

Acute neurorehabilitation – an introduction

Acute neurorehabilitation is an important but little-known field.

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Rehabilitation is a little-known specialised field of medicine that focuses on intervention after an acute incident and works towards a global and holistic aim of improving quality of life and facilitating maximum initial inputs to ensure minimal complications or sequelae.

This article explains the basics of the field, the involvement of various team members and the various models of rehabilitation. It focuses on the details of managing the specific medical challenges faced by the team dealing with a post-neurological insult, and offers some outlines on the rehabilitation process.

What is rehabilitation?

According to DeLisa *et al.* 'Rehabilitation is the process of helping a person to reach the fullest physical, psychological, social, vocational, avocational and educational potential consistent with his or her physiologic or anatomic impairment, environmental limitations and desires and life plans.'¹ Acute rehabilitation services make use of interdisciplinary teams in order to holistically address three levels of incapacity as a result of illness or injury to the physiological body. These three levels (according to the World Health Organization's International Classification of Functioning, Disability and Health) are:

- **impairment:** problems in body function (physiological and psychological functions of body systems) or structure (anatomical parts of the body)
- **activity limitation:** difficulties an individual may have in executing activities or tasks
- **life participation restrictions:** problems an individual may experience when trying to participate in life situations.²

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It is important to note that rehabilitation cannot aim to 'cure' all patients and return them to the exact previous level of functioning.

For example, in the case of a man who has sustained a stroke, the increased muscle tone and weakness of the affected limb can be described as the impairment. As a result of this impairment, he is unable to walk and is confined to a wheelchair, a loss of function that is termed his activity limitation. As a result of no longer being able to walk, the patient's life participation restriction is that he is unable to resume his work as a physical labourer. It would be fair to say that although the impairment level would be the treatment focus in the traditional medical model, the patient (and his family) would be most distressed by the resultant activity limitation or life participation restrictions affecting his personal world. A true rehabilitation model aims to address the 'whole-person function', which requires the involvement of the patient, the family and the entire interdisciplinary team. It is important to note that rehabilitation cannot aim to 'cure' all patients and return them to the exact previous level of functioning. Rather, it attempts to obtain maximal function in patients following an initial injury/illness. Where 'normal' function cannot be regained, alternative and compensatory strategies are taught in order to be able to perform tasks previously achievable. When impairment is so severe as to lead to permanent disability, the aim is to reduce the burden of care for the family and caregivers, and to prevent secondary complications that could lead to further hospitalisations and life-threatening conditions.

An interdisciplinary team in an acute rehabilitation unit usually consists of the following professionals:

- medical/rehabilitation doctor
- nursing team
- physiotherapist
- occupational therapist
- speech and language therapist
- psychologist
- social worker
- dietician
- case manager.

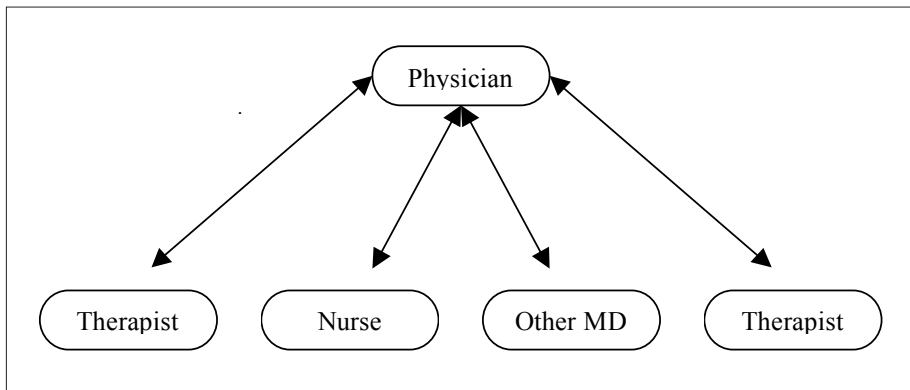


Fig. 1. The medical model.

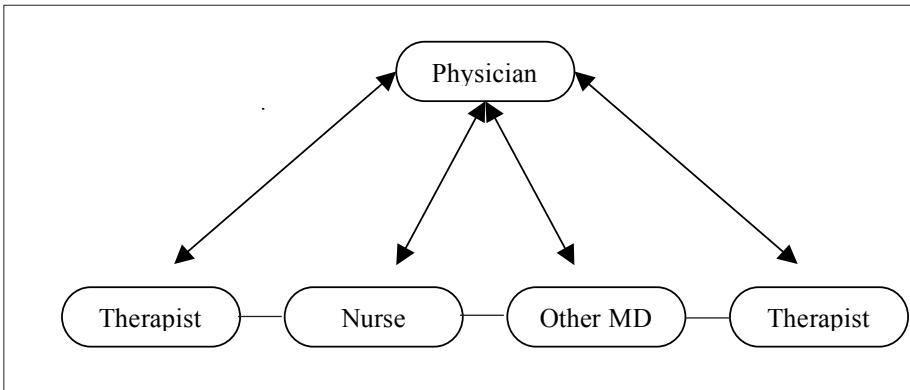


Fig. 2. The multidisciplinary model.

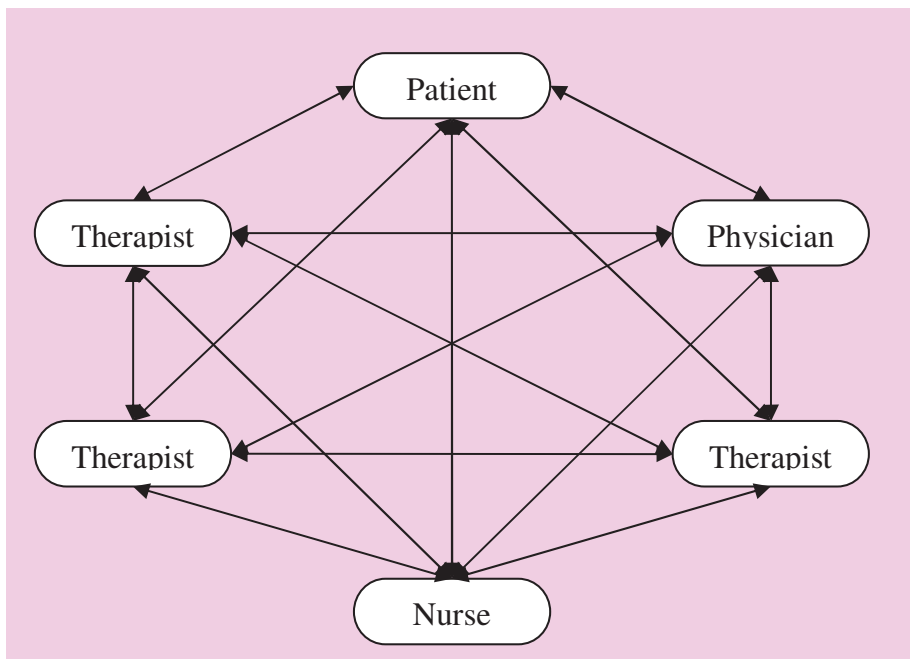


Fig. 3. The interdisciplinary model.

These professionals work closely with an extensive network of supporting services, including, *inter alia*, specialist doctors, outpatient therapists, vocational rehabilitation specialists, community counsellors and support groups, prosthetists, orthopaedic and other equipment supply services, and disability associations.

The term 'acute' refers to the fact that patients are usually referred to the rehabilitation service a short time after the illness or injury was sustained; the basic admitting criterion

is that the patient has been medically stabilised and is in a condition to participate in an intensive therapy programme. The therapy programme is structured and graded around each individual's abilities and needs, following clinical evaluation by each therapeutic professional. In order to benefit from the level of therapy on offer in the acute rehabilitation setting, the patient should be able to participate in and benefit from at least three modalities of intervention on offer. However, it is understood that patients

in the early stages of rehabilitation may have limited levels of endurance in the initial stages of therapy and will receive shorter, more frequent sessions over a graded period of time. The length of time spent on individual therapy sessions will then be increased as their endurance increases. The rationale behind admitting patients into acute rehabilitation services as soon as possible after the initial neurological insult is multifactorial and includes considerations such as optimising the window period for new skills development, based on the concepts of neural plasticity and cellular healing, as well as ensuring the timeous management of patients before the development of long-term complications that can be detrimental to the rehabilitation process.

Models of rehabilitation

Medical model

In a medical treatment model a physician tends to a patient's needs. If the services of another discipline are required, that professional is given specific requests for assistance by the attending physician.³

Multidisciplinary model

This is a treatment model in which the team remains a typically attending physician-controlled team, with vertical lines of communication to an array of consulting professionals. The organisation of this type of team starts to allow for lateral lines of communication between multidisciplinary professionals, but the direction and goals of treatment are still largely driven by the perceived needs of the attending doctor.³

Interdisciplinary model

This model allows for lateral and vertical lines of communication between health professionals in a system of group responsibility for developing optimal care plans. The patient and family are considered part of this planning group and have a central role in the team's considerations.³

Defining acute v. subacute rehabilitation services

Different models of rehabilitation are suited to different settings and provide differing levels of intensity of intervention along the care continuum. A good example is the distinction between acute rehabilitation and subacute rehabilitation, which use the interdisciplinary and multidisciplinary modes respectively. The resultant difference in the intensity and spectrum of services offered in these distinct settings is summarised in Table I.

Table I. Defining acute and subacute rehabilitation

Acute rehabilitation	Subacute rehabilitation
<ul style="list-style-type: none"> Based on a comprehensive interdisciplinary team approach, in which all team members intervene as a standard part of the treatment programme Examines, diagnoses and identifies the patient's functional deficits proactively Creates and engineers, through innovative and restorative treatment modalities, new ways and means for the patient to regain maximum function 	<ul style="list-style-type: none"> Based on a multidisciplinary team approach where team members intervene if prescribed Functional deficits are identified by the doctor who prescribes therapy where necessary Focus is on consolidating current function and compensating for functional losses – acute window of opportunity for new skill development usually past. Chronic maintenance and prevention of complications or deterioration also form part of the programme Patient medically stable, not in need of intensive medical interventions. Receives nursing care to encourage healing and/or convalescence
<p>The treatment programme includes:</p> <ul style="list-style-type: none"> Full admission assessment and case management Protocol and outcomes-driven intensive inpatient interdisciplinary rehabilitation Treatment programme takes the form of an intense, structured programme of daily therapy, with input from many of the interdisciplinary professionals on a daily basis Full discharge assessment and case management Training programmes for caregivers Family educational and support programmes 	<p>The treatment programme includes:</p> <ul style="list-style-type: none"> Medical assessment and referral to other professional services as necessary Intervention from individual members of the team as prescribed Lower level of therapy, with intervention from multidisciplinary team members on a 'needs to' basis Discharge arrangements as required Training sessions for caregivers where necessary and possible Consultation with social worker for support where prescribed

Prevention of long-term complications

While the primary goal of rehabilitation is to restore maximal function (life participation level), the attainment of this goal necessitates the successful management of a number of issues at the impairment and activity limitation level which, if left unattended, could result in long-term complications. Failure to manage these potential complications could not only ultimately lead to a loss or reversal of the desired function, but could have far-reaching consequences including sustained length of hospital stay, further hospitalisations after discharge and even death.

'Silent' aspiration is surprisingly frequent and can be deadly.

A comprehensive rehabilitation programme aims to prevent these long-term complications, through the successful management of the following (non-exhaustive) risks prevalent in patients suffering from acute neurological insults, which tend to occur largely in patients with stroke, spinal cord and brain injuries:

- spasticity and associated abnormalities of tone
- pressure sores
- feeding complications and aspiration
- chest infections
- contractures
- venous thromboembolism
- muscle atrophy
- neurogenic bladder and bowel dysfunction
- autonomic dysfunction
- pain.

Spasticity and associated abnormalities of tone

Muscle tone is the resistance felt in a muscle as a limb is moved passively. A change in muscle tone (either increased or decreased) is a common result of an upper motor neuron injury and is often accompanied by weakness and impaired motor control. If left unattended, these physiological changes can result in musculoskeletal changes such as abnormal ranges of joint motion and reduced muscle length, ultimately resulting in a loss of functional mobility. Treatment options include physical modalities such as passive movements, static muscle stretches, serial casting, weight-bearing exercises, muscle cooling and electrical stimulation. Medical management includes the use of drugs such as baclofen, diazepam, clonidine, tizanidine, methocarbamol, dantrolene and chemical nerve blocks such as botulinum toxin. Our first-line treatment of choice at present is baclofen (Lioresal) in doses of up to 100 mg daily (25 mg qid) orally. Where baclofen alone fails to control the spasticity, one can consider adding several of the above-mentioned agents. Patients who experience long-term problems that cannot be controlled by oral medication will often benefit from intrathecal baclofen pumps. Where loss of muscle/joint range is irreversible by any other method, surgical options such as tendon lengthening, tenotomy and tendon transfer may be considered.⁴

Pressure sores

A pressure sore is an area of unrelieved pressure over a defined area, usually over a bony prominence, resulting in ischaemia, cell death and tissue necrosis. In most cases, except where actual changes in skin viability are recorded as a result of the neurological injury (such as in the case of high cervical spinal cord lesions), pressure sores are a direct result of immobility and are considered entirely preventable if correctly managed from the outset. Measures to prevent the development of pressure sores include frequent turning, regular and systematic skin inspection, correct positioning and appropriate support surfaces.⁵ Products used in the treatment of wounds include dressings such as Primapore, Opsite, Tegaderm, Acticoat, Biotane and Granuflex, as well as applications to promote healing such as Meladerm ointment. The application of these different options depends on the severity and nature of the wound.

Feeding complications and aspiration

Swallowing dysfunction is common in patients with neurological injuries,

particularly in strokes, traumatic brain injuries and progressive neurological disorders. Patients with a compromised swallowing mechanism may be unable to protect their airways when ingesting solids or liquids, which could result in life-threatening aspiration pneumonias. Such patients need to be prevented from ingesting consistencies of food that may be harmful to them, while at the same time optimising their nutritional status through alternative strategies (such as nasogastric or percutaneous endoscopic feeding). In some patients the risk of aspiration may be decreased by changing the consistency of the foodstuff. For example, products such as Thick and Easy (Fresubin Kabi) are used to thicken liquids to the appropriate consistencies. Aspiration may be detected by the development of pulmonary infections or by the tendency of patients to cough following ingestion of food or fluid. However, 'silent' aspiration is surprisingly frequent and can be deadly.

The most appropriately trained professionals to assess and rehabilitate patients with swallowing disorders are speech and language therapists, in conjunction with dietitians. Where necessary, referral can be made to ear, nose and throat specialists, or radiographic studies of the oropharynx, oesophagus and upper gastrointestinal tract can be ordered. In the event of the development of aspiration pneumonia, aggressive and urgent intervention with antibiotic therapy is indicated. The role of the respiratory therapist is also invaluable in the treatment and prevention of chest infections as a result of aspiration.⁶

Chest infections

A significant complication of bed rest and immobility is the development of chest infections. The myriad of musculoskeletal and pathophysiological changes that can occur as a result of neurological injury is an obvious indication that the risks of patients developing respiratory dysfunctions are significant. Treatment or prevention involves early mobilisation, frequent respiratory toileting, adequate hydration and frequent position changes. Physiotherapeutic techniques include deep breathing and coughing exercises, chest percussion, postural drainage, the use of incentive spirometers and, where necessary, oropharyngeal suctioning.⁶ Medication should only be started once the chest infection has been diagnosed, based on positive clinical, radiological and laboratory test results. Appropriate antibiotic cover, based on the outcome of sensitivity tests, may then be instituted. The early addition of appropriate antibiotics, together with inhalation therapy (nebulisation), plays an integral role in ensuring a good outcome for these patients.

Voiding dysfunctions are common in patients referred for rehabilitation.

Venous thromboembolism

Immobility or the paralysis of a limb exposes a patient to venous stasis and increased blood coagulability, which could lead to the development of deep vein thrombosis (DVT) and the risk of thromboembolism. Signs and symptoms of DVTs include oedema, tenderness, hyperaemia and venous distention, and they can be confirmed most easily by Doppler studies. The most common means of preventing thromboembolic complications is to use low-dose subcutaneous injections of low-molecular weight heparin, e.g. enoxaparin sodium (Clexane), in doses of 0.5 mg/kg/day prophylactically. Other preventive measures include external intermittent leg compression, elastic leg wrappings, active exercises and early mobilisation. Pulmonary embolus from venous thrombosis should be suspected in the presence of acute dyspnoea, tachypnoea, tachycardia, chest pain, increased distress/restlessness and a cough with blood-stained sputum. Following clinical examination and depending on the patient's haemodynamic and respiratory stability, further investigations including a chest X-ray and VQ scan (which assesses ventilation and perfusion of the lungs) can be performed to confirm the clinical diagnosis. Appropriate antithrombotic therapy should then be instituted in a high-care setting to monitor any potential complications related to the anticoagulation regimen. Treatment of DVT and pulmonary embolism includes low-molecular-weight heparin in doses of 1 mg/kg bd, as well as warfarin. Anticoagulation therapy is monitored by measuring PTT and INR. When the patient's INR reaches 2.0, the low-molecular-weight heparin can be stopped.

Warfarin therapy can be continued until the DVT/pulmonary embolism has resolved, for at least 3 - 6 months. Continuous INR monitoring and dosing, in collaboration with a haematologist, are essential.⁶

Neurogenic bladder and bowel dysfunction

Voiding dysfunctions are common in patients referred for rehabilitation. These voiding problems may result from medications, cognitive changes, physical impairments or neurological aetiologies. These dysfunctions can cause enormous embarrassment to the patient and may ultimately make the difference between reintegration into the community or total confinement at home. Left unresolved, these problems could lead to other medical complications and even death.⁷ Therapeutic interventions involve the introduction of specialised bladder and bowel programmes, which include the use of medicines as well as the adoption of numerous physical adaptive strategies. Where necessary, surgical treatment options are also available.

If a patient has a hyper-reflexic bladder, a urinary tract antispasmodic such as oxybutynin or tolterodine may be used to relax the bladder wall and allow for adequate bladder filling before the patient performs intermittent self-catheterisation. An assessment of the contractility of the bladder wall and the sphincter pressures is therefore necessary before a decision is made about the self-catheterisation programme. This is done by means of a urodynamic study (UDS). In order to establish a baseline for the future urological management of the patient and also to ascertain the status of the patient's

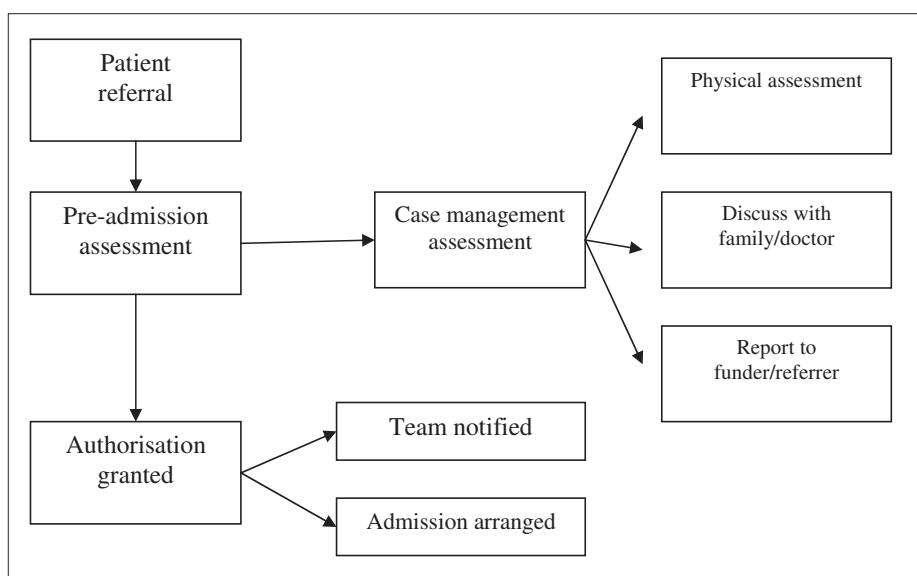


Fig. 4. The clinical rehabilitation pathway - pre-admission.

Acute neurorehabilitation

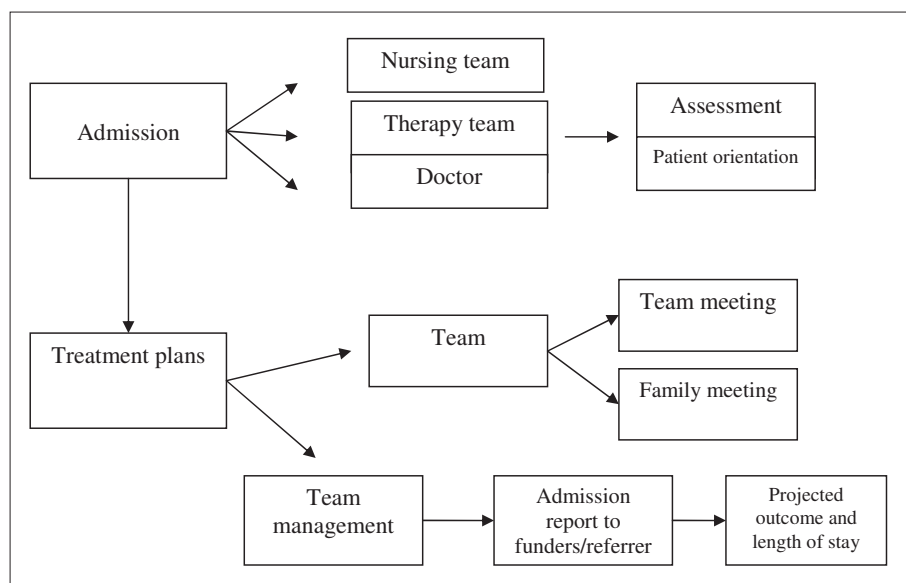


Fig. 5. The clinical rehabilitation pathway – post-admission.

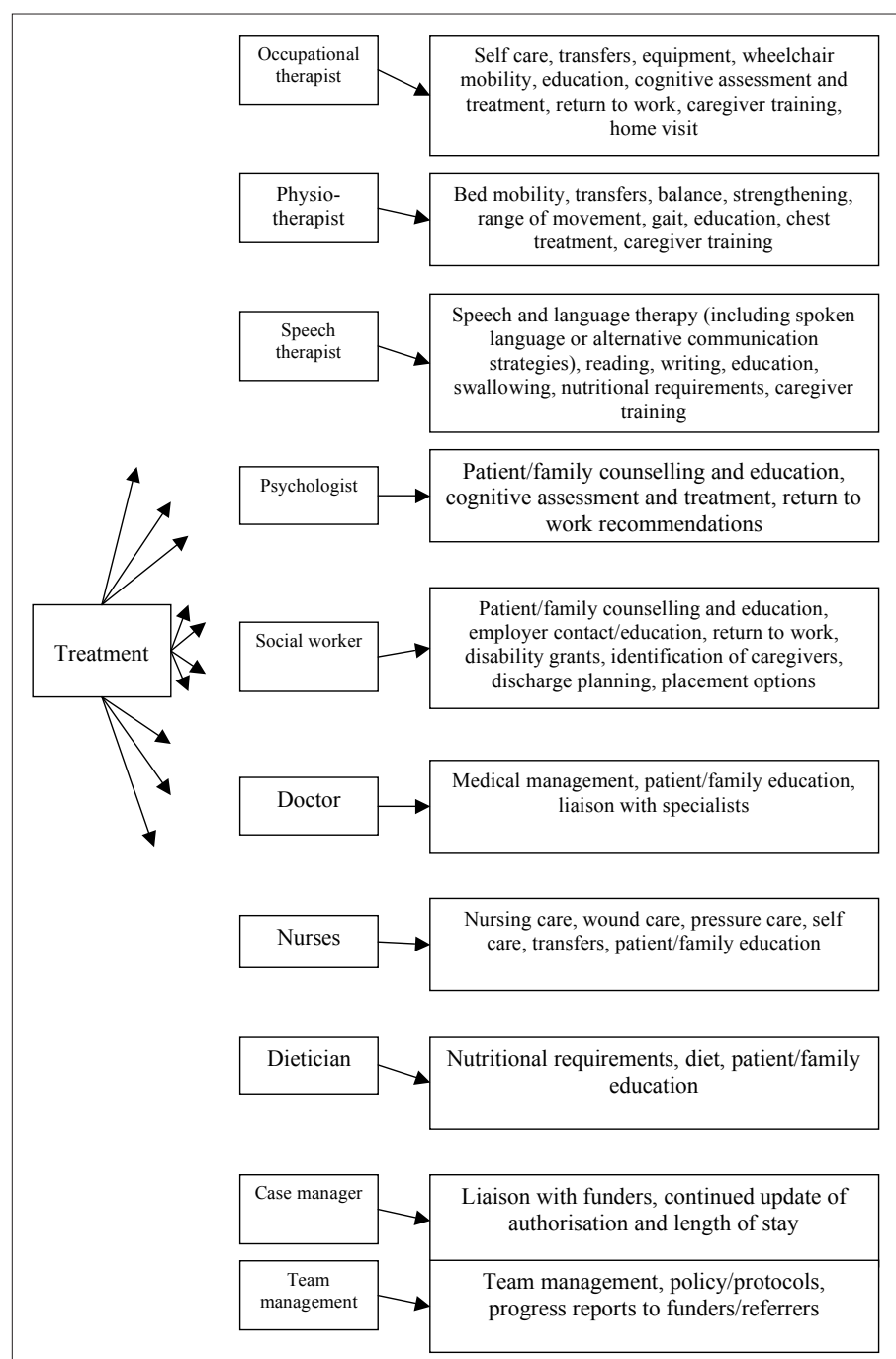


Fig. 6. The clinical rehabilitation pathway – intervention and team roles.

urological system anatomically, other tests including an intravenous pyelogram (IVP) and voiding cysto-urethrogram (VCU) are important in the initial urological assessment. Treatment for a high-pressure bladder may include oxybutynin (Lenditro) 5 mg tds, tolterodine (Detrusitol SR) 4 mg daily and/or various other anticholinergic drugs.

Bowel programmes include the use of laxatives such as Depuran, Senokot and Dulcolax and medications such as Movicol, in combination with specialised diets and strict fluid regimens. Some patients have found programmes for manual irrigation of the bowel, such as the Coloplast system, to be extremely successful in their bowel management programmes. However, these patients need to be extensively educated regarding the signs of possible side-effects from such programmes.

Autonomic dysreflexia

Hypersensitivity and dysfunction of the autonomic nervous system as a result of cervical or high thoracic spinal cord injury can result in a hypertensive crisis requiring immediate emergency attention. If the causes of the condition can be diagnosed and managed timeously, a hypertensive crisis can be preventable. The causes of autonomic dysreflexia include pneumonia, urinary tract infection, constipation or bowel obstruction, deep vein thrombosis, chest infection and sepsis. Symptoms of autonomic dysreflexia include fever, tachycardia, tachypnoea, hypertension and pain.⁷ The medical management of this condition necessitates immediate identification of the noxious stimulus that has triggered the autonomic outpouring, followed by removal of this stimulus, e.g. unblocking a kinked or blocked urinary catheter. The use of antihypertensive medication is reserved for cases where all possible causes have been excluded without any improvement in the patient's blood pressure. The treatment of choice for the acute presentation of hypertension is Adalat (nifedipine) 10 mg po stat. These are high-risk patients and should be managed as a medical emergency.

While the prevention of long-term complications is inherent in the philosophy of the rehabilitation service, it is undeniably true that the entire efficacy of the rehabilitation programme can be influenced by the presence of one or more of the aforementioned complications upon admission. Immeasurable time and resources can be wasted on the management of medical complications, rather than focusing on the physical, functional and cognitive rehabilitation of the individual. The importance of the

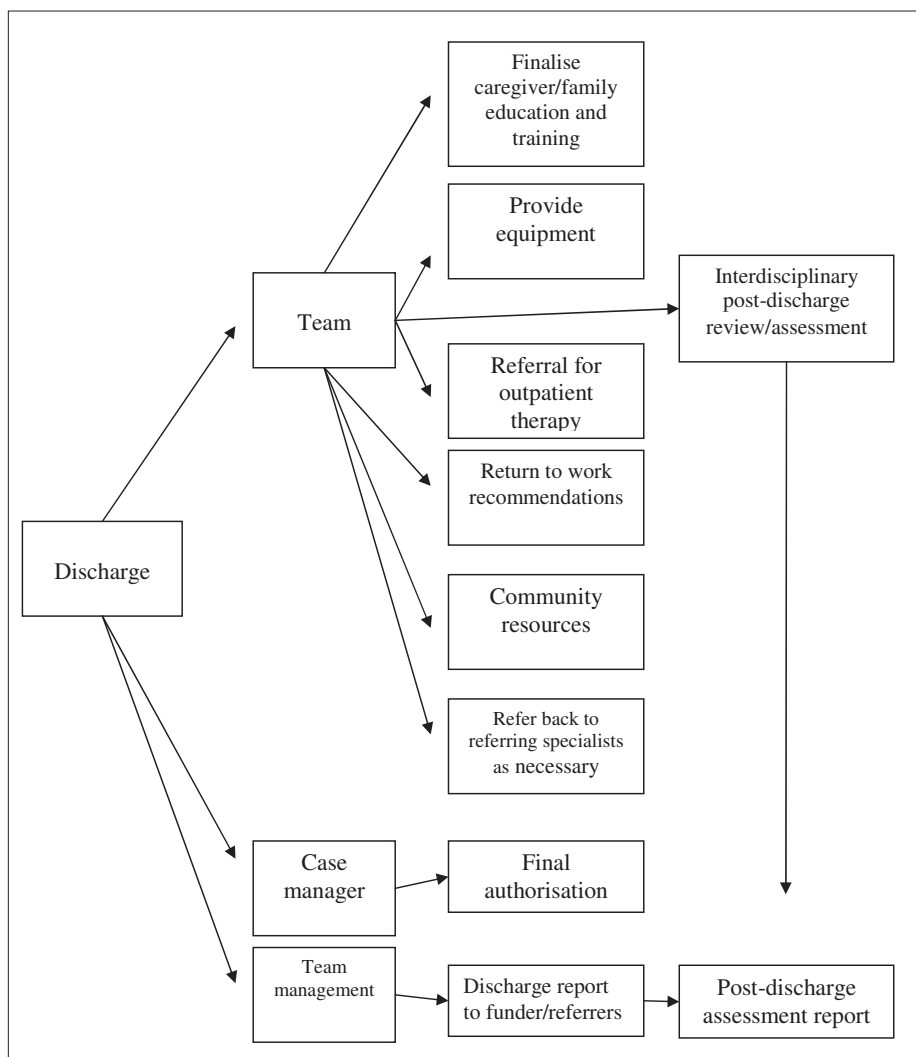


Fig. 7. The clinical rehabilitation pathway – discharge.

early identification and referral of suitable rehabilitation candidates, as well as the prevention of avoidable complications directly after the initial neurological insult, should be impressed upon all the medical practitioners involved from the first day of a patient's admission to an acute hospital ward.

Acute rehabilitation – clinical pathways

Admission to any rehabilitation unit usually involves some form of pre-admission screening. Fig. 4 schematically depicts the processes used in a private group of rehabilitation units.

In the case of patients not suitable for inpatient acute rehabilitation, where beds are not available or when funds are not available, recommendations for alternative, provincial hospital, home- or community-based rehabilitation are usually made.

Admission is followed by a comprehensive assessment by the interdisciplinary team and detailed patient and family orientation, including formal family and team meetings as depicted schematically in Fig. 5. This

assessment is in turn followed by a detailed interdisciplinary intervention as shown in Fig. 6, which also briefly describes the role of the various professionals.

The key to achieving successful outcomes is a structured and detailed discharge plan. The pre-admission and admission assessments are usually good predictors of the functional outcome and discharge destination.

Acute rehabilitation services in South Africa

Many of the private health care companies in South Africa run private rehabilitation services, utilising a variety of models and treatment intensities. There are services available in most major centres throughout South Africa.

The provincial health care services also offer multidisciplinary rehabilitation services in the tertiary academic hospitals around the country, as well as some specialised service centres.

Despite services being available in both private and public service sectors, well-co-ordinated and holistic rehabilitation

services can still be challenging to locate and to access in our country. However, as awareness of the rehabilitation function is heightening, so the various services are expanding and growing. Significant development in the field has been demonstrated over the past 10 years, and continues to do so.

Conclusion

While the acute rehabilitation service requires a specific structure to ensure the concordant integration of numerous therapeutic functions to maximise a patient's rehabilitative outcome, it is only the first step in the individual's recovery process after a neurological insult/injury. It affords patients and families their first opportunity to make some sort of sense out of their newly disordered worlds, within a secure and supportive environment. Economic implications should also be considered; the maximisation of functional outcome as well as the effective management of possible complications as a result of an effectively implemented rehabilitation process has a significant impact on the ultimate financial outlay of the patient, as well as funders and state medical systems.

The rehabilitation process equips patients and their families with the basic physical, functional, cognitive and emotional skills that will form the foundation on which they will be able to rebuild their lives after discharge. Rehabilitation aims to provide a solid framework on which patients will be able to forge a number of new abilities that will be refined and developed over time.

Follow-up, referral to outpatient therapists, community support services and ongoing medical support by both the specialist and general practitioner alike, are imperative if a rehabilitation programme is not to flounder once a patient is discharged from the acute inpatient environment. Rehabilitation should thus be viewed as a progressive and continuously evolving process, with numerous players on stage, but none more important than the patient at the heart of the production.

Acknowledgement

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In a nutshell

- Acute rehabilitation services make use of interdisciplinary teams in order to treat neurologically impaired patients.
- The interdisciplinary teams work closely with an extensive network of supporting services.
- The primary goal of rehabilitation is to restore maximal function following a neurological insult or illness.
- Patients are admitted to acute rehabilitation units a short time after the neurological insult, once medically stable and able to participate in a graded programme of therapy.
- The patient and family form a pivotal part of the interdisciplinary model of rehabilitation.
- Patients with neurological deficits are often at high risk of developing serious secondary complications.
- The prevention of secondary complications is an important goal in the effective management of neurologically impaired patients.
- Acute inpatient rehabilitation is usually followed up by ongoing outpatient therapy services after discharge.
- The delivery of effective rehabilitation services after injury has important economic implications for the patient, family, funders and state medical systems.

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