phys Med Rehabil. 1973;54: 271–6.

635. Yorkston KM, Honsinger MJ, Beukelman DR, Taylor TD. The effects of palatal lift fitting on the perceived articulatory adequacy of dysarthric speakers. In: Yorkston KM, Beukelman DR, eds. *Recent Advances in Clinical Dysarthria*. Boston: College-Hill Press. 1989:85–98.

636. Jordan LC, & Hillis, A.E. Aphasia and right hemisphere syndromes in stroke. Curr Neurol Neurosci Rep. 2005;5:458–64.

637. Cherney LR, Halper AS. Assessment and treatment of functional communication following right hemisphere damage. In: Worrall LE, Frattali CM, eds. Neurogenic Communication Disorders: A Functional Approach. New York: Thieme 2000.

638. Lethlean J. Treatment of pragmatic difficulties associated with right hemisphere syndrome: an evidence based review. Brisbane: Queensland Health 2008.

639. Pendlebury ST, Rothwell PM. Prevalence, incidence, and factors associated with pre-stroke and post-stroke dementia: a systematic review and meta-analysis. Lancet neurol. 2009;8(11):1006–18.

640. Tellier M, Rochette A. Falling through the cracks: a literature review to understand the reality of mild stroke survivors. Top Stroke Rehabil. 2009;16(6):454–62.

641. Srikanth V, Thrift AG, Fryer JL, Saling MM, Dewey HM, Sturm JW, et al. The validity of brief screening cognitive instruments in the diagnosis of cognitive impairment and dementia after first-ever stroke. International Psychogeriatrics. 2006;18(2):295–305.

642. Blake H, McKinney M, Treece K, Lee E, Lincoln NB. An evaluation of screening measures for cognitive impairment after stroke. Age ageing. 2002;31(6):451–6.

643. Bowen A, McKenna K, Tallis RC. Reasons for variability in the reported rate of occurrence of unilateral spatial neglect after stroke. Stroke. 1999;30(6):1196–202.

644. Azouvi P, Bartolomeo P, Beis JM, Perennou D, Pradat-Diehl P, Rousseaux M. A battery of tests for the quantitative assessment of unilateral neglect. Restor Neurol Neurosci. 2006;24(4–6):273–85.

645. Menon A, Korner-Bitensky N. Evaluating unilateral spatial neglect post stroke: Working your way through the maze of assessment choices. Top Stroke Rehabil. 2004;11(3):41–66.

646. Butler JA. How comparable are tests of apraxia? Clin Rehabil. 2002;16(4):389–98.

647. van Heugten CM, Dekker J, Deelman BG, Stehmann-Saris FC, Kinebanian A. A diagnostic test for apraxia in stroke patients: internal consistency and diagnostic value. Clin Neuropsychol. 1999;13(2): 182–92.

648. Lincoln NB, Husbands S, Trescoli C, Drummond AE, Gladman JR, Berman P. Five year follow up of a randomised controlled trial of a stroke rehabilitation unit. Br Med J. 2000;320(7234):26.

649. Giaquinto S, Fraioli L. Enhancement of the somatosensory N140 component during attentional training after stroke. Clinical Neurophysiology. 2003;114:329–35.

650. Barker-Collo SL, Feigin VL, Lawes CMM, Parag V, Senior H, Rodgers A. Reducing attention deficits after stroke using attention process training: A randomized controlled trial. Stroke. 2009;40(10):3293–8.

651. Lincoln NB, Majid MJ, Weyman N. Cognitive rehabilitation for attention deficits following stroke. Cochrane Database Syst Rev. 2000, Issue 3. CD002842.

652. das Nair R, Lincoln N. Cognitive rehabilitation for memory deficits following stroke. Cochrane Database Syst Rev. 2007, Issue 3. CD002293.

653. Wilson BA, Emslie HC, Quirk K, Evans JJ. Reducing everyday memory and planning problems by means of a paging system: a randomised control crossover study. J Neurol Neurosurg Psychiatry. 2001;70(4):477–82.

654. Hildebrandt H, Bussmann-Mork B, Schwendemann G. Group therapy for memory impaired patients: a partial remediation is possible. J Neurol. 2006;253(4):512–9.

655. Boyd L, Winstein C. Explicit information interferes with implicit motor learning of both continuous and discrete movement tasks after stroke. J Neurol Phys Ther. 2006;30(2):46–57.

656. Cicerone KD, Dahlberg C, Malec JF, Langenbahn DM, Felicetti T, Kneipp S, et al. Evidence-based cognitive rehabilitation: updated review of the literature from 1998 through 2002. Arch Phys Med Rehabil. 2005;86(8):1681–92.

657. Donkervoort M, Dekker J, Stehmann-Saris FC, Deelman BG. Efficacy of strategy training in left hemisphere stroke patients with apraxia: A randomised clinical trial. Neuropsychol rehabil. 2001;11(5):549.

658. Smania N, Aglioti SM, Girardi F, Tinazzi M, Fiaschi A, Cosentino A, et al. Rehabilitation of limb apraxia improves daily life activities in patients with stroke. Neurology. 2006;67(11):2050–2.

659. Burns MS. Clinical management of agnosia. Top Stroke Rehabil. 2004;11(1):1–9.

660. Jehkonen M, Laihosalo M, Kettunen JE. Impact of neglect on functional outcome after stroke: A review of methodological issues and recent research findings. Restor Neurol Neurosci. 2006;24:209–15.

661. Bowen A, Lincoln NB. Cognitive rehabilitation for spatial neglect following stroke. Cochrane Database Syst Rev. 2007, Issue 2. CD003586.

662. Luaute J, Halligan P, Rode G, Rossetti Y, Boisson D. Visuo-spatial neglect: A systematic review of current interventions and their effectiveness. Neurosci Biobehav Rev. 2006;30(7):961–82.

663. Polanowska K, Seniow J, Paprot E, Leniak M, Czonkowska A. Left-hand somatosensory stimulation combined with visual scanning training in rehabilitation for post-stroke hemineglect: A randomised, double-blind study. Neuropsychol Rehabil. 2009;19(3):364–82.

664. Tsang MHM, Sze KH, Fong KNK. Occupational therapy treatment with right half-field eye-patching for patients with subacute stroke and unilateral neglect: A randomised controlled trial. Disabil Rehabil. 2009;31(8):630–7.

665. Turton AJ, O'Leary K, Gabb J, Woodward R, Gilchrist ID. A single blinded randomised controlled pilot trial of prism adaptation for improving self-care in stroke patients with neglect. Neuropsychol Rehabil. 2010;20(2):180–96.

666. Kelly J, Hunt BJ, Lewis RR, Swaminathan R, Moody A, Seed PT, et al. Dehydration and venous thromboembolism after acute stroke. QJM. 2004;97(5):293–6.

667. Bhalla A, Sankaralingam S, Dundas R, Swaminathan R, Wolfe CD, Rudd AG. Influence of raised plasma osmolality on clinical outcome after acute stroke. Stroke. 2000;31(9):2043–8.

668. Finestone HM, Foley NC, Woodbury MG, Greene-Finestone L. Quantifying fluid intake in dysphagic stroke patients: a preliminary comparison of oral and nonoral strategies. Arch Phys Med Rehabil. 2001;82(12):1744–6.

669. Whelan K. Inadequate fluid intakes in dysphagic acute stroke. Clinical Nutrition. 2001;20(5):423–8.

670. Martineau J, Bauer JD, Isenring E, Cohen S. Malnutrition determined by the patient-generated subjective global assessment is associated with poor outcomes in acute stroke patients. Clinical Nutrition. 2005;24(6):1073–7.

671. Davis JP, Wong AA, Schluter PJ, Henderson RD, O'Sullivan JD, Read SJ. Impact of premorbid undernutrition on outcome in stroke patients. Stroke. 2004;35(8):1930–4.

672. Perry L. Eating and dietary intake in communication-impaired stroke survivors: A cohort study from acute-stage hospital admission to 6 months post-stroke. Clinical Nutrition. 2004;23(6):1333–43.

673. Foley N, Finestone H, Woodbury MG, Teasell R, Greene-Finestone L. Energy and protein intakes of acute stroke patients. J Nutr Health Aging. 2006;10(3):171–5.

674. Esper DH, Coplin WM, Carhuapoma JR. Energy expenditure in patients with nontraumatic intracranial hemorrhage. JPEN J Parenter Enteral Nutr. 2006;30(2):71–5.

675. DAA Malnutrition GUideline Steering Committee. Evidence Based Practice Guidelines for the Nutritional Management of Malnutrition in Adult Patients Across the Continuum of Care. Nutrition and Dietetics. 2009;66(Supp 3).

676. Stratton RJ, Hackston A, Longmore D, Dixon D, Price S, Stroud M, et al. Malnutrition in hospital outpatients and inpatients: Prevalence, concurrent validity and ease of use of the 'malnutrition universal screening tool' ('MUST') for adults. Br J Nutr. 2004;92(5):799–808.

677. Fergusan M, Capra S, Bauer J, Banks M. Development of a valid and reliable malnutrition screening tool for adult acute hospital patients. Nutrition. 1999;15(6):458–64.

678. Banks M, Ash S, Bauer J, Gaskill D. Prevalence of malnurtrition in adults in Queensland public hospitals and residential aged care facilities. Nutr Diet. 2007;64:172–8.

679. Hodgkinson B, Evans D, Wood J. Maintaining oral hydration in older adults: a systematic review. Int J Nurs Pract. 2003;9(3):S19–28.

680. Simmons SF, Alessi C, Schnelle JF. An intervention to increase fluid intake in nursing home residents: prompting and preference compliance. J Am Geriatr Soc. 2001 Aug;49(7):926–33.

681. Challiner YC, Jarrett D, Hayward MJ, al-Jubouri MA, Julious SA. A comparison of intravenous and subcutaneous hydration in elderly acute stroke patients. Postgrad Med J. 1994;70(821):195–7.

682. Milne AC, Avenell A, Potter J. Meta-analysis: protein and energy supplementation in older people. Ann Intern Med. 2006;144(1):37–48.

683. Rabadi MH, Coar PL, Lukin M, Lesser M, Blass JP. Intensive nutritional supplements can improve outcomes in stroke rehabilitation. Neurology. 2008;71(23):1856–61.

684. James R, Gines D, Menlove A, Horn SD, Gassaway J, Smout RJ. Nutrition support (tube feeding) as a rehabilitation intervention. Arch Phys Med Rehabil. 2005;86(12 SUPPL 2):S82–S92.

685. Horn SD, DeJong G, Smout RJ, Gassaway J, James R, Conroy B. Stroke rehabilitation patients, practice, and outcomes: Is earlier and more aggressive therapy better? Arch Phys Med Rehabil. 2005;86(12 SUPPL.):S101–S14.

686. The FOOD Trial Collaboration. Does routine oral nutritional supplementation for hospitalised stroke patients improve their outcomes? Results of the FOOD Trial: A multicentre international randomised controlled trial. Lancet. 2005;365(9461):755–63.

687. The FOOD Trial Collaboration. Does the timing and method of enteral tube feeding for dysphagic hospitalised stroke patients influence their outcomes? Results of the FOOD Trial: A multicentre international randomised controlled trial. Lancet. 2005;365(9461):764–72.

688. Norton B, Homer-Ward M, Donnelly MT, Long RG, Holmes GK. A randomised prospective comparison of percutaneous endoscopic gastrostomy and nasogastric tube feeding after acute dysphagic stroke. Br Med J. 1996;312(7002):13–6.

689. Kostadima E, Kaditis AG, Alexopoulos EI, Zakynthinos E, Sfyras D. Early gastrostomy reduces the rate of ventilator-associated pneumonia in stroke or head injury patients. Eur Respir J. 2005;26(1):106–11.

690. Hamidon BB, Abdullah SA, Zawawi MF, Sukumar N, Aminuddin A, Raymond AA. A prospective comparison of percutaneous endoscopic gastrostomy and nasogastric tube feeding in patients with acute dysphagic stroke. Med J Malaysia. 2006;61(1):59–66.

691. Brady M, Furlanetto D, Hunter RV, Lewis S, Milne V. Staff-led interventions for improving oral hygiene in patients following stroke. Cochrane Database Syst Rev. 2006, Issue 4. CD003864.

692. Lance JW. Symposium synopsis. In: Feldman RG, Young RR, Koella WP, eds. Spasticity: Disordered motor control. Chicago/Miami: Symposia Specialists 1980:485–94.

693. van Kuijk AA, Geurts AC, Bevaart BJ, van Limbeek J. Treatment of upper extremity spasticity in stroke patients by focal neuronal or neuromuscular blockade: a systematic review of the literature. J Rehabil Med. 2002;34(2):51–61.

694. Bovend'Eerdt TJ, Newman M, Barker K, Dawes H, Minelli C, Wade DT. The effects of stretching in spasticity: a systematic review. Arch Phys Med Rehabil. 2008 Jul;89(7):1395–406.

695. Sheehan JL, Winzeler-Merçay U. A randomized controlled pilot study to obtain the best estimate of the size of the effect of a thermoplastic resting splint on spasticity in the stroke-affected wrist and fingers. Clin Rehabil. 2006;20(12):1032–7.

696. Rosales RL, Chua-Yap AS. Evidence-based systematic review on the efficacy and safety of botulinum toxin-A therapy in post-stroke spasticity. J Neural Transm. 2008;115(4):617–23.

697. Elia AE, Filippini G, Calandrella D, Albanese A. Botulinum neurotoxins for post-stroke spasticity in adults: a systematic review. Mov Disord. 2009;24(6):801–12.

698. Garces K, McCormick A, McGahan L, Skidmore B. Botulinum toxin a in the treatment of upper and lower limb spasticity: A systematic review of randomized controlled trials. Ottawa: Canadian Coordinating Office for Health Technology Assessment (CCOHTA). 2006;12.

699. McCrory P, Turner-Stokes L, Baguley IJ, De Graaff S, Katrak P, Sandanam J, et al. Botulinum toxin A for treatment of upper limb spasticity following stroke: a multi-centre randomized placebo-controlled study of the effects on quality of life and other person-centred outcomes. J Rehabil Med. 2009;41(7):536–44.

700. Jahangir AW, Tan HJ, Norlinah MI, Nafisah WY, Ramesh S, Hamidon BB, et al. Intramuscular injection of botulinum toxin for the treatment of wrist and finger spasticity after stroke. Med J Malaysia. 2007;62(4):319–22.

701. Kong KH, Neo JJ. A randomized controlled study of botulinum toxin A in the treatment of hemiplegic shoulder pain associated with spasticity. Clin Rehabil. 2007;21(1):28–35.

702. Lim JY, Koh JH. Intramuscular botulinum toxin-A reduces hemiplegic shoulder pain: a randomized, double-blind, comparative study versus intraarticular triamcinolone acetonide. Stroke. 2008;39(1):126–31.

703. Marco E, Duarte E. Is botulinum toxin type A effective in the treatment of spastic shoulder pain in patients after stroke? A double-blind randomized clinical trial. J Rehabil Med. 2007;39(6):440–7.

704. Yelnik AP, Colle FM. Treatment of shoulder pain in spastic hemiplegia by reducing spasticity of the subscapular muscle: a randomised, double blind, placebo controlled study of botulinum toxin A. J Neurol Neurosurg Psychiatry. 2007;78(8):845–8.

705. de Boer KS, Arwert HJ. Shoulder pain and external rotation in spastic hemiplegia do not improve by injection of botulinum toxin A into the subscapular muscle. J Neurol Neurosurg Psychiatry. 2008;79(5): 581–3.

706. Hesse S, Reiter F, Konrad M, Jahnke MT. Botulinum toxin type A and short-term electrical stimulation in the treatment of upper limb flexor spasticity after stroke: a randomized, double-blind, placebo-controlled trial. Clin Rehabil. 1998;12(5):381–8.

707. Johnson CA, Burridge JH, Strike PW, Wood DE, Swain ID. The effect of combined use of botulinum toxin type A and functional electric stimulation in the treatment of spastic drop foot after stroke: a preliminary investigation. Arch Phys Med Rehabil. 2004;85(6):902–9.

708. Baricich A, Carda S, Bertoni M, Maderna L, Cisari C. A single-blinded, randomized pilot study of botulinum toxin type A combined with non-pharmacological treatment for spastic foot. J Rehabil Med. 2008;40(10):870–2.

709. Farina S, Migliorini C, Gandolfi M, Bertolasi L, Casarotto M, Manganotti P, et al. Combined effects of botulinum toxin and casting treatments on lower limb spasticity after stroke. Funct Neurol. 2008;23(2):87–91.

710. Meythaler JM, Vogtle L, Brunner RC. A Preliminary Assessment of the Benefits of the Addition of Botulinum Toxin A to a Conventional Therapy Program on the Function of People With Longstanding Stroke. Arch Phys Med Rehabil. 2009;90(9):1453–61.

711. Heckmann J, Mokrusch T, Krockel A, Warnke S, Von S, Neundorfer B. EMG-triggered electrical muscle stimulation in the treatment of central hemiparesis after a stroke. European Journal of Physical Medicine & Rehabilitation. 1997;7(5):138–41.

712. Bakhtiary AH, Fatemy E. Does electrical stimulation reduce spasticity after stroke? A randomized controlled study. Clin Rehabil 2008;22(5):418–25.

713. Hara Y, Ogawa S, Muraoka Y. Hybrid power-assisted functional electrical stimulation to improve hemiparetic upper-extremity function. Am J Phys Med Rehabil 2006;85(12):977–85.

714. Swaan D, van Wieringen PC, Fokkema SD. Auditory electromyographic feedback therapy to inhibit undesired motor activity. Arch Phys Med Rehabil. 1974;55(6):251–4.

715. Gracies JM, Marosszeky JE, Renton R, Sandanam J, Gandevia SC, Burke D. Short-term effects of dynamic lycra splints on upper limb in hemiplegic patients. Arch Phys Med Rehabil. 2000;81(12):1547–55.

716. Creedon SD, Dijkers MP, Hinderer SR. Intrathecal baclofen for severe spasticity: a meta-analysis. International Journal of Rehabilitation and Health. 1997;3(3):171–85.

717. Sampson FCH, A. , Evans G, Morton R, Collett B. Functional benefits and cost/benefit analysis of continuous intrathecal baclofen infusion for the management of severe spasticity. J Neurosurg. 2002;96(6):1052–7.

718. Meythaler JM, Guin-Renfroe S, Brunner RC, Hadley MN. Intrathecal baclofen for spastic hypertonia from stroke. Stroke. 2001;32:2099–109.

719. Steinbok P, O'Donnell M. Baclofen infusion for spastic cerebral palsy. Clin Neurosurg. 2000;47:440–57.

720. Kofler M, Quirbach E, Schauer R, Singer M, Saltuari L. Limitations of intrathecal baclofen for spastic hemiparesis following stroke. Neurorehabil Neural Repair. 2009;23(1):26–31.

721. Montane E, Vallano A, Laporte JR. Oral antispastic drugs in nonprogressive neurologic diseases: a systematic review. Neurology. 2004;63(8):1357–63.

722. Stamenova P, Koytchev R, Kuhn K, Hansen C, Horvath F, Ramm S, et al. A randomized, double-blind, placebo-controlled study of the efficacy and safety of tolperisone in spasticity following cerebral stroke. Eur J Neurol.2005;12(6):453–61.

723. Simpson DM, Gracies JM, Yablon SA, Barbano R, Brashear A, Bo N. Botulinum neurotoxin versus tizanidine in upper limb spasticity: a placebo-controlled study. J Neurol Neurosurg Psychiatry. 2009;80:380–5.

724. Turton AJ, Britton E. A pilot randomized controlled trial of a daily muscle stretch regime to prevent contractures in the arm after stroke. Clin Rehabil. 2005;19(6):600–12.

725. Horsley SA, Herbert RD, Ada L. Four weeks of daily stretch has little or no effect on wrist contracture after stroke: a randomised controlled trial. Aust J Physiother. 2007;53(4):239–45.

726. de Jong LD, Nieuwboer A, Aufdemkampe G. Contracture preventive positioning of the hemiplegic arm in subacute stroke patients: a pilot randomized controlled trial. Clin Rehabil. 2006;20(8):656–67.

727. Gustafsson L, McKenna K. A programme of static positional stretches does not reduce hemiplegic shoulder pain or maintain shoulder range of motion – a randomized controlled trial. Clin Rehabil. 2006;20(4):277–86.

728. Dean CM, Mackey FH, Katrak P. Examination of shoulder positioning after stroke: A randomised controlled pilot trial. Aust J Physiother. 2000;46(1):35–40.

729. Ada L, Foongchomcheay A, Canning C. Supportive devices for preventing and treating subluxation of the shoulder after stroke. Cochrane Database Syst Rev. 2005, Issue 1. CD003863.

730. Bürge E, Kupper D, Finckh A, Ryerson S, Schnider A, Leemann B. Neutral functional realignment orthosis prevents hand pain in patients with subacute stroke: a randomized trial. Arch Phys Med Rehabil. 2008;89(10):1857–62.

731. Robinson W, Smith R, Aung O, Ada L. No difference between wearing a night splint and standing on a tilt table in preventing ankle contracture early after stroke: a randomised trial. Aust J Physiother. 2008;54(1):33–8.

732. Lannin NA, Cusick A, McCluskey A, Herbert RD. Effects of splinting on wrist contracture after stroke: A randomized controlled trial. Stroke. 2007;38(1):111–6.

733. Lannin NA, Herbert RD. Is hand splinting effective for adults following stroke? A systematic review and methodologic critique of published research. *Clin Rehabil* 2003:807–16.

734. Harvey L, de Jong I, Goehl G, Mardwedel S. Twelve weeks of nightly stretch does not reduce thumb web-space contractures in people with a neurological condition: a randomised controlled trial. Aust J Physiother. 2006;52(4):251–8.

735. Rydwik E, Eliasson S, G. A. The effect of exercise of the affected foot in stroke patients – a randomized controlled pilot trial. Clin Rehabil. 2006 Aug;20(8):645–55.

736. Kumar R, Metter EJ, Mehta AJ, Chew T. Shoulder pain in hemiplegia. The role of exercise. Am J Phys Med Rehabil. 1990 Aug;69(4):205–8.

737. Kluding PM, Santos M. Effects of ankle joint mobilizations in adults poststroke: a pilot study. Arch Phys Med Rehabil. 2008;89(3):449–56.

738. Pandyan AD, Granat MH, Stott DJ. Effects of electrical stimulation on flexion contractures in the hemiplegic wrist. Clin Rehabil. 1997;11(2):123–30.

739. Mortenson PA, Eng JJ. The use of casts in the management of joint mobility and hypertonia following brain injury in adults: a systematic review. Phys Ther. 2003;83(7):648–58.

740. Lannin NA, Novak I, Cusick A. A systematic review of upper extremity casting for children and adults with central nervous system motor disorders. Clin Rehabil. 2007;21(11):963–76.

741. Ada L, Foongchomcheay A. Efficacy of electrical stimulation in preventing or reducing subluxation of the shoulder after stroke: a meta-analysis. Aust J Physiother. 2002;48(4):257–67.

742. Yu DT, Chae J. Intramuscular neuromuscular electric stimulation for poststroke shoulder pain: a multicenter randomized clinical trial. Arch phys med rehabil. 2004;85(5):695–704.

743. Chae J, Yu DT, Walker ME, Kirsteins A, Elovic EP, Flanagan SR. Intramuscular electrical stimulation for hemiplegic shoulder pain: A 12-month follow-up of a multiple-center, randomized clinical trial. Am J Phys Med Rehabil. 2005;84:832–42.

744. Koyuncu E, Nakipoğlu-Yüzer GF, Doğan A, Ozgirgin N. The effectiveness of functional electrical stimulation for the treatment of shoulder subluxation and shoulder pain in hemiplegic patients: A randomized controlled trial. Disabil Rehabil. 2010;32(7):560–6.

745. Moodie N, Brisbin J, Morgan A. Subluxation of the glenohumeral joint in hemiplegia: evaluation of supportive devices. Physiotherapy Canada. 1986;38:151–7.

746. Williams R, Taffs L, Minuk T. Evaluation of two support methods for the subluxated shoulder of hemiplegic patients. Phys Ther. 1988;68(8):1209–14.

747. Zorowitz RD, Hughes MB, Idank D, Ikai T, Johnston MV. Shoulder pain and subluxation after stroke: correlation or coincidence? Am J Occup Ther. 1996;50(3):194–201.

748. Dieruf K, Poole JL, Gregory C, Rodriguez EJ, Spizman C. Comparative effectiveness of the givmohr sling in subjects with flaccid upper limbs on subluxation through radiologic analysis. Arch Phys Med Rehabil. 2005;86:2324–9.

749. Price CIM, Pandyan AD. Electrical stimulation for preventing and treating post-stroke shoulder pain. Cochrane Database Syst Rev. 1999, Issue 3. CD001698.

750. Church C, Price C. Randomized controlled trial to evaluate the effect of surface neuromuscular electrical stimulation to the shoulder after acute stroke. Stroke. 2006;37(12):2995–3001.

751. Mangold S, Schuster C. Motor training of upper extremity with functional electrical stimulation in early stroke rehabilitation. Neurorehabil Neural Repair. 2009;23(2):184–90.

752. Griffin A, Bernhardt J. Strapping the hemiplegic shoulder prevents development of pain during rehabilitation: a randomized controlled trial. Clin Rehabil. 2006;20(4):287–95.

753. Snels IAK, Beckerman H, Twisk JWR, Dekker JHM, de Koning P, Koppe PA, et al. Effect of triamcinolone acetonide injections on hemiplegic shoulder pain: a randomized clinical trial. Stroke. 2000;31(10):2396–401.

754. Arroll B, Goodyear-Smith F. Corticosteroid injections for painful shoulder: a meta-analysis. Br J Gen Pract. 2005;55(512):224–8.

755. Buchbinder R, Green S, Youd JM. Corticosteroid injections for shoulder pain. Cochrane Database Syst Rev. 2003, Issue 1. CD004016.

756. Koester MC, Dunn WR, Kuhn JE, Spindler KP. The efficacy of subacromial corticosteroid injection in the treatment of rotator cuff disease: A systematic review. J Am Acad Orthop Surg. 2007; 15(1):3–11.

757. Partridge C, Edwards S, Mee R, van Langenberghe H. Hemiplegic shoulder pain: a study of two methods of physiotherapy treatment. Clin Rehabil. 1990;4:43–9.

758. Inaba MK, Piorkowski M. Ultrasound in treatment of painful shoulders in patients with hemiplegia. Phys Ther. 1972;52(7):737–42.

759. Australian Acute Musculoskeletal Pain Guidelines Group. Evidence-based Management of Acute Musculoskeletal Pain. Australian Academic Press, Brisbane 2003.

760. Andersen G, Vestergaad K, Ingeman-Nielsen M, Jensen TS. Incidence of central post-stroke pain. Pain. 1995;61:187–93.

761. Saarto T, Wiffen PJ. Antidepressants for neuropathic pain. Cochrane Database Syst Rev. 2007, Issue 4. CD005454.

762. Lampl C, Yazdi K, Roper C. Amitriptyline in the prophylaxis of central poststroke pain. Preliminary results of 39 patients in a placebo-controlled, long-term study. Stroke. 2002;33(12):3030–2.

763. Leijon G, Boivie J. Central post-stroke pain – a controlled trial of amitriptyline and carbamazepine. Pain. 1989;36(1):27–36.

764. Duhmke RM, Hollingshead J, Cornblath DR. Tramadol for neuropathic pain. Cochrane Database Syst Rev. 2006, Issue 3. CD003726.

765. Bainton T, Fox M, Bowsher D, Wells C. A double-blind trial of naloxone in central post-stroke pain. Pain. 1992;48(2):159–62.

766. Attal N, Gaude V, Brasseur L, Dupuy M, Guirimand F, Parker F, et al. Intravenous lidocaine in central pain: a double-blind, placebo-controlled, psychophysical study. Neurology. 2000;54(3):564–74.

767. Attal N, Guirimand F, Brasseur L, Gaude V, Chauvin M, Bouhassira D. Effects of IV morphine in central pain: a randomized placebo-controlled study. Neurology. 2002;58(4):554–63.

768. Vestergaard K, Andersen G, Gottrup H, Kristensen BT, Jensen TS. Lamotrigine for central poststroke pain: a randomized controlled trial. Neurology. 2001;56(2):184–90.

769. Nnoaham KE, Kumbang J. Transcutaneous electrical nerve stimulation (TENS) for chronic pain. Cochrane Database Syst Rev. 2008, Issue 3. CD003222.

770. Mailis A, Furlan A. Sympathectomy for neuropathic pain. Cochrane Database Syst Rev. 2002, Issue 1. CD002918.

771. Wiffen P, Collins S, McQuay H, Carroll D, Jadad A, Moore A. Anticonvulsant drugs for acute and chronic pain. Cochrane Database Syst Rev. 2005, Issue 3. CD001133.

772. Faghri PD, Rodgers MM. The effects of functional neuromuscular stimulation-augmented physical therapy program in the functional recovery of hemiplegic arm in stroke patients. Clin Kinesiology. 1997;51:9–15.

773. Roper TA, Redford S, Tallis RC. Intermittent compression for the treatment of the oedematous hand in hemiplegic stroke: a randomized controlled trial. Age Ageing. 1999;28(1):9–13.

774. Giudice ML. Effects of continuous passive motion and elevation on hand edema. Am J Occup Ther. 1990;44(10):914–21.

775. Kelly JO, Kilbreath SL, Davis GM, Zeman B, Raymond J. Cardiorespiratory fitness and walking ability in subacute stroke patients. Arch Phys Med Rehabil. 2003;84(12):1780–5.

776. Saunders DH, Greig CA, Mead GE, Young A. Physical fitness training for stroke patients. Cochrane Database Syst Rev. 2009, Issue 4. CD003316.

777. McGeough E, Pollock A, Smith LN, Dennis M, Sharpe M, Lewis S, et al. Interventions for post-stroke fatigue. Cochrane Database Syst Rev. 2009, Issue 3. CD007030.

778. de Groot M, Phillips S, Eskes G. Fatigue associated with stroke and other neurologic conditions: implications for stroke rehabilitation. Arch Phys Med Rehabil. 2003;84(11):1714–20.

779. Lynch J, Mead G, Greig C, Young A, Lewis S, Sharpe M. Fatigue after stroke: the development and evaluation of a case definition. J Psychosom Res. 2007;63:539–44.

780. Martin JL, Williams KS, Abrams KR, Turner DA, Sutton AJ, Chapple C, et al. Systematic review and evaluation of methods of assessing urinary incontinence. Health Technology Assessment. 2006;10(6):iii–87.

781. Thomas LH, Cross S, Barrett J, French B, Leathley M, Sutton CJ, et al. Treatment of urinary incontinence after stroke in adults. Cochrane Database Syst Rev. 2008, Issue 1. CD004462.

782. Dumoulin C, Korner-Bitensky N, Tannenbaum C. Urinary incontinence after stroke: Does rehabilitation make a difference? A systematic review of the effectiveness of behavioral therapy. Top Stroke Rehabil. 2005;12(3):66–76.

783. Wallace SA, Roe B, Williams K, Palmer M. Bladder training for urinary incontinence in adults. The Cochrane Database Syst Rev. 2004, Issue 1. CD001308.

784. Nabi G, Cody JD, Ellis G, Hay-Smith J, Herbison GP. Anticholinergic drugs versus placebo for overactive bladder syndrome in adults. Cochrane Database Syst Rev. 2006, Issue 4. CD003781.

785. Gross JC, Faulkner EA, Goodrich SW, Kain ME. A patient acuity and staffing tool for stroke rehabilitation inpatients based on the FIM instrument. Rehabil Nurs. 2001 May-Jun;26(3):108–13.

786. Gerber DA, Good DC, Laven LJ, Verhulst SJ. Causes of urinary incontinence after acute hemispheric stroke. Stroke. 1993;24(3): 378–81.

787. Eustice S, Roe B, Paterson J. Prompted voiding for the management of urinary incontinence in adults. Cochrane Database Syst Rev. 2000, Issue 2. Art. No.: CD002113. DOI: 10.1002/14651858.CD002113. 2000.

788. Niël-Weise BS, van den Broek PJ. Urinary catheter policies for long-term management of voiding in adults. Niël-Weise BS, van den Broek PJ. Urinary catheter policies for long-term management of voiding in adults. Cochrane Database Syst Rev. 2005, Issue 1. CD004201.

789. Urinary Incontinence Guideline panel. Incontinence in Adults: quick refererence Guide for Clinicians. Journal of Pharmaceutical Care in Pain and Symptoms Control. 1993;1(2):53.

790. Johanna Briggs Institute. Management of Short term Indwelling Urethral Catheters to prevent Urinary Tract Infections: Evidence Based Practice Information Sheets for Health Professionals. 2000;4(1).

791. Quigley PA, Riggin OZ. A comparison of open and closed catheterization techniques in rehabilitation patients. Rehabil Nurs. 1993;18(1):26–9, 33.

792. Harari D, Coshall C, Rudd AG, Wolfe CD. New-onset fecal incontinence after stroke: prevalence, natural history, risk factors, and impact. Stroke. 2003;34:144–50.

793. Harari D, Norton C, Lockwood L, Swift C. Treatment of constipation and fecal incontinence in stroke patients: randomized controlled trial. Stroke. 2004;35(11):2549–55.

794. Venn MR, Taft L, Carpentier B, Applebaugh G. The influence of timing and suppository use on efficiency and effectiveness of bowel training after a stroke. Rehabil Nurs. 1992;17(3):116–20.

795. Munchiando JF, Kendall K. Comparison of the effectiveness of two bowel programs for CVA patients. Rehabil Nurs. 1993;18(3):168–72.

796. Hackett ML, Yapa C, Parag V, Anderson CS. Frequency of depression after stroke: A systematic review of observational studies. Stroke. 2005;36(6):1330–40.

797. Poynter B, Shuman M, Diaz-Granados N, Kapral M, Grace SL, Stewart DE. Sex differences in the prevalence of post-stroke depression: A systematic review. Psychosomatics. 2009;50(6):563–9.

798. Burvill PW, Johnson GA, Jamrozik KD , Anderson CS , Stewart-Wynne EG, Chakera TM. Anxiety disorders after stroke: results from the Perth Community Stroke Study. Br J Psychiatry. 1995;166:328–32.

799. Hackett ML, Anderson CS. Predictors of depression after stroke: A systematic review of observational studies. Stroke. 2005;36(10): 2296–301.

800. Aben I, Verhey F, Lousberg R, Lodder J, Honig A. Validity of the Beck Depression Inventory, Hospital Anxiety and Depression Scale, SCL-90, and Hamilton Depression Rating Scale as screening instruments for depression in stroke patients. Psychosomatics. 2002;43(5):386–93.

801. Bennett HE, Thomas SA, Austen R, Morris AM, Lincoln NB. Validation of screening measures for assessing mood in stroke patients. Br J Clin Psychol. 2006;45(3):367–76.

802. Aström M. Generalized anxiety disorder in stroke patients. A 3-year longitudinal study. Stroke. 1996;27(2):270–5.

803. House A, Dennis M, Mogridge L, Warlow C, Hawton K, Jones L. Mood disorders in the year after first stroke. Br J Psychiatry. 1991;158(JAN.):83–92.

804. McHale M, Hendrikz J, Dann F, Kenardy J. Screening for depression in patients with diabetes mellitus. Psychosom Med. 2008;70(8):869–74.

805. Benaim C, Cailly B, Perennou D, Pelissier J. Validation of the aphasic depression rating scale. Stroke. 2004;35(7):1692–6.

806. Hackett ML, Anderson CS, House A, Halteh C. Interventions for preventing depression after stroke. Cochrane Database Syst Rev. 2008, Issue 3. CD003689.

807. Hackett ML, Yang M, Anderson CS, Horrocks JA, House A. Pharmaceutical interventions for emotionalism after stroke. Cochrane Database Syst Rev. 2008, Issue 2. CD003690.

808. Mitchell PH, Veith RC, Becker KJ, Buzaitis A, Cain KC, Fruin M, et al. Brief psychosocial-behavioral intervention with antidepressant reduces poststroke depression significantly more than usual care with antidepressant: living well with stroke: randomized, controlled trial. Stroke. 2009;40(9):3073–8.

809. Hackett ML, Yang M, Anderson CS, Horrocks JA, House A. Pharmaceutical interventions for emotionalism after stroke. Cochrane Database Syst Rev. 2010, Issue 2. CD003690.

810. Sims J, Galea M, Taylor N, Dodd K, Jespersen S, Joubert L, et al. Regenerate: assessing the feasibility of a strength-training program to enhance the physical and mental health of chronic post stroke patients with depression. Int J Geriatr Psychiatry. 2009;24(1):76–83.

811. Brittle N, Patel S, Wright C, Baral S, Versfeld P, Sackley C. An exploratory cluster randomized controlled trial of group exercise on mobility and depression in care home residents. Clin Rehabil. 2009;23(2):146–54.

812. Lennon O, Carey A, Gaffney N, Stephenson J, Blake C. A pilot randomized controlled trial to evaluate the benefit of the cardiac rehabilitation paradigm for the non-acute ischaemic stroke population. Clin Rehabil. 2008;22(2):125–33.

813. Smith PS, Thompson M. Treadmill training post stroke: are there any secondary benefits? A pilot study. Clin Rehabil. 2008;22(10-11):997–1002.

814. Lai SM, Studenski S, Richards L, Perera S, Reker D, Rigler S, et al. Therapeutic exercise and depressive symptoms after stroke. J Am Geriatr Soc. 2006;54(2):240–7.

815. Van der Wurff FB, Stek ML, Hoogendijk WL, Beekman ATF. Electroconvulsive therapy for the depressed elderly. Cochrane Database Syst Rev. 2003, Issue 2. CD003593.

816. Kelly G, Brown S, Todd J, Kremer P. Challenging behaviour profiles of people with acquired brain injury living in community settings. Brain Injury. 2008;22(6):457–70.

817. Murray J, Young J, Forster A. Review of longer-term problems after a disabling stroke. Reviews in Clinical Gerontology. 2007;17:277–92.

818. Hochstenbach J, Prigatano G, Mulder T. Patients' and realtives' reports of disturbances nine months after stroke: subjective changes in physical functioning, cognition, emotion and behaviour. Arch Phys Med Rehabil. 2005;86:87–93.

819. Stone J, Townend E, Kwan J, Dennis MS, Sharpe M. Personality change after stroke: some preliminary observations. J Neurol Neurosurg Psychiatry. 2004;75:1708–13.

820. Alderman N, Burgess PW-. A Comparison of treatment methods for behaviour disorder following herpes simplex encephalitis. Neuropsychol Rehabil. 1994;4(1):31–48.

821. Yody BB, Schaub C, Conway J, Peters S, Strauss D, Helsinger S. Applied Behaviour Management and Acquired Brain Injury: Approaches and Assessment. J Head Trauma Rehabil. 2000;15(4):1041–60.

822. Giles GM, Manchester D. Two Approaches to Behavior Disorder after Traumatic Brain Injury. J Head Trauma Rehabil. 2006;21(2):168–78.

823. Sherman DG. Prevention of Venous Thromboembolism, Recurrent Stroke, and Other Vascular Events After Acute Ischemic Stroke: The Role of Low-Molecular-Weight Heparin and Antiplatelet Therapy. J Stroke Cerebrovasc Dis. 2006;15(6):250–9.

824. Andre C, De Freitas GR, Fukujima MM. Prevention of deep venous thrombosis and pulmonary embolism following stroke: A systematic review of published articles. Eur J Neurol. 2007;14(1):21–32.

825. National Health and Medical Research Council. Clinical practice guideline for the prevention of venous thromboembolism (deep vein thrombosis and pulmonary embolism) in patients admitted to Australian hospitals. Melbourne: National Health and Medical Research Council 2009.

826. Goodacre S, Sampson F, Stevenson M, Wailoo A, Sutton A, Thomas S, et al. Measurement of the clinical and cost-effectiveness of non-invasive diagnostic testing strategies for deep vein thrombosis. Health Technology Assessment. 2006;10(15):iii–99.

827. Bernhardt J. Inactive and alone: physical activity within the first 14 days of acute stroke unit care. Stroke. 2004;35(4):1005–9.

828. Sandercock PAG, Counsell C, Gubitz GJ, Tseng MC. Antiplatelet therapy for acute ischaemic stroke. Cochrane Database Syst Rev. 2008, Issue 3. CD000029.

829. Shorr AF, Jackson WL, Sherner JH, Moores LK. Differences between low-molecular-weight and unfractionated heparin for venous thromboembolism prevention following ischemic stroke: A metaanalysis. Chest. 2008;133(1):149–55.

830. Mazzone C, Chiodo GF, Sandercock P, Miccio M, Salvi R. Physical methods for preventing deep vein thrombosis in stroke. Cochrane Database Syst Rev. 2004, Issue 4. CD001922.

831. Clots Trial Collaboration. Effectiveness of thigh-length graduated compression stockings to reduce the risk of deep vein thrombosis after stroke (CLOTS trial 1): a multicentre, randomised controlled trial. The Lancet. 2009;373(9679):1958–65.

832. McInnes E, Bell-Syer SE, Dumville JC, Legood R, Cullum NA. Support surfaces for pressure ulcer prevention. Cochrane Database Syst Rev. 2008, Issue 4. CD001735.

833. Pancorbo-Hidalgo PL, Garcia-Fernandez FP, Lopez-Medina IM, Alvarez-Nieto C. Risk assessment scales for pressure ulcer prevention: A systematic review. J Adv Nurs. 2006;54(1):94–110.

834. Baba-Akbari Sari A, Flemming K, Cullum NA, Wollina U. Therapeutic ultrasound for pressure ulcers. Cochrane Database Syst Rev. 2006, Issue 3. CD001275.

835. Langer G, Schloemer G, Knerr A, Kuss O, Behrens J. Nutritional interventions for preventing and treating pressure ulcers. Cochrane Database Syst Rev. 2003, Issue 4. CD003216.

836. Royal College of Nursing, National Institute for Health and Clinical Excellence. The management of pressure ulcers in primary and secondary care: A clinical practice guideline. June 2005.

837. Jorgensen L, Engstad T, Jacobsen BK. Higher incidence of falls in long-term stroke survivors than in population controls: depressive symptoms predict falls after stroke. Stroke. 2002;33(2):542–7.

838. Tutuarima JA, Van der Meulen JH, Haan RJ. Risk factors for falls of hospitalised stroke patients. Stroke. 1997;28:297–301.

839. Yates JS, Lai SM, Duncan PW, Studenski S. Falls in community-dwelling stroke survivors: an accumulated impairments model. J Rehabil Res Dev Clin Suppl. 2002;39(3):385–94.

840. Teasell R, McRae M, Foley N, Bhardwaj A. The incidence and consequences of falls in stroke patients during inpatient rehabilitation: factors associated with high risk. Arch Phys Med Rehabil. 2002;83(3): 329–33.

841. Hyndman D, Ashburn A, Stack E. Fall events among people with stroke living in the community: circumstances of falls and characteristics of fallers. Arch Phys Med Rehabil. 2002;83(2):165–70.

842. Wagner LM, Phillips VL, Hunsaker AE, Forducey PG. Falls among community-residing stroke survivors following inpatient rehabilitation: A descriptive analysis of longitudinal data. BMC Geriatrics. 2009;9(1)(46).

843. Harris JE, Eng JJ, Marigold DS, Tokuno CD, Louis CL. Relationship of balance and mobility to fall incidence in people with chronic stroke. Phys Ther. 2005;85(2):150–8.

844. Blum L, Korner-Bitensky N. Usefulness of the Berg Balance Scale in stroke rehabilitation: a systematic review. Phys Ther. 2008;88(5): 559–66.

845. Schmid A, Acuff M, Doster K, Gwaltney-Duiser A, Whitaker A, Damush T, et al. Poststroke fear of falling in the hospital setting. Top Stroke Rehabil. 2009;16(5):357–66.

846. Parker MJ, Gillespie LD, Gillespie WJ. Hip protectors for preventing hip fractures in the elderly. Cochrane Database Syst Rev. 2005, Issue 3. CD001255.

847. Cumming RG, Sherrington C, Lord SR, Simpson JM, Vogler C, Cameron ID, et al. Cluster randomised trial of a targeted multifactorial intervention to prevent falls among older people in hospital. Br Med J. 2008;336(7647):758–60.

848. Barreca S, et al. Effects of extra training on the ability of stroke survivors to perform an independent sit-to-stand: a randomized controlled trial. J Geriatr Phys Ther. 2004;27(2):59–64.

849. Marigold DS, Eng JJ, Dawson AS, Inglis JT, Harris JE, Gylfadottir S. Exercise leads to faster postural reflexes, improved balance and mobility, and fewer falls in older persons with chronic stroke. J Am Geriatr Soc. 2005;53(3):416–23.

850. Green J, Forster A, Bogle S, Young J. Physiotherapy for patients with mobility problems more than 1 year after stroke: a randomised controlled trial. Lancet. 2002;359(9302):199–203.

851. Cheng PT, Wu SH, Liaw MY, Wong AM, Tang FT. Symmetrical body-weight distribution training in stroke patients and its effect on fall prevention. Arch Phys Med Rehabil. 2001;82:1650–54.

852. Cheng PT, Wang CM, Chung CY, Chen CL. Effects of visual feedback rhythmic weight-shift training on hemiplegic stroke patients. Clin Rehabil. 2004;18(7):747–53.

853. Yaggi H, Mohsenin V. Obstructive sleep apnoea and stroke. Lancet neurol. 2004;3(6):333–42.

854. Giles TL, Lasserson TJ, Smith BH, White J, Wright J, Cates CJ. Continuous positive airways pressure for obstructive sleep apnoea in adults. Cochrane Database Syst Rev. 2006, Issue 3. CD001106.

855. Wessendorf TE, Wang YM, Thilmann AF, Sorgenfrei U, Konietzko N, Teschler H. Treatment of obstructive sleep apnoea with nasal continuous positive airway pressure in stroke. Eur Respir J. 2001;18(4):623–9.

856. Sandberg O, Franklin KA, Bucht G, Eriksson S, Gustafson Y. Nasal continuous positive airway pressure in stroke patients with sleep apnoea: a randomized treatment study. Eur Respir J. 2001;18(4):630–4.

857. Hsu CY, Vennelle M, Li HY, Engleman HM, Dennis MS, Douglas NJ. Sleep-disordered breathing after stroke: a randomised controlled trial of continuous positive airway pressure. J Neurol Neurosurg Psychiatry. 2006;77(10):1143–9.

858. Lim J, Lasserson T, Fleetham J, Wright J. Oral appliances for obstructive sleep apnoea. Cochrane Database Syst Rev. 2004, Issue 4. CD004435.

859. Sundaram S, Lim J, Lasserson TJ. Surgery for obstructive sleep apnoea in adults. Cochrane Database Syst Rev. 2005, Issue 4. CD001004.

860. Smith I, Lasserson TJ, Wright J. Drug treatments for obstructive sleep apnoea. Cochrane Database Syst Rev. 2006, Issue 2. CD003002.

861. Jokic R, Klimaszewski A, Crossley M, Sridhar G, Fitzpatrick MF. Positional treatment vs continuous positive airway pressure in patients with positional obstructive sleep apnea syndrome. Chest. 1999;115(3): 771–81.

862. Fu D, Fu H, McGowan P, Shen YE, Zhu L, Yang H, et al. Implementation and quantitative evaluation of chronic disease self-management programme in Shanghai, China: randomized controlled trial. Bull World Health Organ. 2003;81(3):174–82.

863. Lorig KR, Ritter P, Stewart AL, Sobel DS, Brown BW, Jr., Bandura A, et al. Chronic disease self-management program: 2-year health status and health care utilization outcomes. Medical Care. 2001;39(11):1217–23.

864. Lorig KR, Sobel DS, Stewart AL, Brown BW, Jr., Bandura A, Ritter P, et al. Evidence suggesting that a chronic disease self-management program can improve health status while reducing hospitalization: a randomized trial. Medical Care. 1999;37(1):5–14.

865. Warsi A, Wang PS, LaValley MP, Avorn J, Solomon DH. Self-management education programs in chronic disease: a systematic review and methodological critique of the literature. Arch Intern Med. 2004;164(15):1641–9.

866. Kendall E, Catalano T, Kuipers P, Posner N, Buys N, Charker J. Recovery following stroke: The role of self-management education. Soc Sci Med. 2007;64(3):735–46.

867. Kendall E, Catalano T, Kuipers P, Posner N, Buys N, Charker J, et al. Recovery following stroke: the role of self-management education. Soc Sci Med. 2007;64(3):735–46.

868. Pound P, Gompertz P, Ebrahim S. A patient-centred study of the consequences of stroke. Clin Rehabil. 1998;12(4):338–47.

869. Griffen JA, Rapport LJ, Bryer RC, Scott CA. Driving status and community integration after stroke. Top Stroke Rehabil. 2009;16(3):212–21.

870. Radford KA, Lincoln NB. Concurrent validity of the stroke drivers screening assessment. Arch Phys Med Rehabil. 2004 Feb;85(2): 324–8.

871. Korner-Bitensky NA, Mazer BL, Sofer S, Gelina I, Meyer MB, Morrison C, et al. Visual testing for readiness to drive after stroke: a multicenter study. Am J Phys Med Rehabil. 2000;79(3):253–9.

872. Nouri FM, Lincoln NB. Predicting driving performance after stroke. Br Med J. 1993;307:482–3.

873. Mazer BL, Korner-Bitensky NA, Sofer S. Predicting ability to drive after stroke. Arch Phys Med Rehabil. 1998;79(7):743–50.

874. National Transport Commission. Assessing Fitness to Drive for commercial and private drivers. Draft medical standards for licensing and clinical management guidelines. Accessed from http://www.ntc.gov.au/filemedia/Reports/ReviewAssessFitDriveGlinesApr10.pdf; 2010.

875. Unsworth CA. Development and current status of occupational therapy driver assessment and rehabilitation in Victoria, Australia. Aust Occup Ther J. 2007;54:153–56.

876. Lovell R, Russell K. Developing referral and reassessment criteria for drivers with dementia. Aust Occup Ther J. 2005;52:26–33.

877. Klavora P, Heslegrave RJ, Young M. Driving skills in elderly persons with stroke: comparison of two new assessment options. Arch Phys Med Rehabil. 2000;81(6):701–5.

878. Unsworth CA, Lovell R, Terrington N, Thomas S. Review of tests contributing to the occupational therapy off-road driver assessment. Aust Occup Ther J. 2005;52:57–74.

879. Kay L, Bundy A, Clemson L. Predicting fitness to drive using the visual recognition slide test (USyd). Am J Occup Ther. 2008;62:187–97.

880. Unsworth CA, Pallant J, Russell K, Germano C, Odell M. Validation of a Test of Road Law and Road Craft Knowledge With Older and/or Functionally Impaired Drivers. Am J Occup Ther. 2010;64(2):306–15.

881. Akinwuntan AE, DeWeerdt W, Feys H, Baten G, Arno P, Kiekens C. Reliability of a road test after stroke. Arch Phys Med Rehabil. 2003;84(12):1792–6.

882. DiStefano M, Macdonald W. Assessment of older drivers: Relationships among on-road errors, medical conditions and test outcome. J Safety Res. 2003;34:415–29.

883. Akinwuntan AE, De Weerdt W. Effect of simulator training on driving after stroke: A randomized controlled trial. Neurology. 2005;65(6): 843–50.

884. Crotty M, George S. Retraining visual processing skills to improve driving ability after stroke. Arch Phys Med Rehabil. 2009;90(12): 2096–102.

885. Sjogren K F-MAR. Adjustment to life after stroke with special reference to sexual intercourse and leisure. J Psychosom Res. 1982;26:409–17.

886. Corr S, Phillips CJ, Walker M. Evaluation of a pilot service designed to provide support following stroke: a randomized cross-over design study. Clin Rehabil. 2004;18(1):69–75.

887. Desrosiers J, Noreau L, Rochette A, Carbonneau H, Fontaine L, Viscogliosi C, et al. Effect of a Home Leisure Education Program After Stroke: A Randomized Controlled Trial. Arch Phys Med Rehabil. 2007;88(9):1095–100.

888. Daniel K, Wolfe CDA, Busch MA, McKevitt C. What are the social consequences of stroke for working-aged adults?: a systematic review. Stroke. 2009;40(6):e431-e40.

889. Wozniak MA, Kittner SJ. Return to work after ischemic stroke: a methodological review. Neuroepidemiology. 2002;21(4):159–66.

890. van Velzen JM, van Bennekom CAM, Edelaar MJA, Sluiter JK, Frings-Dresen MHW. How many people return to work after acquired brain injury? A systematic review. Brain Injury. 2009;23(6):473–88.

891. Bray GP, DeFrank RS, Wolfe TL. Sexual functioning in stroke survivors. Arch Phys Med Rehabil. 1981;62(6):286–288.

892. Boldrini P, Basaglia N, Calanca MC. Sexual changes in hemiparetic patients. Arch Phys Med Rehabil. 1991;72:202–7.

893. Korpelainen JT, Nieminen P, Myllyla VV. Sexual functioning among stroke patients and their spouses. Stroke. 1999;30(4):715–9.

894. Hawton K. Sexual adjustment of men who have had strokes. J Psychosom Res. 1984;28(3):243–9.

895. Giaquinto S, Buzzelli S, Di Francesco L, Nolfe G. Evaluation of sexual changes after stroke. J Clin Psychiatry. 2003;64(3):302–7.

896. Aloni R, Schwartz J, Ring H. Sexual function in post-stroke female patients. Sexuality & Disability. 1994;12(3):191–9.

897. McCormick GP, Riffer DJ, Thompson MM. Coital positioning for stroke afflicted couples. Rehabil Nurs. 1986;11:17–9.

898. Glass TA, Maddox GL. The quality and quantity of social support: stroke recovery as psycho-social transition. Soc Sci Med. 1992;34(11):1249–61.

899. Friedland JF, McColl M. Social support intervention after stroke: results of a randomized trial. Arch Phys Med Rehabil. 1992;73(6):573–81.

900. Ch'ng AM, French D, McLean N. Coping with the challenges of recovery from stroke: long term perspectives of stroke support group members. J Health Psychol. 2008;13(8):1136–46.

901. Catalano T, Dickson P, Kendall E, Kuipers P, Posner TN. The perceived benefits of the chronic disease self-management program among participants with stroke: A qualitative study. Australian Journal of Primary Health. 2003;9(2–3):80–9.

902. Rigby H, Gubitz G, Phillips S. A systematic review of caregiver burden following stroke. Int J Stroke. 2009;4(4):285–92.

903. Brereton L, Carroll C, Barnston S. Interventions for adult family carers of people who have had a stroke: a systematic review. Clin Rehabil. 2007;21(10):867–84.

904. Lee J, Soeken K, Picot SJ. A meta-analysis of interventions for informal stroke caregivers. West J Nurs Res. 2007;29(3):344–56.

905. Eldred C, Sykes C. Psychosocial interventions for carers of survivors of stroke: a systematic review of interventions based on psychological principles and theoretical frameworks. Br J Health Psychol 2008;13(Pt 3):563–81.

906. Lui MHL, Ross FM, Thompson DR. Supporting family caregivers in stroke care: a review of the evidence for problem solving. Stroke. 2005;36(11):2514–22.

907. Visser-Meily A, van Heugten C, Post M, Schepers V, Lindeman E. Intervention studies for caregivers of stroke survivors: a critical review. Patient Educ Couns. 2005;56(3):257–67.

908. Lee J, Soeken K, Picot SJ, Lee J, Soeken K, Picot SJ. A meta-analysis of interventions for informal stroke caregivers. West J Nurs Res. 2007;29(3):344–56.

909. Hartke RJ, King RB. Telephone group intervention for older stroke caregivers. Top Stroke Rehabil. 2003;9(4):65–81.

910. Grant JS. Social problem-solving partnerships with family caregivers. Rehabil Nurs. 1999;24(6):254–60.

911. Pierce LL, Steiner V, Govoni AL, Hicks B, Cervantez Thompson TL, Friedemann ML. Internet-based support for rural caregivers of persons with stroke shows promise. Rehabil Nurs. 2004;29(3):95–9, 103.

912. Pierce LL, Steiner VL, Khuder SA, Govoni AL, Horn LJ. The effect of a Web-based stroke intervention on carers' well-being and survivors' use of healthcare services. Disabil Rehabil. 2009;31(20):1676–84.

913. Cadilhac DA, Carter R, Thrift AG, Dewey HM. Estimating the long-term costs of ischemic and hemorrhagic stroke for Australia: new evidence derived from the North East Melbourne Stroke Incidence Study (NEMESIS). Stroke. 2009;40(3):915–21.

914. Vos T, Corry J, Haby MM, Carter R, Andrews G. Cost-effectiveness of cognitive-behavioural therapy and drug interventions for major depression. Aust N Z J Psychiatry. 2005;39(8):683–92.

915. World Health Organisation. The World Health Report 2002: Reducing Risks, Promoting Healthy Lifestyle. Geneva: World Health Organisation.

916. Asplund PK. What MONICA told us about stroke. Lancet Neurology. 2005;4(1):64–8.

917. Thrift AG, Dewey HM, Sturm JW, S.L. P, A.K. G, V.K. S. Increasing stroke incidence with increasing levels of socioeconomic disadvantage. Australasian Epidemiologist. 2004;11(3):52–3.

918. van Exel NJA, Koopmanschap MA, Scholte op Reimer W, Niessen LW, Huijsman R. Cost-effectiveness of integrated stroke services. QJM. 2005;98(6):415–25.

919. Epifanov Y, Dodel R, Haacke C, Schaeg M, Schoffski O, Hennerici M, et al. Costs of acute stroke care on regular neurological wards: A comparison with stroke unit setting. Health Policy. 2007;81 (2–3):339–49.

920. Saka O, Serra V, Samyshkin Y, McGuire A, Wolfe CCDA. Cost-effectiveness of stroke unit care followed by early supported discharge. Stroke. 2009;40(1):24–9.

921. Brady BK, McGahan L, Skidmore B. Systematic review of economic evidence on stroke rehabilitation services. Int J of Technol Assess Health Care. 2005;21(1):15–21.

922. Moodie M, Cadilhac D, Pearce D, Mihalopoulos C, Carter R, Davis S, et al. Economic evaluation of Australian stroke services: A prospective, multicenter study comparing dedicated stroke units with other care modalities. Stroke. 2006;37(11):2790–5.

923. Patel A, Knapp M, Perez I, Evans A, Kalra L. Alternative Strategies for Stroke Care: Cost-Effectiveness and Cost-Utility Analyses from a Prospective Randomized Controlled Trial. Stroke. 2004;35(1):196–203.

924. Moodie ML, Carter R, Mihalopoulos C, Thrift AG, Chambers BR, Donnan GA, et al. Trial application of a Model of Resource Utilization, Costs, and Outcomes for Stroke (MORUCOS) to assist priority setting in stroke. Stroke. 2004;35(5):1041–6.

925. Sulch D, Perez I, Melbourn A, Kalra L. Randomized controlled trial of integrated (managed) care pathway for stroke rehabilitation. Stroke. 2000;31(8):1929–34.

926. Read SJ, Levy J. Effects of care pathways on stroke care practices at regional hospitals. Int Med J. 2006;36(10):638–42.

927. Quaglini S, Cavallini A, Gerzeli S, Micieli G. Economic benefit from clinical practice guideline compliance in stroke patient management. Health Policy. 2004;69(3):305–15.

928. Fjaertoft H, Indredavik B, Magnussen J, Johnsen R. Early supported discharge for stroke patients improves clinical outcome. Does it also reduce use of health services and costs? One-year follow-up of a randomized controlled trial. Cerebrovasc Dis. 2005;19(6):376–83.

929. Anderson C, Ni Mhurchu C, Brown PM, Carter K. Stroke Rehabilitation Services to Accelerate Hospital Discharge and Provide Home-Based Care: An Overview and Cost Analysis. Pharmacoeconomics. 2002;20(8):537.

930. Andersen C, Ni Mhurchu C, Rubenach S, Clark M, Spencer C, Winsor A. Home or hospital for stroke rehabilitation? Results of a randomised controlled trial. II: cost minimisation analysis at 6 months. Stroke. 2000;31(5):1032–7.

931. Andersen C, Rubenach S, Ni Mhurchu C, Clark M, Spencer C, Winsor A. Home or hospital for stroke rehabilitation? Results of a randomised controlled trial. I: health outcomes at 6 months. Stroke. 2000;31(5): 1024–31.

932. Andersson A, Levin, L.Å, Öberg, B., Månsson, L. Health care and social welfare costs in home-based and hospital-based rehabilitation after stroke. Scand J Caring Sci. 2002;16:386–92.

933. Beech R, Rudd AG, Tilling K, Wolfe CD. Economic consequences of early inpatient discharge to community-based rehabilitation for stroke in an inner-London teaching hospital. Stroke. 1999;30:729–35.

934. Gladman J, Whynes, D, Lincoln N. Cost comparison of domiciliary and hospital-based stroke rehabilitation. Age Ageing. 1994;23:241–5.

935. McNamee P, Christensen J, Soutter J, Rodgers H, Craig N, Pearson P, et al. Cost analysis of early supported hospital discharge for stroke. Age Ageing. 1998;27:345–51.

936. Roderick P, Low J, Day R, Peasgood T, Mullee MA, Turnbull JC, et al. Stroke rehabilitation after hospital discharge: a randomized trial comparing domiciliary and day-hospital care. Age Ageing. 2001; 30:303–10.

937. Young J, Forster, A. Day hospital and home physiotherapy for stroke patients: A comparative cost-effectiveness study. J R Coll Physicians Lond. 1993;27:252–8.

938. Tseng MC, Chang KC. Cost-effectiveness analysis of tissue plasminogen activator for acute ischemic stroke: a comparative review. Acta Neurologica Taiwanica. 2004;13(3):149–55.

939. Earnshaw SR, Wilson M, Mauskopf J, Joshi AV. Model-based cost-effectiveness analyses for the treatment of acute stroke events: A review and summary of challenges. Value in Health. 2009;12(4): 507–20.

940. Sandercock P, Berge E, Dennis M, Forbes J, Hand P, Kwan J, et al. Cost-effectiveness of thrombolysis with recombinant tissue plasminogen activator for acute ischemic stroke assessed by a model based on UK NHS costs. Stroke. 2004;35(6):1490–7.

941. Earnshaw SR, Jackson D, Farkouh R, Schwamm L. Cost-effectiveness of patient selection using penumbral-based MRI for intravenous thrombolysis. Stroke. 2009;40(5):1710–20.

942. Ehlers L, Müskens WM, Jensen LG, Kjolby M, Andersen G. National use of thrombolysis with alteplase for acute ischaemic stroke via telemedicine in Denmark: a model of budgetary impact and cost effectiveness. CNS Drugs. 2008;22(1):73–81.

943. Mihalopoulos C, Cadilhac DA, Moodie ML, Dewey HM, Thrift AG, Donnan GA, et al. Development and application of Model of Resource Utilization, Costs, and Outcomes for Stroke (MORUCOS): An Australian economic model for stroke. Int J Technol Assess Health Care. 2005;21(4):499–505.

944. Ward A, Roberts G, Warner J, Gillard S. Cost-effectiveness of botulinum toxin type a in the treatment of post-stroke spasticity. J Rehabil Med. 2005;37(4):252–7.

945. Murtagh J, Foerster V, Warburton RN, Lentle BC, Wood RJ, Mensinkai S, et al. Clinical and cost effectiveness of CT and MRI for selected clinical disorders: results of two systematic reviews. [Technology overview no 22]. Ottawa: Canadian Agency for Drugs and Technologies in Health.

946. Buskens E, Nederkoorn PJ, Buijs-Van Der Woude T, Mali WP, Kappelle LJ, Eikelboom BC, et al. Imaging of carotid arteries in symptomatic patients: cost-effectiveness of diagnostic strategies. Radiology. 2004;233(1):101–12.

947. Brown DL, Hoffman SN, Jacobs TL, Gruis KL, Johnson SL, Chernew ME. CT angiography is cost-effective for confirmation of internal carotid artery occlusions. J Neuroimaging. 2008;18(4):355–9.

948. Meenan RT, Saha S, Chou R, Swarztrauber K, Pyle Krages K, O'Keeffe-Rosetti MC, et al. Cost-effectiveness of echocardiography to identify intracardiac thrombus among patients with first stroke or transient ischemic attack. Med Decis Making. 2007;27(2):161–77.

949. Luengo-Fernandez R, Gray AM, Rothwell PM. Effect of urgent treatment for transient ischaemic attack and minor stroke on disability and hospital costs (EXPRESS study): a prospective population-based sequential comparison. Lancet Neurology. 2009;8(3):235–43.

950. Patel A, Knapp M, Evans A, Perez I, Kalra L. Training care givers of stroke patients: economic evaluation. Br Med J. 2004;328 (7448):1102.

951. Dewey HM, Thrift AG, Mihalopoulos C, Carter R, Macdonell RA, McNeil JJ, et al. Cost of stroke in Australia from a societal perspective: results from the North East Melbourne Stroke Incidence Study (NEMESIS). Stroke. 2001;32(10):2409–16.

952. Benade MM, Warlow CP. Costs and benefits of carotid endarterectomy and associated preoperative arterial imaging: a systematic review of health economic literature. Stroke. 2002;33 (2):629–38.

953. Nussbaum ES, Heros RC, Erickson DL. Cost-effectiveness of carotid endarterectomy. Neurosurgery. 1996 Cited as structured abstract from NHS Economic Evaluation Database (NHSEED). 2007;38:237–44.

954. Henriksson M, Lundgren F, Carlsson P. Cost-effectiveness of endarterectomy in patients with asymptomatic carotid artery stenosis. Br J Surg. 2008;95(6):714–20.

955. Holloway RG, Benesch CG, Rahilly CR, Courtright CE. A systematic review of cost-effectiveness research of stroke evaluation and treatment. Stroke. 1999;30(7):1340–9.

956. Gage BF, Cardinalli, A.B., Albers, G.W., Owens, D.K. Cost-effectiveness of preference-based antithrombotic therapy for patients with nonvalvular atrial fibrillation. Stroke. 1998;29:1083–91.

957. Eckman MH, Levine HJ, Pauker SG. Decision analytic and cost-effectiveness issues concerning anticoagulant prophylaxis in heart disease. Chest. 1992;102:538S–49S.

958. Lightowlers S, McGuire, A. Cost-effectiveness of anticoagulation in non-rheumatic atrial fibrillation in the primary prevention of ischemic stroke. Stroke. 1998;29:1827–32.

959. Sorensen SV, Dewilde SD, Singer DE, Goldhaber SZ, Monz BU, Plumb JM. Cost-effectiveness of warfarin: Trial versus "real-world" stroke prevention in atrial fibrillation. Am Heart J. 2009;157:1064–73.

960. Smith MG, Neville AM, Middleton JC. Clinical and economic benefits of ramipril: An Australian analysis of the HOPE study. Intern Med J. 2003;33(9–10):414–9.

961. Tavakoli M, Pumford N, Woodward M, Doney A, Chalmers J, MacMahon S, et al. An economic evaluation of a perindopril-based blood pressure lowering regimen for patients who have suffered a cerebrovascular event. Eur J Health Econ. 2009;10(1):111–9.

962. PROGRESS-Collaborative-Group. Randomised trial of a perindopril-based blood-pressure-lowering regimen among 6,105 individuals with previous stroke or transient ischaemic attack. Lancet. 2001;358(9287):1033–4.

963. Chambers M, Hutton J, Gladman J. Cost-effectiveness analysis of antiplatelet therapy in the prevention of recurrent stroke in the UK: Aspirin, dipyridamole and aspirin-dipyridamole. Pharmacoeconomics. 1999;16(5 II):577–93.

964. Marissal JP, Selke B, Amarenco P. Economic assessment of the secondary prevention of ischaemic stroke with dipyridamole plus aspirin (Aggrenox(registered trademark)/Asasantin(registered trademark)) in France. Pharmacoeconomics. 2004;22(10):661–70.

965. Schleinitz MD, Weiss JP, Owens DK. Clopidogrel versus aspirin for secondary prophylaxis of vascular events: A cost-effectiveness analysis. Am J Med. 2004;116(12):797–806.

966. Heeg B, Damen J, Van Hout B. Oral antiplatelet therapy in secondary prevention of cardiovascular events: An assessment from the payer's perspective. Pharmacoeconomics. 2007;25(12):1063–82.

967. Malinina D, Zema C, Sander S, Serebruany V. Cost-effectiveness of antiplatelet therapy for secondary stroke prevention. Expert Rev Pharmacoecon Outcomes Res. 2007;7(4):357–63.

968. Matchar DB, Samsa GP, Liu S. Cost-effectiveness of antiplatelet agents in secondary stroke prevention: the limits of certainty. Value in Health. 2005;8(5):572–80.

969. Jones L, Griffin S, Palmer S, Main C, Orton V, Sculpher M, et al. Clinical effectiveness and cost-effectiveness of clopidogrel and modified-release dipyridamole in the secondary prevention of occlusive vascular events: A systematic review and economic evaluation. Health Technology Assessment. 2004;8(38):iii–108.

970. Sarasin FP, Gaspoz JM, Bounameaux H. Cost-effectiveness of new antiplatelet regimens used as secondary prevention of stroke or transient ischemic attack. Arch Intern Med. 2000;160(18):2773–8.

971. Shah H, Gondek K. Aspirin plus extended-release dipyridamole or clopidogrel compared with aspirin monotherapy for the prevention of recurrent ischemic stroke: A cost- effectiveness analysis. Clinical Therapeutics. 2000;22(3):362–70.

972. Heart Protection Study Collaborative Group. Lifetime cost effectiveness of simvastatin in a range of risk groups and age groups derived from a randomised trial of 20,536 people. Br Med J. 2006;333(7579):1145–50.

973. Annemans L, Lamotte M, Clarys P, Van Den Abeele E. Health economic evaluation of controlled and maintained physical exercise in the prevention of cardiovascular and other prosperity diseases. Eur J Cardiovasc Prev Rehabil. 2007 Dec;14(6):815–24.

974. Lowensteyn I, Coupal L, Zowall H, Grover SA. The cost-effectiveness of exercise training for the primary and secondary prevention of cardiovascular disease. J Cardiopulm Rehabil. 2000;20:147–55.

975. Ebrahim S. Cost-effectiveness of stroke prevention. Br Med Bull. 2000;56(2):557–70.

976. Shearer J, Shanahan M. Cost effectiveness analysis of smoking cessation interventions. Aust N Z J Public Health. 2006;30(5):428–34.

977. Tomson T, Helgason A, Gilljam H. Quitline in smoking cessation: a cost-effectiveness analysis. Int J Technol Assess Health Care. 2004;20(4):469–74.

978. Avenell A, Broom J, Brown TJ, Poobalan A, Aucott L, Stearns SC, et al. Systematic review of the long-term effects and economic consequences of treatments for obesity and implications for health improvement. Health Technology Assessment. 2004;8(21):iii–iv, 1–182.

979. Nicholl JPCPBJE. Health and healthcare costs and benefits of exercise. Pharmacoeconomics. 1994;5(2)):109–22.

980. Dalziel K, Segal L, Elley CR. Cost utility analysis of physical activity counselling in general practice. Aust N Z J Public Health. 2006;30(1):57–63.

981. Elley CR, Kerse N, Arroll B, Swinburn B, Ashton T, Robinson E. Cost-effectiveness of physical activity counselling in general practice. N Z Med J. 2004;117(1207):15p.

982. Sevick MA, Dunn AL, Morrow MS, Marcus BH, Chen GJ, Blair SN. Cost-effectiveness of lifestyle and structured exercise interventions in sedentary adults. Results of project ACTIVE. Am J Prev Med. 2000;19(1):1-8.

983. Marshall T. Evaluating national guidelines for prevention of cardiovascular disease in primary care. J Eval Clin Pract. 2005;11(5):452–61.

984. Murray CJL, Lauer JA, Hutubessy RCW, Niessen L, Tomijima N, Rodgers A, et al. Effectiveness and costs of interventions to lower systolic blood pressure and cholesterol: A global and regional analysis on reduction of cardiovascular-disease risk. Lancet. 2003;361 (9359):717–25.

985. Pocock SJ, McCormack V, Gueyffier F, Boutitie F, Fagard RH, Boissel JP. A score for predicting risk of death from cardiovascular disease in adults with raised blood pressure, based on individual patient data from randomised controlled trials. Br Med J. 2001;323(7304):75–81.

986. Sesso HD, Chen RS, L'Italien GJ, Lapuerta P, Lee WC, Glynn RJ. Blood Pressure Lowering and Life Expectancy Based on a Markov Model of Cardiovascular Events. Hypertension. 2003;42(5):885–90.

987. Pignone M, Mulrow CD. Evidence based management of hypertension: Using cardiovascular risk profiles to individualise hypertensive treatment. Br Med J. 2001;322(7295):1164–6.

988. Manuel DG, Lim J, Tanuseputro P, Anderson GM, Alter DA, Laupacis A. Revisiting Rose: strategies for reducing coronary heart disease. Br Med J. 2006;332(7542):659–62.

989. Cadilhac DA, Carter RC, Thrift AG, Dewey HM. Why invest in a national public health program for stroke? An example using Australian data to estimate the potential benefits and cost implications. Health Policy. 2007;83(2–3):287–94.

990. Royal Australian College of General Practitioners. Putting Prevention into Practice. Guidelines for the implementation of prevention in the general practice setting. 2nd ed. Melbourne: RACGP; 2006.

Index

A

Aboriginal and Torres Strait Islander 33, 133, 135

acupuncture 67, 81, 88, 102

agnosia 92, 95

alcohol 69, 104

anticoagulation therapy 56, 62, 63, 72, 75, 125

antiplatelet therapy 44, 61, 71-72, 74, 75, 108, 109, 125

anxiety See mood disturbance

aphasia 46, 79, 80, 89-90, 91, 106, 107

apraxia

- *limb* 94
- *speech* See dyspraxia of speech

audit 35, 49, 59, 60, 73, 81, 110, 132, 133, 136

B

behavioural change 108

blood glucose 55, 65, 120

blood pressure 44, 53, 59, 62, 64, 71, 88, 125, 126

C

care pathway 31, 34, 37, 48, 51, 120

cerebral oedema 63-64

cholesterol 44, 56, 73, 75, 126

community rehabilitation and follow-up services 37, 41-42, 47, 117

contracture 99, 100, 101, 132, 134

cost-effectiveness 119-126, 134

counselling 31, 47, 69, 70, 73, 92, 115, 116, 117, 126

D

data collection See audit

deep venous thrombosis 108

dehydration 83, 103, 104, 117

depression See mood disturbance

diet 69-70, 71, 75, 81, 82, 97, 104, 106, 126

discharge planning 30, 31, 35, 38, 39, 40, 106, 117, 136

domiciliary rehabilitation See rehabilitation: home-based

driving 84, 88, 113-114, 134

dysarthria 89, 91-92, 134

dysphagia 59, 62, 79, 81-82, 97, 98, 134

dysphasia See aphasia

dyspraxia of speech 89, 91

E

early mobilisation 35, 80, 108

early supported discharge 41, 42, 120, 121

education

- *carer* 42, 46, 47, 48, 92, 101, 104, 106, 108, 117
- *health professional* 30, 31, 34, 35, 37, 38, 49, 51, 65, 98, 101, 110, 133
- *public* 34, 51
- *stroke survivor* 42, 46, 47, 48, 69, 70, 101, 104, 106, 107, 108, 110, 113, 115, 116

executive function 92, 94

F

falls 39, 110, 134

family meetings 39, 47

fatigue 104

fitness 69, 85, 103, 107, 134

further research 56, 85, 98, 106, 122, 123, 124, 126, 134

G

general practitioner 31, 34, 39, 42, 43, 44, 47, 49, 133

glycaemic control 66, 71, 78

H

hemianopia 84, 113

hormone replacement therapy 75

hydration 82, 97-98, 108, 109

I

imaging

- *brain* 33, 34, 35, 36, 37, 38, 49, 54, 55, 61, 72, 123, 126, 136
- *cardiac* 54, 56, 124
- *carotid* 44, 54, 55, 56, 73, 74, 123, 136
- *CT* 34, 54, 55, 60, 61, 123, 136
- *MRI* 44, 54, 55, 60, 61, 123, 136

inattention See neglect

incontinence

- *faecal* 106, 109
- *urinary* 104-105, 109

inpatient stroke care coordinator 38

intracerebral haemorrhage 59, 62

- *management* 63-64

L

leisure 87, 89, 115

M

malnutrition 81, 97-98, 109

medication compliance 70, 71, 73

mood disturbance 106-107, 134

anxiety 46, 47, 106, 107, 115, 117

depression 46, 47, 80, 106, 107, 115, 117

multidisciplinary team 31, 35, 36, 40, 41, 46, 47, 135

N

nasogastric feeding 62, 97, 98, 108

neglect 89, 92, 95

O

obesity 69, 126

obstructive sleep apnoea 111

oral care 98

oral contraception 76

oxygen therapy 65, 119

P

pain

central post-stroke 102, 134

shoulder 99, 100, 101-102, 142

patent foramen ovale 75

PEG 97, 98

physical activity See fitness

post-discharge care plan 39, 40

pressure ulcers 109-110

pulmonary embolism 108-109

Q

quality improvement See audit

R

rehabilitation

ADL 41, 43, 79, 85, 87-88, 94, 95, 115

amount 34, 37, 59, 79, 108, 134

amount and intensity 35, 37, 79, 80, 81, 83, 85, 89, 134

cognitive 93-95

community 41-42, 47, 116, 117, 121, 122

cost-effectiveness 121-122

home-based 41, 122, 126

inpatient 36-37, 124

long-term 43

timing 34, 37, 59, 64, 79, 80, 89, 104, 108, 134

respite care 48, 117, 134

return to work 43, 115

rural and remote centres 33, 38, 39, 46, 60, 117, 134

S

secondary prevention 49, 53, 62, 69-76, 123, 124, 125, 126, 134

self-management 39, 46, 104, 113, 134

sexual function 115-116, 134

smoking 69, 70, 126

socioeconomic 119-126

spasticity 83, 87, 99, 100, 123, 126, 132, 134

stroke recognition 34, 51

stroke unit care 33, 34, 35-36, 41, 45, 49, 51, 63, 80, 108, 109, 120, 121, 123, 126

subluxation 101

support

carer 41, 47, 48, 117, 134

peer 116, 133, 134

swelling 103

T

team meeting 35, 39, 45, 46, 120, 136

telemedicine 34, 36, 38-39, 46, 60, 61, 122

telerehabilitation 38

telestroke 38-39, 59

thrombolysis 33, 34, 35, 37, 38, 51, 54, 55, 56, 59-60, 61, 64, 122, 123, 126, 132, 134, 137

intra-arterial (IAT) 61

training

carer 41, 117, 124, 126

transient ischaemic attack (TIA) 33, 44-45, 49, 51, 53-55, 56, 57, 61, 62, 69, 71, 72, 73, 74, 75, 113, 114, 120, 124, 125, 126, 134

transition care See community rehabilitation and follow-up services

triaging 34, 51

V

visual loss 84, 89, 113



National Stroke Foundation
Level 7, 461 Bourke Street
Melbourne VIC 3000
Phone +61 3 9670 1000
Fax +61 3 9670 9300
www.strokefoundation.com.au