UNIVERSITATEA DE STAT DE MEDICINĂ ȘI FARMACIE
"NICOLAE TESTEMIȚANU" DIN REPUBLICA MOLDOVA

Principles of Rehabilitation in neurological diseases

Department of Medical Rehabilitation, Physical Medicine and Manual Therapy

The goal of the lesson

Acknowledgment with the peculiarities of the medical rehabilitation process of patients with nervous system diseases, in the context of the complexity of the pathological process and multidisciplinary multi-factorial approach.

Objectives of the lesson

- Understand the neuroplasticity phenomenon and its importance in the neuro-rehabilitation process.
- Knowing the role of the multidisciplinary team in the neurological rehabilitation process.
- Assess the patient with neurological conditions from a functional perspective
- Understanding the principles of recovery of neurological patients in the context of the complexity of the pathological process and subsequent complications.
- Learn modern approaches to rehabilitation for nervous system disorders.

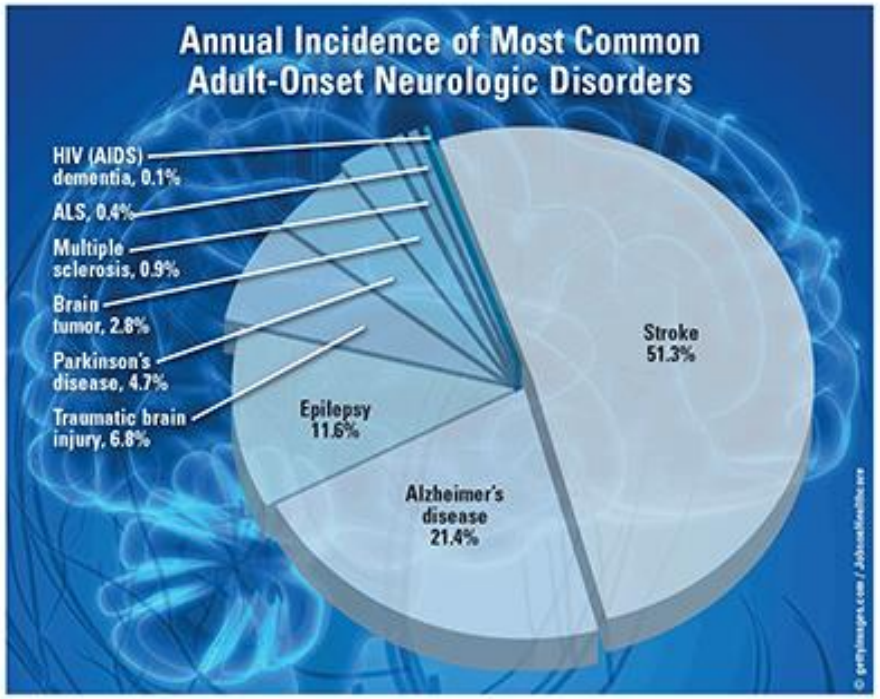
Definition

Neurorehabilitation is a complex medical process which aims to aid recovery from a nervous system injury, and to minimize and/or compensate for any functional alterations resulting from it in order to increase or restore the quality of life of the individual.

"Enhancing Nervous System Recovery through Neurobiologics, Neural Interface Training, and Neurorehabilitation,„ *Neuroprosthetics*: 584. 2016

Epidemiology

- Neurological conditions are the most common cause of serious disability and have a major, but often unrecognized, impact on health and social services.
- Over an estimated **1 billion people** worldwide are affected by neurological disease and disorders
- Over **6.8 million die** every year as a result of neurological diseases and disorders
- Approximately **25%** of people between 16 and 64 years of age suffer from a chronic neurological disability
- Approximately **33%** of disabled people living in residential care (nursing homes) have a neurological condition
- About one quarter of people aged between 16 and 64 with chronic disability have a neurological condition.
- Stroke rate rises steeply with increasing age and for people aged 45–85 is approximately 4 per 1000 annually.



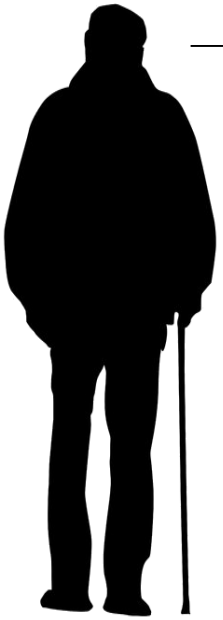
Neurology. 2014 Oct 28; 83(18): 1661–1664.
The international incidence and prevalence of neurologic conditions.
Tamara Pringsheim, Kirsten Fiest, Nathalie Jette.

National Stroke Association (USA)

- 10% of stroke survivors recover almost completely
- 25% recover with minimal impairment
- 40% experience moderate to severe impairments that require special care
- 10% require care in a nursing home or other long-term facility
- 15% die shortly after the stroke
- 14% of stroke survivors experience a second stroke in the first year following a stroke

NATIONAL STROKE ASSOCIATION®
HOPE AFTER STROKE

Motor Impairments after Stroke



49% balance

44% arm movement

52% hand movement

44% leg movement

54% walking

[113]

31% require assistance

20% need help walking

16% institutionalized

71% vocationally impaired after 7 years

34% unemployed at <65 years

[114]

! Impairments have impacts on activity and participation, independence and quality of life.

Indications for neurorehabilitation

✓ Stroke (ischemic, haemorrhagic);

✓ Traumatic brain injury

✓ Spinal cord injury

✓ Multiple sclerosis

✓ Degenerative diseases (Parkinson's disease, dementia and others)

✓ Diseases of the peripheral nervous system

(neuropathy, radiculopathy, plexopathy);

✓ Neuromuscular diseases (myodistrophy);

✓ Others.

Functional neurological deficits

- Motor disfunctions (paresis / plegia, hemi, para, tetra)
- Sensitive deficiencies (superficial, deep)
- Changes of muscle tone (spasticity)
- Coordination disorders (cerebellar ataxia, sensitive ataxia)
- Communication disorders (Aphasia)
- Swallowing disorders (solid / liquid / mixed dysphagia)
- Sphincter disorders (retention, incontinence)
- Cognitive disorders (amnesia, apraxia, disturbance of attention, concentration, planning, execution)

J R Coll Physicians Edinb. 2011 Mar;41(1):38-41;
Functional neurological symptoms. Stone J.

The main limitations of activity

Walking, transfers
Climb/Down Stairs
Bathihg
Dressing/undressing
Personal hygiene

Moving away from home
Allimentation
Use of the toilet
Recreation
Professional activity

Eating

Bathing

Dressing

Transferring

Toileting

Walking or moving around

Neural Plasticity

Neuroplasticity phenomenon is at the scientific basis of neurological recovery .

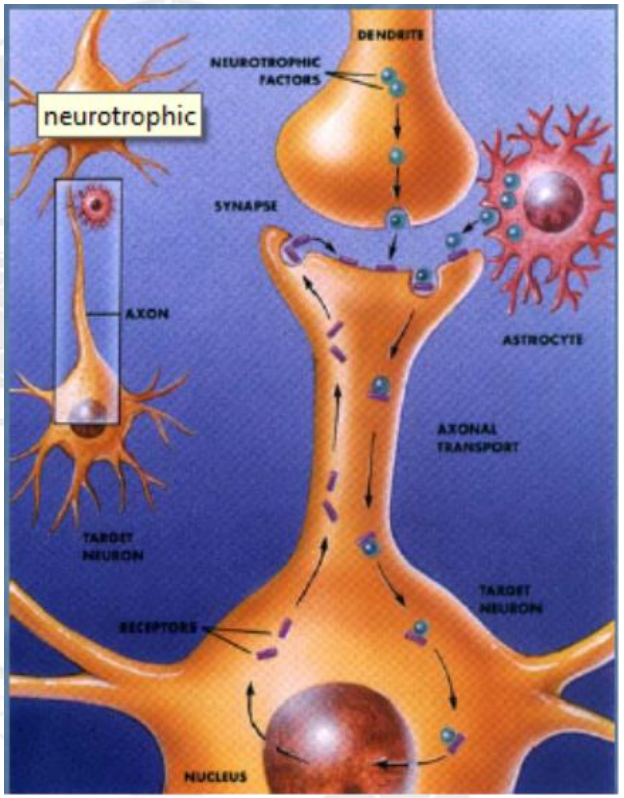
Paul Bach-y-Rita

April 4, 1934 – November 20, 2006
was an American neuroscientist whose most notable work was in the field of neuroplasticity

Handb Clin Neurol. 2013; 110: 3–12.
Neural plasticity and its contribution to functional recovery.
NIKHIL SHARMA, JOSEPH CLASSEN, LEONARDO G. COHEN.

What is Neural Plasticity?

- Neuroplasticity is the adaptability of the nervous system to various lesions by structural and functional reorganization in white and gray matter.

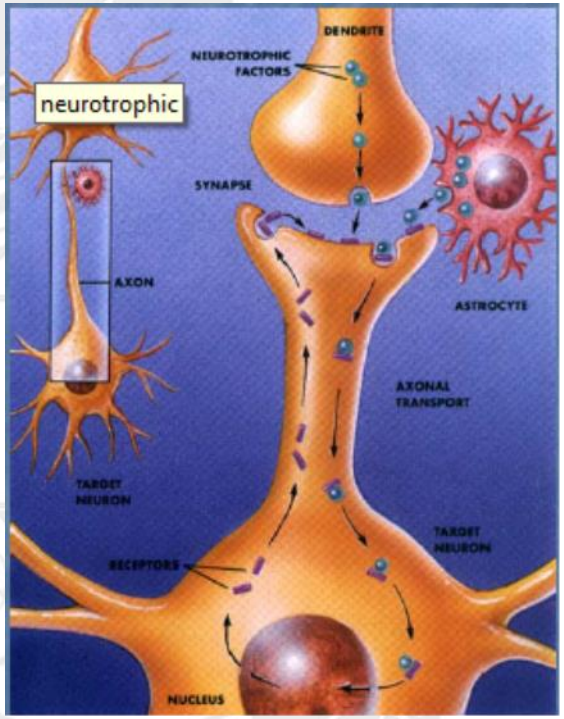


Leonardo G. Cohen, Mark Hallett, 2003.
Handbook of Neurological Rehabilitation.

LUCENDO ALLIS EGO IPSE ARDEO!

What is Neural Plasticity?

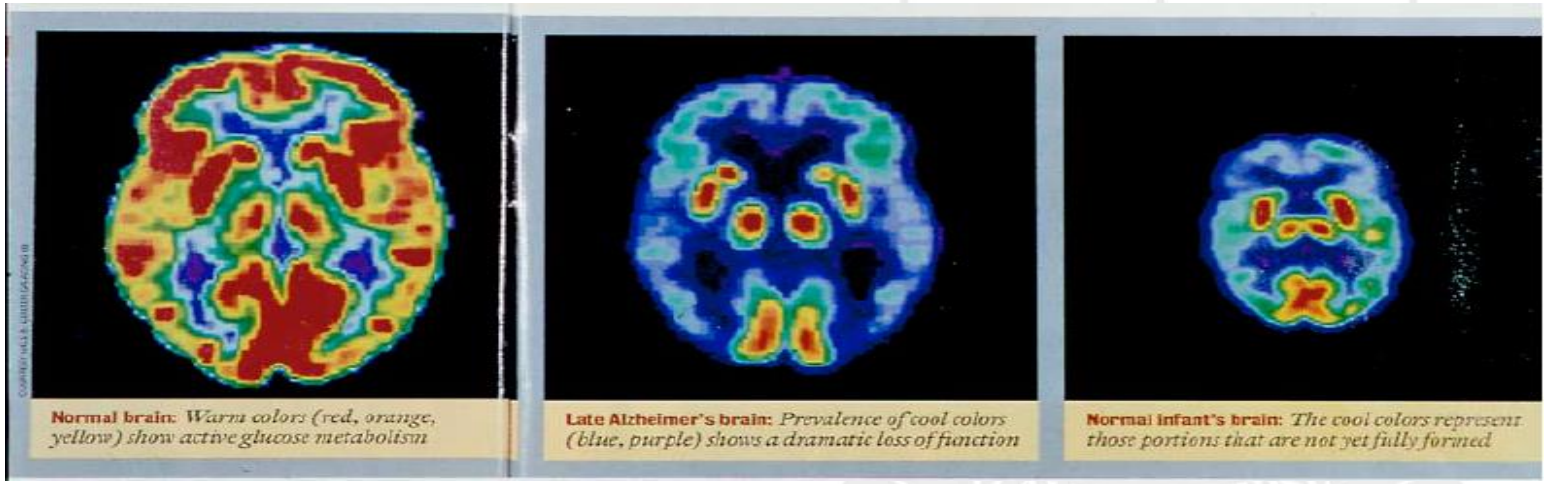
- the ability of the brain to form and reorganize synaptic connections, especially in response to learning or experience or following injury.



Leonardo G. Cohen, Mark Hallett, 2003.
Handbook of Neurological Rehabilitation.

Neuroplasticity

- Neuroplasticity in the human brain can be highlighted by techniques such as PET, functional MRI (highlighting the activation and recruitment of brain regions involved in different functions).

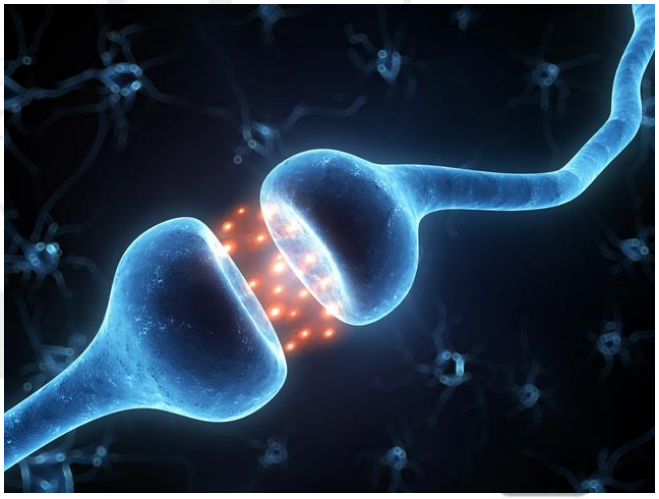


Neuroplasticity

- It refers to "use-dependent" changes in neural networks.
- These changes may be:

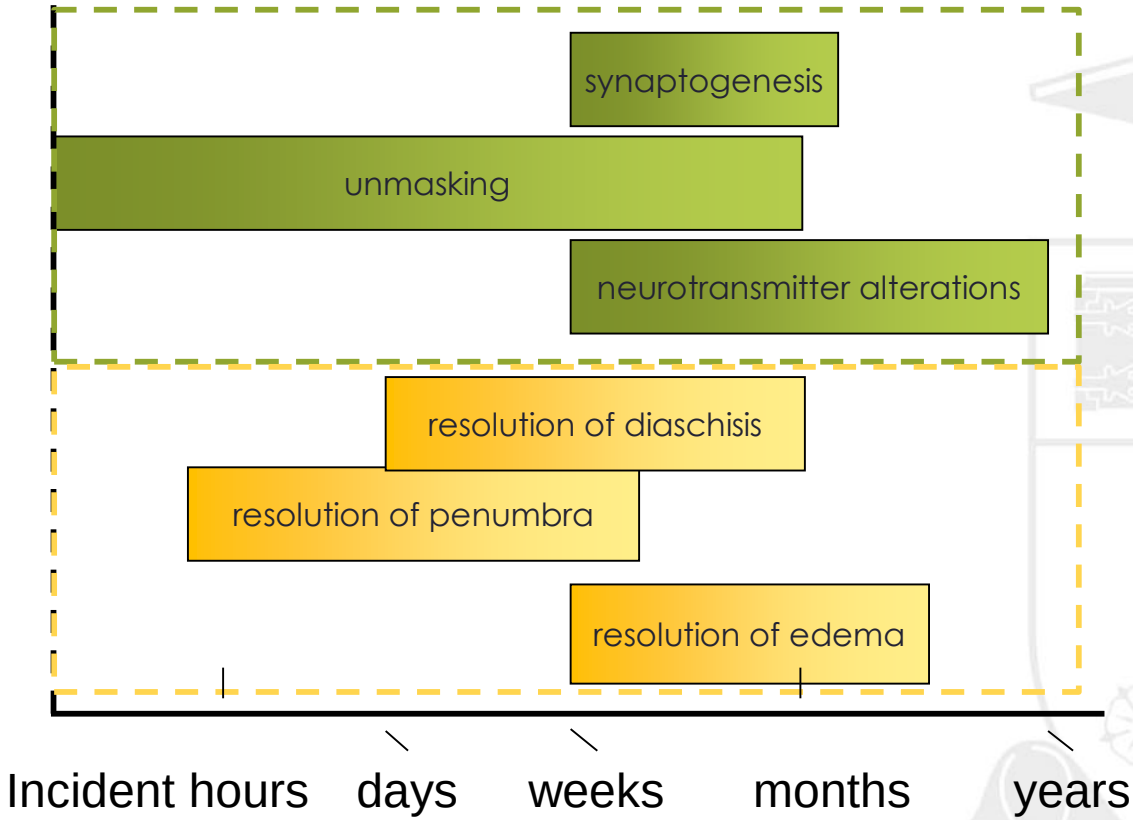
✓ short-term (substitution) - function modulations

✓ long-term (restitution) - structural changes



Handb Clin Neurol. 2013; 110: 3–12.
Neural plasticity and its contribution to functional recovery.
NIKHIL SHARMA, JOSEPH CLASSEN, LEONARDO G. COHEN.

Mechanisms of Recovery



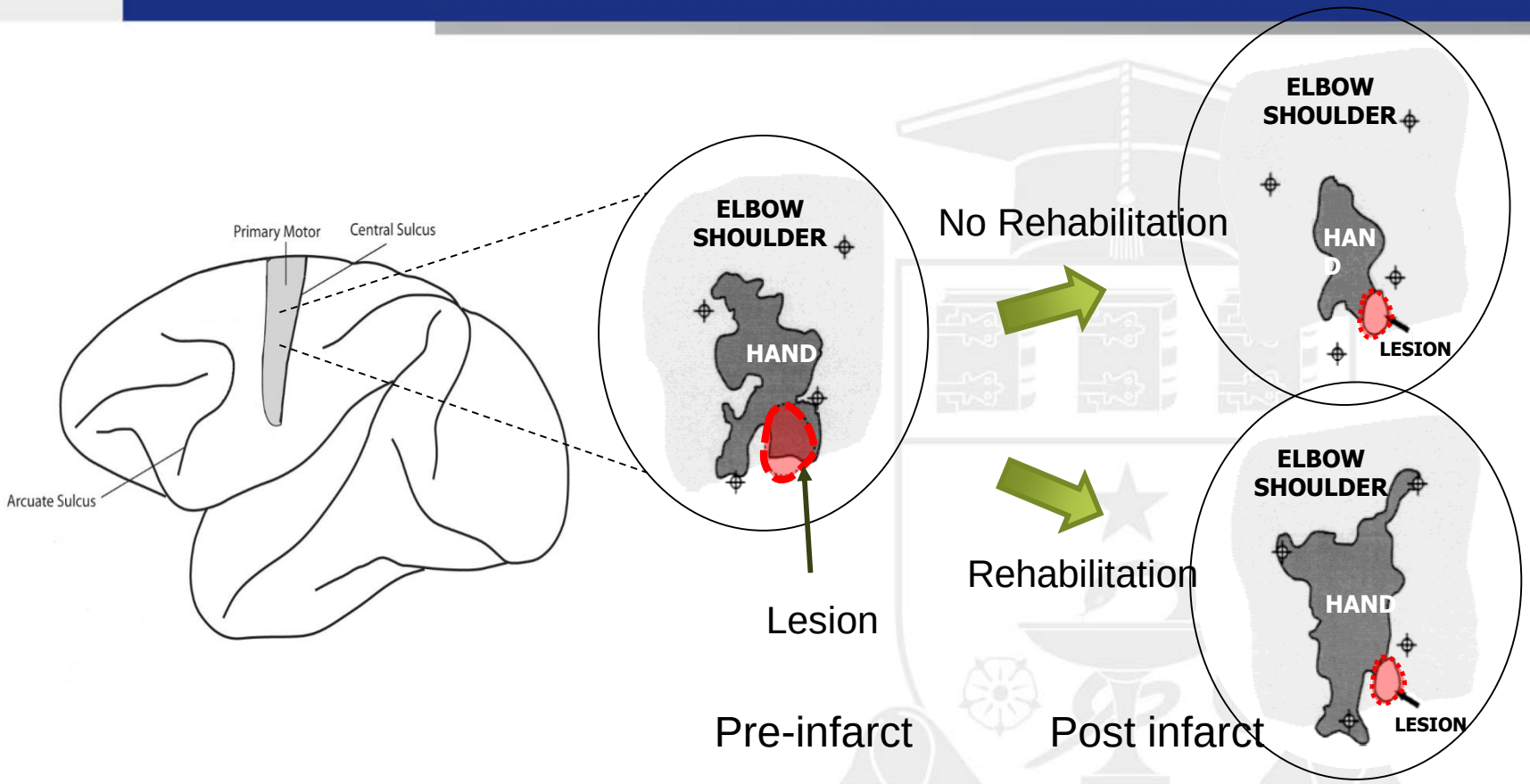
Neuroplasticity

Injury Reversal

! Recovery is a combination of reversal of injury related factors (edema, diaschisis) and neuroplasticity.

Adapted from Neuroplasticity After Aquired Brain Injury By Heidi Reyst, Rainbow Rehabilitation Centers

Activity-Induced Neuroplasticity

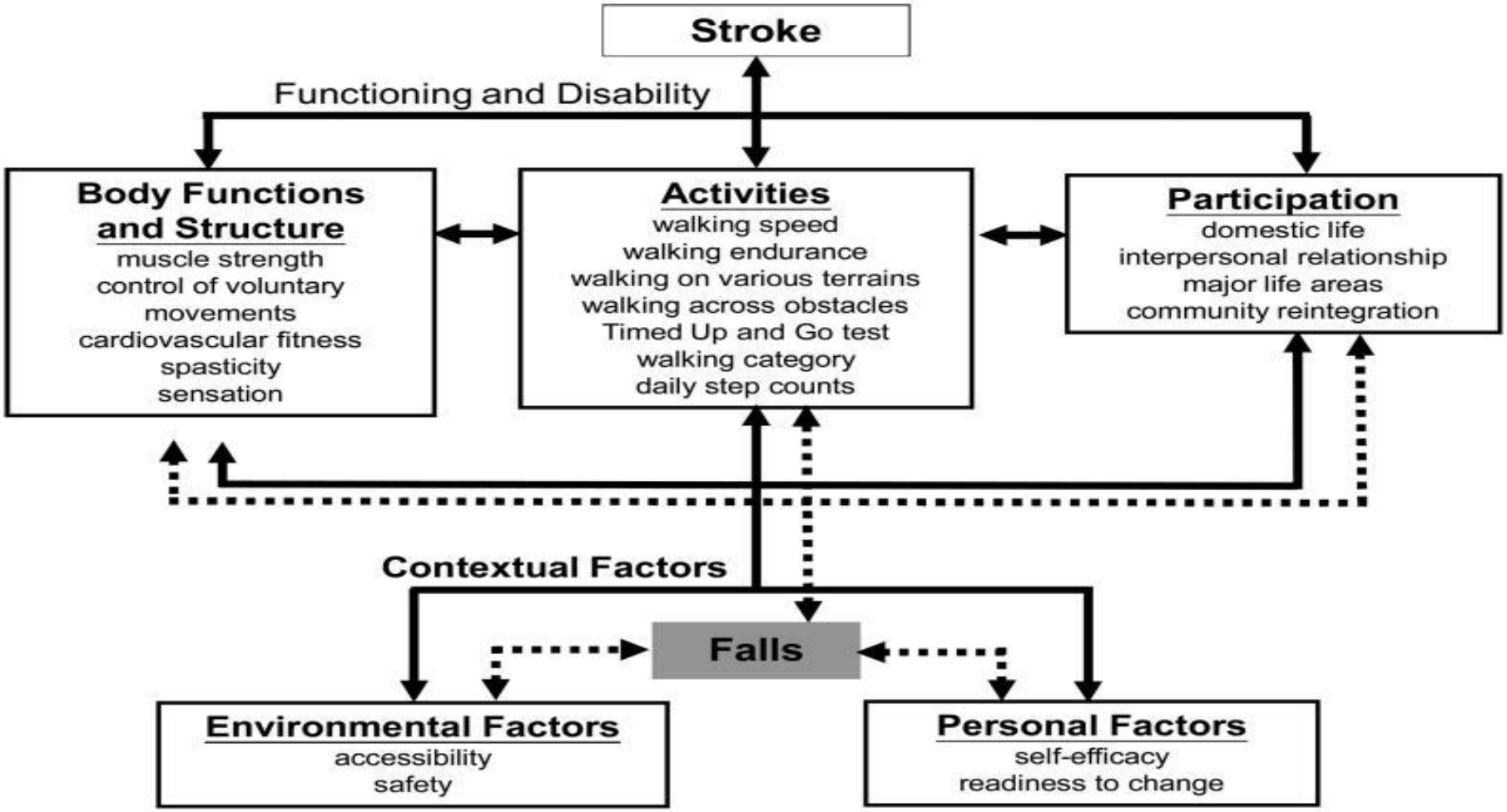


! Active training enhances neuroplasticity and results in reorganization of cortical maps.

The relationship of interdependence

- Information received from the muscles, joints, skin, vision, is interpreted, processed and transformed into commands transmitted between the command system (brain) and the effector system (muscles, joints).
- This broad spectrum of messages and possibilities stimulates the brain to form new synapses to provide new commands.

ICF for Stroke



The International Classification of Functioning, Disability and Health (ICF) is a framework for describing and organising information on functioning and disability.

https://www.physio-pedia.com/Gait_Training_in_Stroke

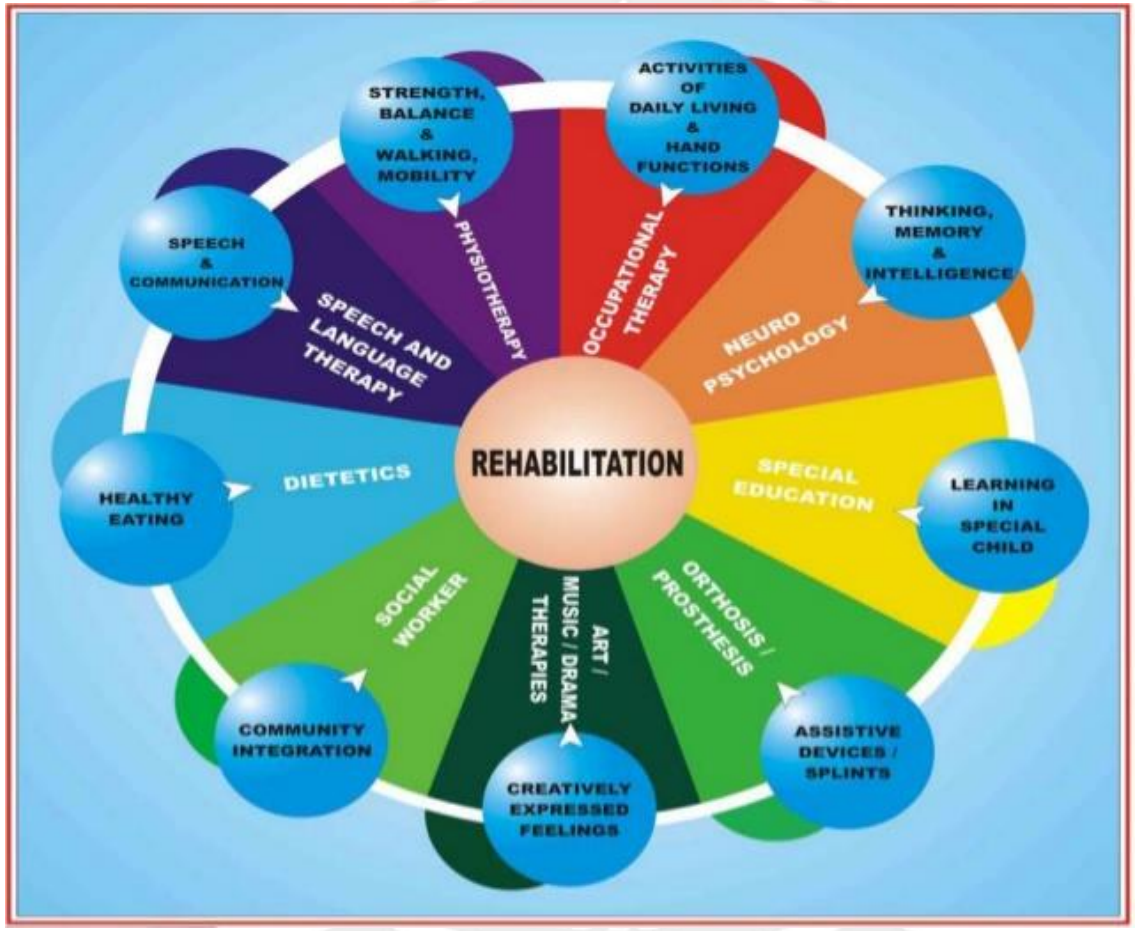
Principles of rehabilitation

- Early initiation
- Continuity of the process
- Staging of the process
- Complexity
- Multidisciplinary approach
- Centralized rehabilitation per patient

Rehabilitation Stroke Services Framework 2013.
www.strokefoundation.com.au

Multidisciplinary team approach

- Neurologist/neurosurgeon
- Orthopaedist/orthopaedic surgeon
- Physiatrist
- Internist
- Rehabilitation nurse
- Dietitian
- Physical therapist
- Occupational therapist
- Speech therapist/language therapist
- Psychologist/psychiatrist
- Recreational therapist
- Audiologist
- Chaplain
- Vocational therapist



J Rehabil Med. 2012 Nov;44(11):901-12.
Multidisciplinary team care in rehabilitation: an overview of reviews.

Services include

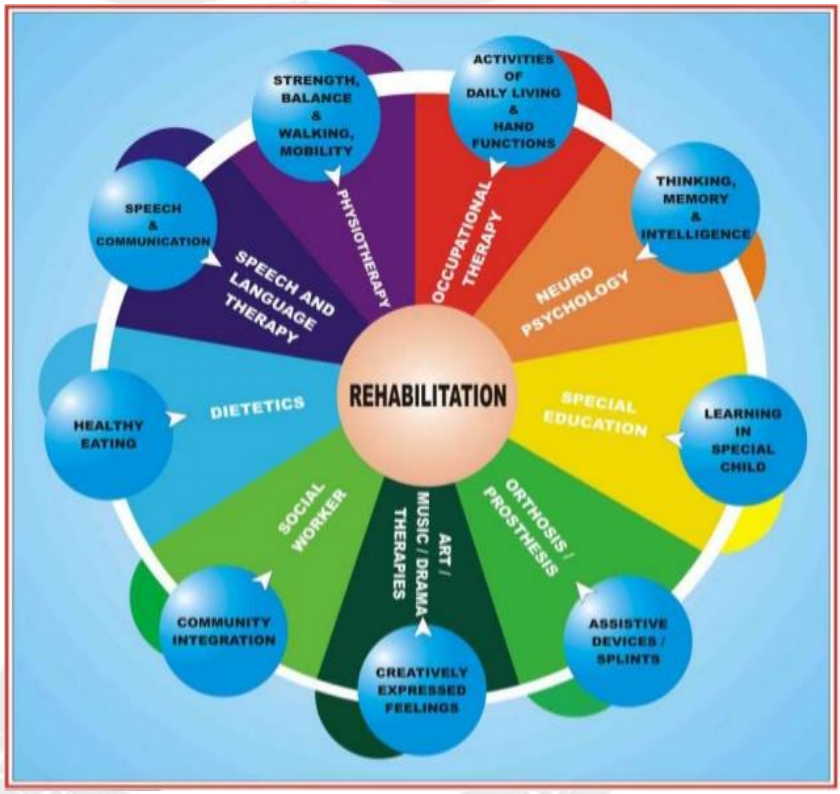
- Assistance with activities of daily living (adls) such as eating, dressing, bathing, using the toilet, handwriting, cooking, and basic housekeeping

- Speech therapy (to help patients who are having trouble speaking, expressing their thoughts, or swallowing; to improve speech patterns, enunciation, and oral communication, in general)

- Counseling (to deal with anxiety and depression)

- Bladder and bowel retraining

- Activities to improve control and muscle balance in the trunk, pelvis, and shoulder girdle



The multidisciplinary team realizes:

- Selecting patients who will follow the complex rehabilitation program;
- Full initial evaluation;
- Setting goals and objectives of the rehabilitation program;
- Provide a progressive recovery program adapted to each stage of the disease;
- Evaluation of the results, modification and long-term evaluation of the recovery program.

J Rehabil Med. 2012 Nov;44(11):901-12.
Multidisciplinary team care in rehabilitation: an overview of reviews.

CLINICAL NEUROLOGY IN A REHABILITATION SETTING

- Complicated interrelationships between impairments, activities, participation, and quality of life call for a wide range of medical skills.

- assessment is obviously centered on the patient, additional information should always be collected from family members or professional helpers

- based survey of abilities and disabilities provides further background information. (ADL checklist)

CLINICAL NEUROLOGY IN A REHABILITATION SETTING

- Neurological assessment, often makes a decisive contribution to assessing rehabilitation by identifying deficiencies that cause disabilities (Where? / What? / How?)
- Functional testing of walk, balance, muscle strength, physiological and pathological reflexes, cognitive and psycho-emotional state, and degree of independence.

NEUROLOGICAL ASSESSMENT

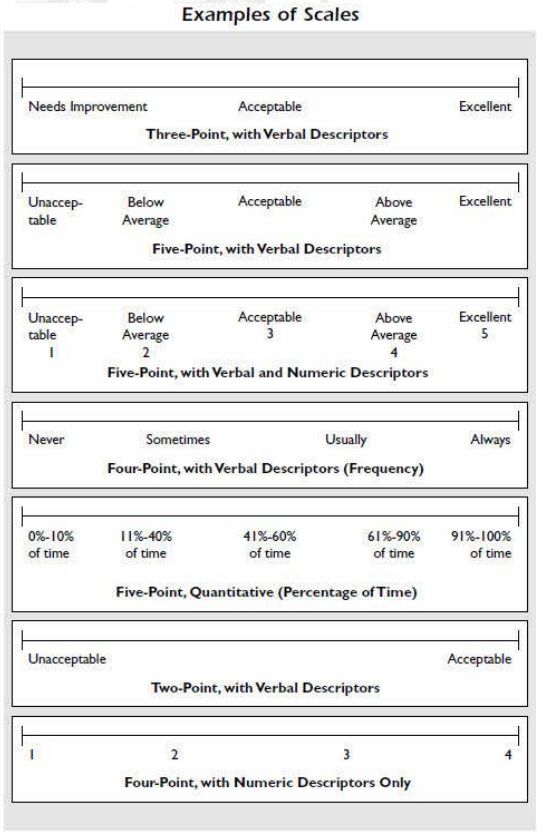
The evaluation process can be based on the **PULSES** principle:

- Physical condition
- Upper limb functions
- Lower limb functions
- Sensory (speech, vision, hearing)
- Excretory functions
- Status (mental and emotional)

Nicolas Brd. Neurological Assessment. Student Handbook. 3rd Edition, January 2016.

Scales

- Simple tools, for measuring functional abilities
- Highlight the results of the recovery process
- They are specific and relevant
- They are quickly and easily used
- Reliable, validated



Examples of Scales

- Barthel score
- Rankin Scale
- ADL scale (Activity of daily living)
- The Functional Independence Measure (FIM)
- Modified Ashworth scale
- Medical research council scale
- Mini mental test Montreal cognitive assesment (MoCA)
- and others...

Activity of Daily Living scale

- (1) dressing
- (2) bathing
- (3) transfers
- (4) grooming
- (5) managing stairs
- (6) walking
- (7) feeding
- (8) toilet
- (9) wheelchair
- (10) continence

Table 1.1 The ASIA impairment scale

Grade	Description
A	Complete: no motor or sensory function is preserved in the segments
B	Incomplete: sensory (but not motor) function is preserved below the neurological level and extends through the sacral segments S4–S5
C	Incomplete: motor function is preserved below the neurological level, and the majority of key muscles below the neurological level have a muscle grade less than 3
D	Incomplete: motor function is preserved below the neurological level, and the majority of key muscles below the neurological level have a muscle grade greater than or equal to 3

The Barthel ADL Index (from Mahoney & Barthel, 1965)

Item	*Categories*
Bowels	0 = incontinent (or needs to be given enemata) 1 = occasional accident (once per week) 2 = continent *If needs enema from nurse, then "incontinent".* *Occasional = once a week.*
Bladder	0 = incontinent/catheterised, unable to manage 1 = occasional accident (max once every 24 h) 2 = continent (for over 7 days) *Occasional = less than once a day.*
	1 = needs some help but can do something alone 2 = independent (on and off, dressing, wiping) *With help = can wipe self, and do some other of above.*
Feeding	0 = unable 1 = needs help cutting, spreading butter, etc. 2 = independent (food provided in reach) *Help = food cut up, patient feeds self.*
Transfer	0 = unable—no sitting balance 1 = major help (one or two people, physical), can sit 2 = minor help (verbal or physical) 3 = independent *Dependent = no sitting balance (unable to sit): two*

The goal of rehabilitation

- is to allow people with disabilities to live the life they want, with all the inevitable restrictions imposed by the disease.
- in this aspect, a set of measures is used to:

  - overcome or alleviate these deteriorations,
  - eliminate or reduce barriers to participation in the environment chosen by the person,
  - supports their reintegration into society.

Disabil Rehabil. 2010;32(17):1419-27.
Goal setting in neurological rehabilitation: staff perspectives.
Van De Weyer RC, Ballinger C, Playford ED.

Disabil Rehabil. 2007 Mar 15;29(5):389-94.
Goal setting in neurological rehabilitation: patients' perspectives.
Holliday RC, Ballinger C, Playford ED.

Goals of Rehab in Neurology

Many rehabilitation teams use the **SMART** acronym, requiring each goal to be:

- Specific
- Measurable (at least in principle)
- Achievable (both for the client and for the team)
- Relevant to rehabilitation aims
- Timed: achievable within a defined period of time

Rehabilitation Goal Training. Participant Workbook. (2013)
https://www.aci.health.nsw.gov.au/__data/assets/pdf_file/0014/272210/Rehab_Goal_Training_Workbook.pdf

Neurorehabilitation objectives

- Minimize infirmity
- Increasing the degree of functional independence
- Prevention of recurrences and complications
- Social integration
- Increasing the quality of life
- Cost reduction

Rehabilitation Goal Training. Participant Workbook. (2013)
https://www.aci.health.nsw.gov.au/__data/assets/pdf_file/0014/272210/Rehab_Goal_Training_Workbook.pdf

Possible complications in neurorehabilitation:

- The occurrence of bedsores;
- Management of spasticity;
- Urinary and pulmonary infections;
- Tendon and joint inflammation;
- Central neuropathic pain;
- Regional complex pain syndrome;
- Hemiplegic painful shoulder;
- Immobilising osteoporosis;
- Venous thromboembolism;
- Swallowing and sphincter disorders;
- Cognitive and communication disorders.

Initiating and phasing of the recovery

- Early initiation and phasing of the recovery program is an essential element of the success of neurorehabilitation.
- Depending on the stage of pathogenic and sanogenetic processes that occur, three periods are highlighted in stroke:
- early recovery (up to 6 months after onset);
- late recovery (6 to 12 months);
- chronic/sequelae (1 year after onset).

National clinical guideline for stroke. Chisinau 2008.

Conduit of patients depending on the rehabilitation phase

Primary rehabilitation period (up to 1 month from onset)

- Primary prophylaxis of recurrences;
- Prevention and treatment of medical complications;
- maintenance of motor schemes;
- Increase in tone and muscle strength;
- Increasing the degree of motility and conducting transfers;
- Preventing vicious deformations and attitudes;
- Management of complications (dysphagia, dysphasia, sphincter disorders);
- Pharmacological facilitation of the neurorecovery process.

National clinical guideline for stroke. Chisinau 2008.

Conduit of patients depending on the rehabilitation phase

Early rehabilitation period (from 1 to 6 months)

- Secondary prophylaxis of recurrences;
- Treatment of medical complications;
- Promoting motor control and active re-training of walking;
- Acquiring self-service activities;
- Performing activities related to everyday life;
- Involvement of compensatory skills stimulation techniques of cognitive functions;
- Monitoring of post-lesional depression and anxiety.

National clinical guideline for stroke. Chisinau 2008.

Conduit of patients depending on the rehabilitation phase

Tardive rehabilitation (from 6 to 12 months)

- Management of spasticity;
- Learning palliative movements;
- Strengthening and improving motor control, balance, coordination and correct movements;
- Acquiring self-service activities by promoting palliative movements;
- Automating the usual movements;
- Conscious inclusion in the compensation of speech and understanding defects;
- Applying methodologies and intervention techniques to attention, memory, spatial perception, computation and practice depending on cognitive deficit.

National clinical guideline for stroke. Chisinau 2008.

Conduit of patients depending on the rehabilitation phase

Period of consequences/sequelae (more than 12 months)

- Management of spasticity;
- Secondary prophylaxis of recurrences and medical complications;
- Maintenance of functions in chronic conditions, prevention of progressive deterioration and disability;
- Increasing occupational performance for ADLs, work and recreation;
- Maintaining the results obtained and preventing the degradation of impressive and expressive speech;
- Focus on clearing and optimizing cognitive deficits;
- Ensure a comprehensive understanding of the psycho-social functioning of the patient / caregiver, the environment, resources, goals and community integration.

National clinical guideline for stroke. Chisinau 2008.

REHABILITATION PROCES

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Early Mobilisation

- If patient's condition is stable however, active mobilisation should begin as soon as possible, within 24 to 48 hours of admission
- Early mobilisation is beneficial to patient outcome by reducing the complication
- It has strong positive psychological benefit for the patient
- Specific tasks (turning from side to side in bed, sitting in bed) and self-care activities (self-feeding, grooming and dressing) can be given for early mobilisation.

Stroke. 2015;46:1141-1146
Early Mobilization After Stroke.
Julie Bernhardt, Coralie English, Liam Johnson, Toby B. Cumming

Duration and intensity of recovery treatment

- The intensity of recovery therapy should be tailored to each case.
- Complex procedures can be applied in several rounds over a day, with breaks of 30 to 60 minutes between them.
- There are preparatory procedures (analgesic physiotherapy, massage, infrared radiation, infiltration, etc.) that need to be followed by the application of the basic therapies.

Curr Opin Neurol. 2015 Dec; 28(6): 549–555.
Dose and timing in neurorehabilitation: Prescribing motor therapy after stroke.
Catherine E. Lang, Keith R. Lohse, Rebecca L. Birkenmeier.

Duration and intensity of recovery treatment

- It is recommended to have a daily 2-hour program in one or two stages,
- at least 5 days per week,
- at least in the immediate aftermath of the lesion / damage.
- Subsequently, under the conditions of a favourable evolution and independent performance of the recuperation program by the patient, supervised sessions can be held twice a week for at least 1 year.

Curr Opin Neurol. 2015 Dec; 28(6): 549–555.
Dose and timing in neurorehabilitation: Prescribing motor therapy after stroke.
Catherine E. Lang, Keith R. Lohse, Rebecca L. Birkenmeier.

The core of rehabilitation

- Drug treatment
- Treatment of medical complications
- Physical rehabilitation treatment (KT, OT, FT)
- Cognitive recovery
- Recovering language and dysphagia
- Social / community / counselling assistance.

Basic Physical Therapy

- Bed positioning, mobility
- Range of motion exercises (ROME)
- Sitting/trunk control
- Transfer
- Walking
- Stair climbing

Physical Therapy Interventions for Patients With Stroke in Inpatient Rehabilitation Facilities.
Diane U Jette Nancy K Latham Randall J Smout Julie Gassaway Mary D SlavinSusan D Horn.
Physical Therapy, Volume 85, Issue 3, 1 March 2005, Pages 238–248

Physical therapy – objectives

- Avoiding or correcting the occurrence of deformations, joint inflamation and vicious attitudes.
- Avoiding paralyzed muscular atrophy.
- Recovery from vasculopathy syndrome.
- Increase functionality of healthy muscle fibers.

Physical Therapy Interventions for Patients With Stroke in Inpatient Rehabilitation Facilities.
Diane U Jette Nancy K Latham Randall J Smout Julie Gassaway Mary D SlavinSusan D Horn.
Physical Therapy, Volume 85, Issue 3, 1 March 2005, Pages 238–248

Occupational Therapy

- Occupational therapy includes activities from the most diverse areas the individual performs during the day. These activities concern:

a. Self-care daily;
b. Entertainment, leisure;
c. Work;
d. Educational activities;
e. Hobbies;
f. Other activities

(American Occupational Therapy Association, 2008)

Communication

- Speech and language therapy
- Common communication disorder (Aphasia/Dysarthria)
- To facilitate recovery of communication, develop strategies to compensate
    - Gesture
    - Picture
    - Communication board
    - Computer

Speech and language therapy after stroke.
UK Stroke Association 2012

Swallowing

- Dysphagia: abnormality in swallowing fluids or solid food.
- Specific treatment for swallowing disorders (exercises to improve the functionality of the muscles involved in swallowing).
- Electrotherapy (Vital Stim)
- Liquidise food using blender or use of substances to change food homogeneity.
- Certain positions or strategies that favour swallowing.
- Applying gastrostomy to necessity.

Gastroenterol Hepatol (N Y). 2011 May; 7(5): 308–332. Management of Dysphagia in Stroke Patients. Reza Shaker MD, Joseph E. Geenen.

Spasticity

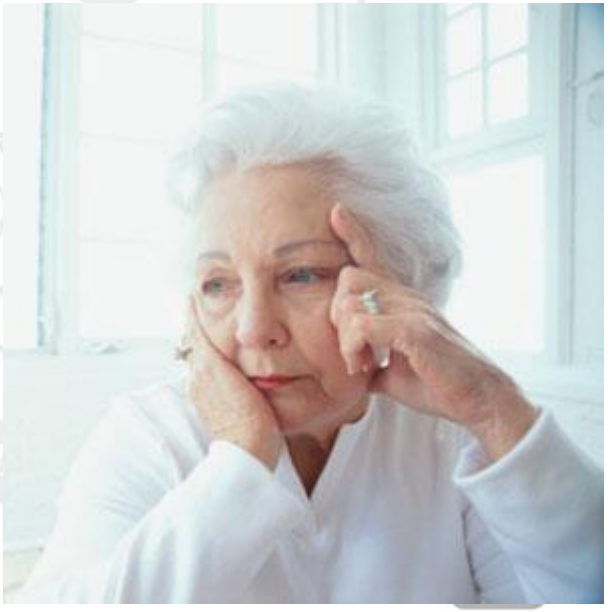
- Treatment
  - Avoid noxious stimuli
  - Positioning, passive stretching, ROME
  - Use of antispastic drugs
  - Botulinum toxin A injection
  - Neurosurgical procedure (selective dorsal rhizotomy)

Spasticity after stroke: Physiology, assessment and treatment.
Aurore Thibaut1 , Camille Chatelle et. All. Brain Inj, Early Online: 1–13. 2013

Coginitive and perception

Current evidence suggests that 25–30% of ischemic stroke survivors develop immediate or delayed vascular cognitive impairment (VCI) or vascular dementia (VaD).

- Attention deficits
- Visual neglect
- Unilateral neglect
- Memory deficits
- Problem solving difficulties



Biochim Biophys Acta. 2016 May; 1862(5): 915–925.
Stroke injury, cognitive impairment and vascular dementia
Raj N. Kalaria, Rufus Akinyemi, Masafumi Ihara.

Bowel and bladder incontinence

- 50% -experience incontinence during acute phase
- with time, ~ 20%, at six months
- Risk: age, stroke severity, diabetes
- Indwelling catheter : management of fluids, prevent urinary retention, skin breakdown
- Use of foley catheter > 48 hours > UTI
- Management
  - Adequate intake of fluid
  - Bulk and fiber food
  - Bladder/ Bowel training

Continence problems after stroke.
UK Stroke Association 2012. https://www.stroke.org.uk

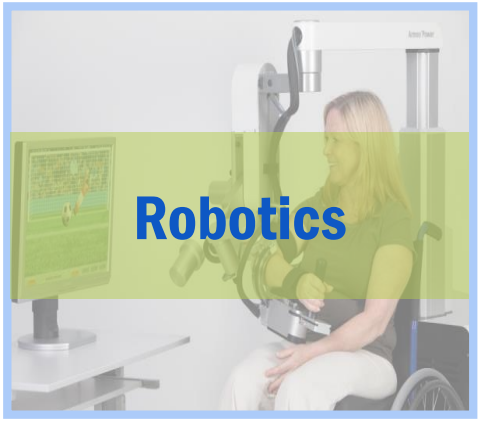
Precautions / Contraindications

- Severe coma or obnubilation;
- Progression of neurological signs and symptoms;
- Subarachnoid or intracerebral hemorrhage;
- Severe hypostatic hypotension;
- Severe myocardial infarction;
- Acute deep vein thrombosis (until initiation of appropriate anticoagulant therapy).

BENEFITS OF NEURO REHABILITATION

- It promotes patient' skills to work at the highest level of independence possible for him/her after the damage to brain or spinal cord.
- It also encourages him/her to rebuild self-esteem and a positive mood.
- Thus, he/she can adapt to the new situation and become empowered for successful community reintegration.

New Technologies:



«Application of robotic devices to assist, enhance and intensify therapy.»

«Use of non-actuated devices (no motors) such as body weight support systems to facilitate rehabilitation.»

«Application of electrical stimulation to create functional movements and improve recovery.»

Conclusion

- Rehabilitation of patients with nervous system disorders is a complex process requiring a multidisciplinary approach, with the application of contemporary methods and techniques of recovery, with the goal of preventing recurrences, combatting complications, and reinvigorating the patient in socium.

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3. AHA/ASA Guideline: Guidelines for Adult Stroke Rehabilitation and Recovery. 2066. http://stroke.ahajournals.org/
4. Roger Chou MD, Laurie Hoyt Huffman MS. Guideline for the Evaluation and Management of Low Back Pain. Evidence Review. American Pain Society. 2007.
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7. Durerea lombară la adult. Protocol clinic naţional – 201. Chisinau 2013.

Questions?