

How to optimise rehabilitation and recovery after a stroke

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Abstract

Stroke can cause significant disability and impact quality of life.^{1,2} Multidisciplinary neurorehabilitation that meets individual needs, helps optimise recovery. Rehabilitation should start early and be ongoing, with effective teamwork, vital for best quality care. In this paper, we describe current stroke rehabilitation processes, from the hyperacute setting, through inpatient and community rehabilitation, to long-term care, and report where UK quality care standards are, and are not, currently being met. Further, we examine the gap between what is recommended and what is delivered in stroke rehabilitation and suggest areas for further improvement.

INTRODUCTION

Stroke is a leading cause of disability and fourth leading cause of death in the UK.³ It can cause impairments in many domains, including sensorimotor, language, vision, cognition, bladder control as well as unseen symptoms like fatigue, depression, emotional lability and anxiety. Optimal recovery requires neurorehabilitation, a process that includes specialist assessment, goal setting, development and execution of targeted interventions, with ongoing assessment of outcome. Through this process, individuals are supported to achieve their maximum potential in physical, cognitive, social, and psychological function, participation in society and a good quality of life.⁴

Best rehabilitation care involves the patient, their family and the care team made up of different disciplines who work together, in an interdisciplinary way, towards achieving the patients' goals, i.e. the Multidisciplinary Team (MDT).

The NICE guidelines, the Royal College of Physicians stroke rehabilitation, the Sentinel Stroke National Audit Programme (SSNAP), the American Stroke Association (ASA) guidelines outline agreed recommendations for quality stroke rehabilitation care, and help track and identify current care gaps. Working on the premise that if all clinical practice guidelines were adopted into routine care, patients' outcomes would significantly improve, we highlight in this paper the gaps between recommended best practice and actual care. Traditionally, evidence from guidelines usually comes from Randomised Controlled Trials. Neurorehabilitation is an emerging field, and while well conducted trials of new interventions are important, there is an argument that pragmatic, real world evidence (e.g. large good quality service evaluations and embedded learning health system approaches⁵) testing optimised models of rehabilitation should play more of a role in shaping guidelines, but that is currently not the case.

The UK post-stroke rehabilitation model has four main phases: acute and post-acute inpatient rehabilitation, community rehabilitation and long-term rehabilitation. These are not necessarily sequential, but should be well integrated and meet patients' needs. For illustration, we address acute, inpatient, community and long-term rehabilitation as representative phases of care and discuss gaps and opportunities for improvement in each.

Acute stroke rehabilitation

Stroke units usually include Hyper Acute Stroke Units (HASU), where people affected by stroke stay typically 2-3 days until medically stable, acute stroke wards and rehabilitation units (often combined) where rehabilitation continues, with support of a specialist multidisciplinary team.⁶

Organised stroke units reduce mortality and improve outcomes,⁷ and represent current gold-standard acute stroke care. However, SSNAP reports that only 77% of patients are taken directly to an organised stroke unit.⁸

Swallowing and continence should be assessed early. The early rehabilitation management plan needs comprehensive assessment of sensorimotor, language and cognitive impairments. Assessment for cognitive impairment and depression is often difficult⁹ but important because identifying problems early in these domains can improve long term outcomes. Mobility, personal care and speech and language interventions are often commenced in this acute phase, but ongoing uncertainty about the exact timing or dose exists. Early mobility training or 'mobilisation' is common^{10,11} but results from AVERT¹² show that intensive upright training started <24 hours of stroke worsens functional outcome.^{10,11} Subsequent dose-response analyses suggested that frequent, short daily interventions¹³ may be beneficial. UK guidelines now recommend that mobilisation commences after 24 hours post stroke,¹⁴ except for patients able to move themselves. The VERSE (Very Early Rehabilitation for SpEech) trial, which tested intensive aphasia therapy, started within 14 days of stroke, versus usual care, found no improvement in language outcomes over lower dose usual care.¹⁵

The clinicians' main role in the acute post-stroke phase is to recognise and treat medical complications that can emerge after a stroke (Table 1). This improves an individual's ability to

achieve their rehabilitation goals and be independent and living at home one year later.¹⁶ Clinicians are often asked to make predictions about recovery relatively early after stroke. In mild to moderate patients who are improving rapidly, we can usually be confident that they will do well. In more severely affected patients, prognosis is less certain, however, pessimism is best avoided at this stage. Given current uncertainty about possible recovery in the long term, particularly for those with more severe stroke, Lynch et al make the point that rehabilitation should be provided to those who can benefit, and that includes people with severe stroke. Therapeutic nihilism may result in lack of therapy that might improve function, and of the opportunity to demonstrate a positive response to therapy input. Lynch et al argue “If stroke experts and policy makers are not advocating for best evidence care...who will?”¹⁷

Medical complications post-stroke.

- *Arrhythmias. These can precede the stroke.*
- *Aspiration pneumonia is a common complication of patients with dysphagia, and guidelines suggest early bedside swallow assessment with adaptation of diet accordingly. However, this does not always happen, and it has been shown that delays cause increased risk of aspiration.*
- *Venous Thromboembolism (Pulmonary Embolism (PE) and Deep Venous Thrombosis (DVT)). Anticoagulation is not indicated in the acute phase, due to increased risk of haemorrhagic transformation. Exceptions are made for selected patients e.g., intracranial venous thrombosis, some patients with cervical or intracranial arterial dissection, or those at high risk of DVTs or*

PEs. Thigh-length Intermittent pneumatic compression has the strongest evidence for Venous Thromboembolism prophylaxis in immobile patients with acute ischaemic stroke.

- *Hyperglycaemia.*
- *Early post-stroke seizures/status epilepticus.*
- *Systemic infections.*
- *Pressure sores.*
- *Neurological deterioration. This should prompt early re-imaging to look for radiological changes such as with recurrent ischaemia/haemorrhage, cerebral oedema, mass effect, midline shift or hydrocephalus. Neurological deterioration can also accompany systemic illness, such as infections.*
- *Patients with large Middle Cerebral Artery infarcts are at risk of developing a malignant cerebral oedema and need to be monitored for this as might require decompressive hemicraniectomy.*
- *Hydrocephalus secondary to posterior circulation stroke. Early recognition and securing intervention (e.g., external ventricular drainage) can be lifesaving.*
- *Post-stroke shoulder pain.*
- *Limb spasticity (See Table 3).*

Table 1. List of the most common medical complications which need to be addressed from the early phases post-stroke.^{18,19}

Best evidence guidance for treatment of the many impairments that can be associated with stroke can be found in the American Stroke Association Guidelines²⁰.

While the acute inpatient stay can be very short, an experienced MDT starting rehabilitation in an organised stroke unit remains the gold standard.

Continuing specialist inpatient rehabilitation

Stroke rehabilitation healthcare in the UK is delivered through a complex network. NHS England defined a 3-tier system, described in more detail on the British Society of Rehabilitation Medicine website (See Table 2).⁴ Most inpatient rehabilitation is provided through level 3 rehabilitation services: general rehabilitation, for those least complex needs; level 2 specialist rehabilitation services for more complex care needs; and level 1 tertiary specialised services for the most complex patients. Large cohort studies show that specialist rehabilitation (level 1 and 2) result in better outcomes for more complex dependent patients, achieving long term cost-effectiveness through ongoing care savings.^{21,22}

Inpatient rehabilitation, which in England, Wales and Northern Ireland lasts on average 18 days (range between 2.1 and 21.6 days),²³ positively impacts patients' autonomy and recovery.^{24,25} NICE guidelines recommend that rehabilitation should start as early as possible, with a recommended minimum of 45 minutes daily of each required therapy, delivered at least 5 days a week.²⁶ SSNAP reports that these targets are not being met; with only 19% of speech and language therapy (SALT) and 37% of occupational therapy sessions meeting the 45 minutes targets per day 5 days a week between 2019 and 2020.⁶ Growing evidence suggests a short and distinct window for greatest recovery potential.^{27,28} We need to develop care systems that support higher intensity training to take advantage of this window.

Specialised Neurorehabilitation services

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| <p>Level 1</p> | <p>Specialised rehabilitation services.</p> <p>For stroke survivors with Category A needs.</p> <ul style="list-style-type: none"> • Level 1 a: for people with high physical dependency • Level 1 b: for people with mixed dependency • Level 1 c: for walking wounded people with cognitive/behavioural disabilities |
| <p>Level 2</p> | <p>Local (specialist) rehabilitation services</p> <p>Catchment population >350-500K</p> <ul style="list-style-type: none"> • Level 2 a: for people with a range of complexity, including Category B and some Category A with highly complex rehabilitation needs • Level 2 b: for people with Category B needs |
| <p>Level 3</p> | <p>Local non-specialist services</p> <p>Catchment population >1 million population</p> <ul style="list-style-type: none"> • Level 3 a: for people with Category C needs • Level 3 b: for people with Category D needs |

| Category A | Category B | Category C | Category D |
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| <p>Complex or profound disabilities, e.g. severe physical, cognitive communicative disabilities or challenging behaviours</p> | <p>Moderate to severe physical, cognitive, communicative disabilities and mild-moderate behavioural problems</p> | <p>Stroke specialist rehabilitation required</p> <p>Individuals may be medically unstable or require specialist</p> | <p>Wide range of comorbidities but usually medically stable</p> <p>Less intensive rehabilitation</p> |

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| <p>Stroke survivors require specialised facilities and more skilled staff, with one or more of:</p> <ul style="list-style-type: none"> · Intensive MDT intervention from 4 or more therapy disciplines in addition to specialist rehabilitation medicine/nursing care · Medium length to long term rehabilitation programme · Very high intensity staffing ratios, e.g. 1:1 nurse specialising, or individual patient therapy sessions with 2-3 trained therapists at any one time · Highest level facilities/equipment · Complex vocational rehabilitation <p>In addition, stroke survivors might require specialist input e.g. for tracheostomy weaning, clinical investigations and treatments, neuropsychiatric care,</p> | <p>Stroke survivors require rehabilitation from expert staff in a dedicated rehabilitation unit with appropriate specialist facilities, with one or more of the following:</p> <ul style="list-style-type: none"> · Intensive MDT from 2-4 therapy disciplines in addition to rehabilitation medicine/nursing care · Medium length rehabilitation · Special facilities/equipment or interventions · Interventions to support goals such as return to work or resumption of other extended activities of daily living · Management of ongoing medical problems | <p>medical investigation/procedures</p> <p>Usually less intensive rehabilitation intervention required, from 1-3 therapy disciplines in relatively short rehabilitation programmes (i.e. up to 6 weeks)</p> <p>Individuals are treated by a local specialist team which may be led by consultants in specialties other than Rehabilitative Medicine (e.g. neurology/stroke) and staffed by stroke therapists and nurses</p> | <p>intervention required, from 1-3 therapy disciplines in relatively short rehabilitation programmes (i.e. 6-12 weeks)</p> <p>Individuals receive an inpatient local non-specialist rehabilitation service which is led by non-medical staff</p> |
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Table 2. Summary of specialised neurorehabilitation services, adapted from the British Society of Rehabilitation Medicine website.⁴

UK policy strongly advocates adopting patient-centred care practices,^{29–31} which current care rarely provides.³² In rehabilitation, patients commonly experience boredom and lack autonomy.³³ The challenge of creating more active rehabilitation environments has seen a number of groups explore new models like environmental enrichment^{34,35,36} and program redesign to increase autonomy and engagement,³⁷ with varying degrees of success.³⁷

Identifying effective strategies to meet best practice rehabilitation guidelines, including standardised screening and higher-intensity training is a priority to optimise stroke rehabilitation and will require a fundamental shift in current approaches.³⁸

Stroke rehabilitation in the community

Although stroke and its sequelae represent a chronic disease, regular review and monitoring of goals after hospital is rare.³⁹ This is counter to the recommended target of reviews at 6 and 12 months.⁴⁰

People with stroke should be able to access rehabilitation at any stage of recovery when needed.²⁶ Unfortunately, 45% of stroke survivors feel abandoned when they leave hospital.³⁹ Current limits to rehabilitation duration make meeting guideline-specified goals for stroke rehabilitation challenging.⁴¹

Effective discharge planning requires coordination between the stroke team, the patient, their family, carers, the GP, and community rehabilitation teams. This activates the personal support a patient requires (e.g., with showering and dressing, equipment needs, etc.), the transfer of care and set up of a social care plan, which should include: diagnosis and health status, rehabilitation progress and onward goals, care needs, medical and psychological needs, mental capacity, management of risk and plans for follow-up.²⁴

Stroke patients in the UK should be offered Early Supported Discharge, which delivers rehabilitation at home. If provided by a coordinated MDT, it reduces long-term dependency, admission to institutional care and reduces the length of hospital stay.⁴² Early Supported Discharge should be offered to stroke patients with a safe and supportive home environment, who can independently, or with assistance, transfer from bed to chair.⁴³ It is estimated that 40% of stroke patients could benefit from it,⁴⁴ yet 19% of hospitals in the UK do not offer Early Supported Discharge services.^{39,45}

Stroke Community Rehabilitation Teams deliver rehabilitation at home after hospital discharge or after Early Supported Discharge. SSNAP reports variable access to CRT across England, Wales, and Northern Ireland and show that only 62% of non-acute Trusts/provider organisations provide CRT.⁶

In the UK over a third of stroke survivors are discharged to an Early Supported Discharge or Community Rehabilitation Team. A further 40% are discharged home without further rehabilitation.⁴⁶

A new National Stroke Service Model suggests integration of Early Supported Discharge and Community Stroke Rehabilitation into a Integrated Community Stroke Service (ICSS), which aims to coordinate support and ensure timely rehabilitation for patients irrespectively or their level of disability.⁴⁷

Rehabilitation is often time limited. In practice, available resources dictate the length of treatment, not whether a patient has the potential to continue to improve, contrary to the RCP guidelines.

Telerehabilitation is increasingly used to overcome challenges of access to rehabilitation services, particularly during the COVID-19 pandemic.⁴⁸ Telerehabilitation consists of virtual appointments, audio or video, and/or therapy delivery using a range of devices and software. The safety, effectiveness and cost-effectiveness of telerehabilitation have received significant attention.^{49,50} Some telerehabilitation barriers relate to end-user comfort with technology and to the inability to perform a physical examination.⁵⁰

Widespread implementation of telerehabilitation systems has yet to take place but could help to support rehabilitation in areas with poor access to services.

Some vocational rehabilitation programmes⁵¹ are available to support return to work after a stroke and should be available where people have specific rehabilitation needs related to their desire to return to work. NICE recommends that healthcare teams should identify the physical, cognitive, communication and psychological demands of the job, and work to put in place interventions to assist the person with stroke return to work. However, 2015 data showed that only 15% of patients in England, Wales, and Northern Ireland were receiving help to return to work.⁶ Patients should be informed about the Equality Act 2010, the support available and healthcare teams are urged to help patients complete temporary or long-term disability forms to access benefits where necessary.^{52,53} With increasing numbers of young stroke survivors, an important optimisation focus should be improving return to work services.⁵⁴

Long-term recovery

While the rate of recovery after stroke appears fastest in the first 3-6 months,⁹⁹ recovery can continue for many months, or even years, and may vary across different domains.

People with stroke should be supported throughout the entire stroke pathway, including provision of long-term support.⁶ Health and social care reviews are important to provide rehabilitation and medical support to stroke survivors and families or carers.⁵⁵ SSNAP reports that review timelines are often not met - nationally, fewer than 30% of people with stroke have 6-months reviews,⁶ and many struggle to re-enter the system if required.^{6,26} Better ways to ensure systematic follow-up, access to stroke services or further rehabilitation to support long-term goal achievement are needed to optimise outcomes for people with stroke.

Recently, clinical trials in New Zealand of the “Take Charge” intervention have shown positive effects on long term outcomes in people with stroke.⁵⁶ Take Charge aims to help stroke survivors create self-directed rehabilitation plans and meaningful goals. It is not therapist-led rehabilitation. Started within 6 weeks of discharge, this simple intervention has the potential to help people with mild and moderate stroke independently work on their own recovery. Similar patient-centred approaches have been described in the work of Sadler et al who developed a 6-week group-based peer support intervention to promote resilience after stroke.⁵⁷ Self management programmes such as Bridges are being implemented in the UK, typically provided as an “add on” to existing standard care.⁵⁸

Further evidence of an effect of a later (chronic stage) training programme is the Queen Square Upper Limb (QSUL) Neurorehabilitation programme, an example of an intervention that appears to lead to significant improvements in arm function and quality life many years after stroke. It is a

therapist-led intensive residential programme, which provides 90 hours of treatment over 6 weeks.⁵⁹

Other methods are emerging as potential treatments for self-directed rehabilitation, such as virtual and augmented reality⁶⁰

Rehabilitation can be effective long after stroke but there can be challenges in delivering it. Some approaches described above such as Take Charge, telerehabilitation, virtual/augmented reality, may help address this challenge. People with stroke very often have other conditions, therefore longer-term services need to dovetail with services for other conditions rather than retaining patients on a stroke-specific pathway indefinitely.

At routine follow-up, people with stroke might be seen by clinicians, nurses, or other health professionals from different specialties, depending on the stroke and rehabilitation unit set-up. Stroke doctors from all backgrounds should have a broad knowledge of stroke to be able to recognise and treat neurological (Table 3), cardiovascular, and medical complications post-stroke.⁶¹

| Complication | Intervention | Implication |
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| <p>Epilepsy</p> | <p>There is no evidence for prophylactic use of antiepileptics drugs (AEDs) for stroke.^{62,63} Seizures within one week from a stroke (early post-stroke seizures) do not necessarily require long-term treatment. Late post-stroke seizures ('unprovoked' or remote symptomatic seizures) are those occurring after a variable interval (days to years) following a stroke; these are generally regarded as seizures occurring at least 7 days after the stroke. Because of the risk of further seizures after even a single late post-stroke seizure, late post-stroke seizures do imply a diagnosis of post-stroke epilepsy. If the correct diagnosis is made, then there can be a good outcome with some studies reporting freedom from seizures with treatment in more than 80% of cases.⁶⁴ There is little evidence to guide choice of treatment but newer AEDs such as lamotrigine are often preferred in this setting given the better side-effect profile, particularly in older people.⁶⁵ Although not specific to a stroke population, the SANAD-2 trial findings also support this approach.</p> | <p>Seizures can impact rehabilitation, the person's wellbeing, and their autonomy (including driving). Diagnosis should be clinical, with a limited role of EEG. Most seizures post-stroke are focal, or with secondary generalisation.⁶⁶ Todd's paresis can also be confused as a recurrent stroke. Despite the challenge in the diagnosis, it is important to have a high level of suspicion and take a careful history.⁶⁷</p> |
| <p>Spasticity</p> | <p>Treatments include:⁶⁸</p> <p>A) Non-pharmacological treatments e.g., exercise and muscle strengthening, resistance training programmes, assistive technology, orthotics and splints, serial casting, constraint induced movement therapy, functional electrical stimulation, posture management.</p> <p>B) Pharmacological treatments such as botulinum toxin, phenol nerve/muscle blockade, intrathecal baclofen or phenol, oral agents like baclofen, dantrolene, tizanidine</p> <p>C) Surgical treatments whenever above not effective.</p> | <p>Post-stroke spasticity can become a significant disability and impact on the person's quality of life. It affects ~1/3 of survivors.⁶⁹ Key for deciding when to start treatment should be based on how disabling the spasticity is for the individual.⁷⁰</p> |

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| <p>Dysphagia</p> | <p>Usually diagnosed very early post-stroke. Refer to SALT and a dietitian if malnutrition is present. Feeding tube management if present or discussions about long-term feeding options might be necessary to ensure sufficient nutrition and to avoid aspiration pneumonia.</p> <p>Other interventions to reduce risk of aspiration include positioning, oral hygiene, influenza and pneumococcal vaccination.⁶⁷</p> | <p>People with dysphagia post-stroke are at high risk of developing aspiration pneumonia. Stroke survivors with severe dysphagia who are unable to swallow without a nasogastric tube (NGT), are often referred for percutaneous gastrostomy tube placement (PEG). This can take a few weeks and in the meantime, individuals might slowly recover their swallowing. NGT are however not allowed in many rehabilitation units, so swallowing decisions need to be made in the acute setting to facilitate the start of rehabilitation. Removal of PEG or other feeding tubes can be performed if swallowing improves.⁷¹</p> |
| <p>Fatigue</p> | <p>Exercise and physiotherapy may help fatigue. Pharmaceutical interventions are underway, including modafinil which is being tested in current trials.⁷² It is important to manage depression associated with fatigue.</p> | <p>Fatigue post-stroke is a subjective feeling of lack of physical and mental energy, which can impact a person's willpower and engagement with rehabilitation. It can also lead to depression.⁷³</p> |

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| <p>Sex and intimacy</p> | <p>Encouraging stroke survivors to discuss sexual problems and directing them to the right specialist can be challenging. Lifestyles advise, including exercise, a healthy diet, no smoking can improve sexual wellbeing. Depression can be a cause or consequence of sexual problems and should be investigated and treated. Some drugs cause side effects such as loss of libido. Couple counselling can provide professional support where couples are having difficulty to talk and address intimacy problems. SALT can provide support where language is impaired, impacting communication within the couple. Neuropathic pain and spasticity have a negative impact on sex, so lubricants, analgesia, position change, treatments for spasticity can help. For people with fatigue post-stroke, sex in the morning when there is more energy can overcome problems with tiredness. Erection problems can be treated with phosphodiesterase-5 inhibitors, vacuum pumps, and alprostadil. Vaginal dryness can be treated with lubricants, vaginal moisturisers, vaginal oestrogen, hormone replacement therapy.^{74,75}</p> | <p>Problems with sexuality can affect stroke survivors, with profound consequences on mood, engagement with rehabilitation, self-confidence, and relationship with partners. However, doctors rarely discuss this. It is debated about which is the best specialty to deal with sex and intimacy problems post-stroke. A study by McGrath et al.⁷⁶ showed that the disciplines stroke survivors and clinicians think should address sexuality and intimacy include at the top of the list rehab clinicians, whereas neurologists are ranked as intermediate high.</p> |
| <p>Neurogenic bowel or bladder</p> | <p>Training stroke survivors and caregivers on nutrition, regular/timed voiding, measuring void residuals, pelvic exercise, mobility. Indwelling bladder catheters should be avoided if possible, to avoid risks of infection. Medications can be started if necessary, including anticholinergics, alpha blockers, mirabegron, botulinum toxin for bladder problems, or laxatives and antispasmodics for bowel dysfunction.⁷⁷</p> | <p>Urinary and bowel symptoms are associated with poorer baseline function and more severe strokes. Early involvement of urologists, gastroenterologists, dietitians should be sought to facilitate better outcomes, avoid risk of malnutrition, constipation, ileus, skin breakdown, UTI or kidney injury.⁷⁸</p> |
| <p>Neuropathic pain</p> | <p>According to NICE, medications of choice are amitriptyline, duloxetine, gabapentin, or pregabalin.⁷⁹ Tramadol is considered as required, but to be avoided long-term. Capsaicin can be used for localised pain where above medications are not appropriate. Non-pharmacological treatments recommended are physiotherapy, exercise, neurological retraining.^{18,77}</p> | <p>Neuropathic pain is often a limiting factor for an effective rehabilitation program, so should be addressed early. It also increases risk of depression, immobility, with secondary functional decline. For complex cases, a specialist pain team service should be involved.⁸⁰</p> |

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| <p>Cognitive impairment</p> | <p>Prevention and treatment of cognitive decline post-stroke currently consists mainly of lifestyle interventions and secondary prevention, with the aim to reduce the vascular risk factors and total vascular burden. However, there is no strong evidence to prove efficacy of these strategies, to date. Early rehabilitation is thought to limit damage from the stroke and improve overall outcomes.⁸¹</p> | <p>No gold standard exists for cognitive screening post-stroke, although it should be undertaken as evidence shows that 10% new strokes develop new dementia soon after their first stroke and more than 1/3 develop dementia after recurrent stroke.⁸² It can involve different domains such as attention, memory, orientation, language, executive functions, neglect, apraxia, and agnosia.</p> |
| <p>Depression</p> | <p>Standard pharmacotherapy and/or psychotherapy for the treatment of depression are applicable also to people with stroke.⁸³ Exercise can also be helpful.⁸⁴</p> <p>There is no convincing evidence that post-stroke depression treatment reduces the risk of depression.⁸⁵ and most antidepressants have side effects such as falls, increased bleeding, seizures and sedation, therefore should be used with caution in people with stroke.⁸³</p> <p>Recent large randomized trials of early onset treatment with SSRIs (fluoxetine) to promote motor recovery, (FLAME,⁸⁶ FOCUS,⁸⁷ AFFINITY trial⁸⁸), found some reduction in onset of new depression after stroke, but this came with increased fracture risk. It is therefore not recommended for routine use.</p> | <p>Depression after a stroke has a prevalence of 29%⁸⁹ and it correlates with worse outcomes.⁹⁰ On the other hand, successful treatment of depression after a stroke is associated with better functional outcome.⁹¹ It is important, therefore, to assess psychological needs throughout rehabilitation</p> <p>Risk factors include stroke severity, pre-stroke depression, cognitive impairment, lack of social support.</p> |
| <p>Anxiety</p> | <p>There is a lack of evidence regarding treatment of poststroke anxiety.</p> <p>Therapeutic options include standard anxiety treatments and behavioral and/or cognitive psychological therapy.⁹² First line treatment for anxiety are SSRIs, and short term of benzodiazepines.⁹²</p> | <p>Anxiety can impact 25% of people who have had a stroke. These people tend to have a poorer quality of life. The most common type of anxiety is a phobic disorder (10%).⁹²</p> <p>Risk factors include premorbid anxiety or depression.</p> <p>Screening for anxiety and depression should be an important prerogative during rehabilitation in order to improve outcomes.</p> |

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| Shoulder pain | <p>Mainstay of treatment⁹³ includes:</p> <ul style="list-style-type: none"> ● Physiotherapy with passive motion exercises; ● Forms of shoulder support like shoulder slings, arm boards; ● Anti Inflammatories like ibuprofen; ● Antispasmodics (eg baclofen, tizanidine, diazepam, botulinum injection); ● Surgical interventions are rarely used. <p>Early prevention of shoulder pain is warranted. This should be pursued by using techniques which help avoiding risky or traumatic positions, for example, by using slings, straps, other forms of support, and by positioning the patient in a way to impede traction of the arm.⁹⁴</p> | <p>Shoulder pain tends to present in the subacute or chronic phases after a stroke.⁹⁵ People with arm weakness, right hemispheric lesions, sensory impairment, spasticity and severe stroke are at higher risk of developing shoulder pain after stroke.⁹³ Counteracting the spasticity can be an effective treatment for shoulder pain, however the decreased tone can negatively affect outcome if it lasts more than 1 week.⁹⁶ Hence, it is important to ensure early care of the shoulder is considered in order to avoid complications.</p> |
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Table 3. Medical complications post-stroke which might require long-term management and follow-up.

A key aspect of post-stroke long-term medical management consists of secondary prevention recommendations such as exercise, diet, alcohol moderation, smoking cessation, medications including antiplatelets, anticoagulation, statins, and antihypertensives.

Successful long-term lifestyle and behaviour change would be expected to make a significant difference in a person's recovery after a stroke, but is challenging. Goals for behavioural change should be realistic, and it may be worth considering prioritising a small number of the most impactful and/or manageable changes. Discussions at follow-up about lifestyle are just as important as medication and should be incorporated in the management plan.^{97,98} Inadequate risk factor management can increase the risk of further strokes, and lead to higher mortality and disability. (Figure 2).

Clinicians have an essential role in the rehabilitation and recovery process. They must be good team members, be able to participate, and often coordinate, the different specialties involved.

They should be able to assess prognosis and rehabilitation potential and to be involved with planning and delivery of services across the rehabilitation pathway.

The International Stroke Recovery and Rehabilitation Taskforces have identified important knowledge gaps and targets for research to help optimise development of new, more effective treatments that target recovery, not just compensation in rehabilitation research.¹⁰⁰ As a young research field there is much to do through collaboration.

CONCLUSION

Approaches to neuro-rehabilitation vary across the world. We acknowledge that we have focused in this article on how stroke neuro-rehabilitation is conducted in the UK.

Post-stroke rehabilitation is complex. It involves large MDTs and complex care systems. Rehabilitation needs vary considerably and take place over long periods of time. We have described the rehabilitation post-stroke process and some of its shortfalls. As a young research field there is much to do. Stricter adherence to the guidelines and optimisation of stroke rehabilitation pathways should be a public health priority in order to improve quality of care and long-term cost-effectiveness.¹⁰¹

Key points

- Rehabilitation and recovery can take a long time and rehabilitation care (acute, community and long-term rehabilitation) should be accessible whenever it is needed.
- Better recovery could be achieved by supporting evidence-based activities and targets, patient-centred care and stroke inter-professional communication.
- Clinicians can support stroke survivors' recovery after they leave hospital, and return to work and secondary prevention should be routinely addressed.
- Teamwork is key in rehabilitation and neurologists have an important role in diagnosis and acute and long-term management of stroke and its sequelae.

Further reading

- Wade DT. What is rehabilitation? An empirical investigation leading to an evidence-based description. *Clin Rehabil.* 2020 May;34(5):571-583. doi: 10.1177/0269215520905112. Epub 2020 Feb 10. PMID: 32037876; PMCID: PMC7350200
- Bernhardt J, Hayward KS, Dancause N, Lannin NA, Ward NS, Nudo RJ, et al. A stroke recovery trial development framework: Consensus-based core recommendations from the Second Stroke Recovery and Rehabilitation Roundtable. *Int J Stroke.* 2019 Oct;14(8):792–802.

Figure Legend

Figure 1. Adapted from “Pathways for rehabilitation following illness or injury” on the British Society of Rehabilitation Medicine website.⁴

Figure 2. NICE lifestyle recommendations.⁹⁸

Footnotes

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References

1. Gorelick, P. B. The global burden of stroke: persistent and disabling. *Lancet neurology* vol. 18 417–418 (2019).
2. Stroke. NHS <https://www.nhs.uk/conditions/stroke/> (2019).
3. Patel, V. Death registrations summary tables - England and Wales. (2018).
4. British society of rehabilitation medicine. <https://www.bsrm.org.uk/downloads/specialised-neurorehabilitation-service-standards--7-30-4-2015-forweb.pdf> (2015).
5. Pinnock, H. *et al.* Standards for Reporting Implementation Studies (StaRI) Statement. *BMJ* **356**, i6795 (2017).
6. Stroke services. SSNAP - Home <https://www.strokeaudit.org/SupportFiles/Documents/miscellaneous/Stroke-Services-Guidance-for-STPs-on-recommended-s.aspx>.
7. London's Hyperacute Stroke Units Improve Outcomes and Lower Costs. *Harvard Business Review* (2013).
8. SSNAP - National. *Stroke association* https://www.stroke.org.uk/sites/default/files/state_of_the_nation_2017_final_1.pdf (2017).
9. SSNAP - Home. <https://www.strokeaudit.org/Documents/National/Clinical/Apr2017Mar2018/Apr2017Mar2018-AnnualReport.aspx>.
10. Langhorne, P., Collier, J. M., Bate, P. J., Thuy, M. N. & Bernhardt, J. Very early versus delayed mobilisation after stroke. *Cochrane Database Syst. Rev.* **10**, CD006187 (2018).
11. Bernhardt, J., Godecke, E., Johnson, L. & Langhorne, P. Early rehabilitation after stroke. *Curr. Opin. Neurol.* **30**, 48–54 (2017).
12. AVERT Trial Collaboration group. Efficacy and safety of very early mobilisation within 24 h of stroke onset (AVERT): a randomised controlled trial. *Lancet* **386**, 46–55 (2015).
13. Bernhardt, J. *et al.* Prespecified dose-response analysis for A Very Early Rehabilitation Trial (AVERT). *Neurology* **86**, 2138–2145 (2016).
14. Evidence | Stroke and transient ischaemic attack in over 16s: diagnosis and initial management |

Guidance | NICE.

15. Godecke, E. *et al.* A randomized control trial of intensive aphasia therapy after acute stroke: The Very Early Rehabilitation for SpEEch (VERSE) study. *Int. J. Stroke* **16**, 556–572 (2021).
16. Collaboration, S. U. T. & Others. Organised inpatient (stroke unit) care for stroke. *Cochrane Database Syst. Rev.* (2013).
17. Lynch, E. A., Luker, J. A., Cadilhac, D. A. & Hillier, S. L. Inequities in access to rehabilitation: exploring how acute stroke unit clinicians decide who to refer to rehabilitation. *Disabil. Rehabil.* **38**, 1415–1424 (2016).
18. Ishida, K. Complications of stroke: An overview. *UpToDate* <https://www.uptodate.com/contents/complications-of-stroke-an-overview> (2020).
19. Bovim, M. R., Askim, T., Lydersen, S., Fjærtøft, H. & Indredavik, B. Complications in the first week after stroke: a 10-year comparison. *BMC Neurol.* **16**, 133 (2016).
20. Winstein, C. J. *et al.* Guidelines for Adult Stroke Rehabilitation and Recovery: A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association. *Stroke* **47**, e98–e169 (2016).
21. Turner-Stokes, L., Williams, H., Bill, A., Bassett, P. & Sephton, K. Cost-efficiency of specialist inpatient rehabilitation for working-aged adults with complex neurological disabilities: a multicentre cohort analysis of a national clinical data set. *BMJ Open* **6**, e010238 (2016).
22. Turner-Stokes, L. Cost-efficiency of longer-stay rehabilitation programmes: can they provide value for money? *Brain Inj.* **21**, 1015–1021 (2007).
23. of Physicians, R. C. Sentinel Stroke National Audit Programme (SSNAP). in (Royal College of Physicians London, 2015).
24. Overview | Stroke rehabilitation in adults | Guidance | NICE.
25. Langhorne, P., Bernhardt, J. & Kwakkel, G. Stroke rehabilitation. *Lancet* **377**, 1693–1702 (2011).
26. Quality statement 2: Intensity of stroke rehabilitation | Stroke in adults | Quality standards | NICE.
27. Hordacre, B. *et al.* Evidence for a Window of Enhanced Plasticity in the Human Motor Cortex Following Ischemic Stroke. *Neurorehabil. Neural Repair* **35**, 307–320 (2021).
28. Dromerick, A. W. *et al.* Critical Period After Stroke Study (CPASS): A phase II clinical trial testing an

- optimal time for motor recovery after stroke in humans. *Proc. Natl. Acad. Sci. U. S. A.* **118**, (2021).
29. DiLollo, A. & Favreau, C. Person-centered care and speech and language therapy. *Semin. Speech Lang.* **31**, 90–97 (2010).
 30. Bertilsson, A.-S. *et al.* A cluster randomized controlled trial of a client-centred, activities of daily living intervention for people with stroke: one year follow-up of caregivers. *Clin. Rehabil.* **30**, 765–775 (2016).
 31. [No title]. <https://www.nice.org.uk/guidance/qs2/resources/stroke-in-adults-pdf-58292707525>.
 32. Kitson, A. L., Dow, C., Calabrese, J. D., Locock, L. & Muntlin Athlin, Å. Stroke survivors' experiences of the fundamentals of care: a qualitative analysis. *Int. J. Nurs. Stud.* **50**, 392–403 (2013).
 33. Luker, J., Lynch, E., Bernhardsson, S., Bennett, L. & Bernhardt, J. Stroke Survivors' Experiences of Physical Rehabilitation: A Systematic Review of Qualitative Studies. *Arch. Phys. Med. Rehabil.* **96**, 1698–708.e10 (2015).
 34. Janssen, H. *et al.* An enriched environment improves sensorimotor function post-ischemic stroke. *Neurorehabil. Neural Repair* **24**, 802–813 (2010).
 35. Khan, F. *et al.* An enriched environmental programme during inpatient neuro-rehabilitation: A randomized controlled trial. *J. Rehabil. Med.* **48**, 417–425 (2016).
 36. Rosbergen, I. C. M. *et al.* Embedding an enriched environment in an acute stroke unit increases activity in people with stroke: a controlled before–after pilot study. *Clin. Rehabil.* **31**, 1516–1528 (2017).
 37. Jones, F. *et al.* Addressing inactivity after stroke: The Collaborative Rehabilitation in Acute Stroke (CREATE) study. *Int. J. Stroke* 1747493020969367 (2020).
 38. Wade, D. T. What is rehabilitation? An empirical investigation leading to an evidence-based description. *Clin. Rehabil.* **34**, 571–583 (2020).
 39. Wieroniey, A. A new era for stroke? *British Journal of Neuroscience Nursing* vol. 12 S6–S8 (2016).
 40. 1 Recommendations | Stroke rehabilitation in adults | Guidance | NICE.
 41. 2019 surveillance of stroke rehabilitation in adults (NICE guideline CG162). (2019).
 42. Langhorne, P., Baylan, S. & Early Supported Discharge Trialists. Early supported discharge services for people with acute stroke. *Cochrane Database Syst. Rev.* **7**, CD000443 (2017).

43. Quality statement 4: Early supported discharge | Stroke in adults | Quality standards | NICE.
44. Supporting life after stroke. *Care Quality Commission*
https://www.cqc.org.uk/sites/default/files/documents/supporting_life_after_stroke_national_report.pdf
(2009).
45. 4 Consideration of the evidence | Alteplase for treating acute ischaemic stroke | Guidance | NICE.
46. Association, S. & Others. State of the nation stroke statistics. Stroke Association, 2018.
47. [No title]. <https://www.england.nhs.uk/wp-content/uploads/2022/02/stroke-integrated-community-service-february-2022.pdf>.
48. Beare, B., Doogan, C. E., Douglass-Kirk, P., Leff, A. P. & Ward, N. Neuro-Rehabilitation OnLine (N-ROL): description and evaluation of a group-based telerehabilitation programme for acquired brain injury. *J. Neurol. Neurosurg. Psychiatry* (2021) doi:10.1136/jnnp-2021-326809.
49. Cramer, S. C. *et al.* Efficacy of Home-Based Telerehabilitation vs In-Clinic Therapy for Adults After Stroke: A Randomized Clinical Trial. *JAMA Neurol.* (2019) doi:10.1001/jamaneurol.2019.1604.
50. Laver, K. E. *et al.* Telerehabilitation services for stroke. *Cochrane Database Syst. Rev.* **1**, CD010255 (2020).
51. Inter-agency Advisory Group on Vocational Rehabilitation after Brain Injury (Great Britain).
Vocational Assessment and Rehabilitation After Acquired Brain Injury: Inter-agency Guidelines.
(Royal College of Physicians, 2004).
52. Getting back to work. *Stroke Association* <https://www.stroke.org.uk/life-after-stroke/getting-back-work>
(2018).
53. Stroke information, stroke advice and stroke facts - what causes a stroke?
<https://differentstrokes.co.uk/stroke-information/information-pack/> (2017).
54. Edwards, J. D., Kapoor, A., Linkewich, E. & Swartz, R. H. Return to work after young stroke: A systematic review. *Int. J. Stroke* **13**, 243–256 (2018).
55. Walters, R. *et al.* Exploring post acute rehabilitation service use and outcomes for working age stroke survivors (≤ 65 years) in Australia, UK and South East Asia: data from the international AVERT trial. *BMJ Open* **10**, e035850 (2020).
56. Fu, V. W. Y., Weatherall, M. & McNaughton, H. The Taking Charge After Stroke (TaCAS) study

protocol: a multicentre, investigator-blinded, randomised controlled trial comparing the effect of a single Take Charge session, two Take Charge sessions and control intervention on health-related quality of life 12 months after stroke for non-Māori, non-Pacific adult New Zealanders discharged to community living. *BMJ Open* **7**, e016512 (2017).

57. Sadler, E., Sarre, S., Tinker, A., Bhalla, A. & McKeivitt, C. Developing a novel peer support intervention to promote resilience after stroke. *Health Soc. Care Community* **25**, 1590–1600 (2017).
58. Jones, F., Pöstges, H. & Brimicombe, L. Building Bridges between healthcare professionals, patients and families: A coproduced and integrated approach to self-management support in stroke. *NeuroRehabilitation* **39**, 471–480 (2016).
59. Ward, N. S., Brander, F. & Kelly, K. Intensive upper limb neurorehabilitation in chronic stroke: outcomes from the Queen Square programme. *J. Neurol. Neurosurg. Psychiatry* **90**, 498–506 (2019).
60. Virtual reality for stroke rehabilitation. <http://dx.doi.org/10.1002/14651858.CD008349.pub4>
doi:10.1002/14651858.CD008349.pub4.
61. Caplan, L. Stroke is best managed by neurologists. *Stroke* **34**, 2763 (2003).
62. Pitkänen, A., Roivainen, R. & Lukasiuk, K. Development of epilepsy after ischaemic stroke. *Lancet Neurol.* **15**, 185–197 (2016).
63. Myint, P. K., Staufenberg, E. F. A. & Sabanathan, K. Post-stroke seizure and post-stroke epilepsy. *Postgrad. Med. J.* **82**, 568–572 (2006).
64. UpToDate. https://www.uptodate.com/contents/overview-of-the-management-of-epilepsy-in-adults?sectionName=Poststroke%20seizures&search=seizures%20post%20stroke&topicRef=1093&anchor=H21&source=see_link.
65. Brodie, M. J., Overstall, P. W. & Giorgi, L. Multicentre, double-blind, randomised comparison between lamotrigine and carbamazepine in elderly patients with newly diagnosed epilepsy. The UK Lamotrigine Elderly Study Group. *Epilepsy Res.* **37**, 81–87 (1999).
66. Silverman, I. E., Restrepo, L. & Mathews, G. C. Poststroke seizures. *Arch. Neurol.* **59**, 195–201 (2002).
67. Bhalla, A. & Birns, J. *Management of Post-Stroke Complications*. (Springer, 2015).
68. Thompson, A. J., Jarrett, L., Lockley, L., Marsden, J. & Stevenson, V. L. Clinical management of

- spasticity. *J. Neurol. Neurosurg. Psychiatry* **76**, 459–463 (2005).
69. Physical effects of stroke. *Stroke Association* <https://www.stroke.org.uk/effects-of-stroke/physical-effects-of-stroke>.
 70. Francisco, G. E. & McGuire, J. R. Poststroke spasticity management. *Stroke* **43**, 3132–3136 (2012).
 71. Martino, R. *et al.* Dysphagia after stroke: incidence, diagnosis, and pulmonary complications. *Stroke* **36**, 2756–2763 (2005).
 72. Bivard, A. *et al.* MIDAS (Modafinil in Debilitating Fatigue After Stroke): A Randomized, Double-Blind, Placebo-Controlled, Cross-Over Trial. *Stroke* **48**, 1293–1298 (2017).
 73. Fatigue after stroke. *Stroke Association* https://www.stroke.org.uk/sites/default/files/fatigue_after_stroke.pdf (2012).
 74. Sex and relationships. *Stroke Association* <https://www.stroke.org.uk/effects-of-stroke/sex-and-relationships> (2017).
 75. Rosenbaum, T., Vadas, D. & Kalichman, L. Sexual function in post-stroke patients: considerations for rehabilitation. *J. Sex. Med.* **11**, 15–21 (2014).
 76. McGrath, M., Lever, S., McCluskey, A. & Power, E. Developing interventions to address sexuality after stroke: Findings from a four-panel modified Delphi study. *J. Rehabil. Med.* **51**, 352–360 (2019).
 77. Poststroke Care - Practical Neurology.
 78. Continence problems after stroke. *Stroke Association* https://www.stroke.org.uk/sites/default/files/continence_problems_after_stroke.pdf (2012).
 79. NICE-The National Institute for Health & Excellence, C. BNF: British national formulary - NICE.
 80. Treister, A. K., Hatch, M. N., Cramer, S. C. & Chang, E. Y. Demystifying Poststroke Pain: From Etiology to Treatment. *PM R* **9**, 63–75 (2017).
 81. Pendlebury, S. T. Dementia in patients hospitalized with stroke: rates, time course, and clinico-pathologic factors. *Int. J. Stroke* **7**, 570–581 (2012).
 82. Pendlebury, S. T. & Rothwell, P. M. Prevalence, incidence, and factors associated with pre-stroke and post-stroke dementia: a systematic review and meta-analysis. *Lancet Neurol.* **8**, 1006–1018 (2009).
 83. Robinson, R. G. & Jorge, R. E. Post-Stroke Depression: A Review. *Am. J. Psychiatry* **173**, 221–231

(2016).

84. Gordon Neil F. *et al.* Physical Activity and Exercise Recommendations for Stroke Survivors. *Stroke* **35**, 1230–1240 (2004).
85. Allida, S. *et al.* Pharmacological, psychological, and non-invasive brain stimulation interventions for treating depression after stroke. *Cochrane Database Syst. Rev.* **1**, CD003437 (2020).
86. Chollet, F. *et al.* Fluoxetine for motor recovery after acute ischaemic stroke (FLAME): a randomised placebo-controlled trial. *Lancet Neurol.* **10**, 123–130 (2011).
87. FOCUS Trial Collaboration. Effects of fluoxetine on functional outcomes after acute stroke (FOCUS): a pragmatic, double-blind, randomised, controlled trial. *Lancet* **393**, 265–274 (2019).
88. AFFINITY Trial Collaboration. Safety and efficacy of fluoxetine on functional outcome after acute stroke (AFFINITY): a randomised, double-blind, placebo-controlled trial. *Lancet Neurol.* **19**, 651–660 (2020).
89. Ayerbe, L., Ayis, S., Wolfe, C. D. A. & Rudd, A. G. Natural history, predictors and outcomes of depression after stroke: systematic review and meta-analysis. *Br. J. Psychiatry* **202**, 14–21 (2013).
90. Towfighi, A. *et al.* Poststroke Depression: A Scientific Statement for Healthcare Professionals From the American Heart Association/American Stroke Association. *Stroke* **48**, e30–e43 (2017).
91. Chemerinski, E., Robinson, R. G. & Kosier, J. T. Improved recovery in activities of daily living associated with remission of poststroke depression. *Stroke* **32**, 113–117 (2001).
92. Chun, H.-Y. Y., Whiteley, W. N., Dennis, M. S., Mead, G. E. & Carson, A. J. Anxiety After Stroke: The Importance of Subtyping. *Stroke* **49**, 556–564 (2018).
93. Harrison, R. A. & Field, T. S. Post stroke pain: identification, assessment, and therapy. *Cerebrovasc. Dis.* **39**, 190–201 (2015).
94. Shoulder Pain in Hemiplegia. <https://emedicine.medscape.com/article/328793-overview> (2021).
95. Paolucci, S. *et al.* Prevalence and Time Course of Post-Stroke Pain: A Multicenter Prospective Hospital-Based Study. *Pain Med.* **17**, 924–930 (2016).
96. Carroll, D. HAND FUNCTION IN HEMIPLEGIA. *J. Chronic Dis.* **18**, 493–500 (1965).
97. Billinger, S. A. *et al.* Physical activity and exercise recommendations for stroke survivors: a statement for healthcare professionals from the American Heart Association/American Stroke Association.

Stroke **45**, 2532–2553 (2014).

98. Making changes to your lifestyle | Information for the public | Cardiovascular disease: risk assessment and reduction, including lipid modification | Guidance | NICE.
99. Bernhardt, J. *et al.* Agreed Definitions and a Shared Vision for New Standards in Stroke Recovery Research: The Stroke Recovery and Rehabilitation Roundtable Taskforce. *Neurorehabil. Neural Repair* **31**, 793–799 (2017).
100. Bernhardt, J. *et al.* A stroke recovery trial development framework: Consensus-based core recommendations from the Second Stroke Recovery and Rehabilitation Roundtable. *Int. J. Stroke* **14**, 792–802 (2019).
101. Stroke rehabilitation needs radical overhaul. <https://www.bhf.org.uk/for-professionals/healthcare-professionals/blog/2018/stroke-rehabilitation-needs-radical-overhaul>.