



Stroke Rehabilitation: How to facilitate neuroplasticity?

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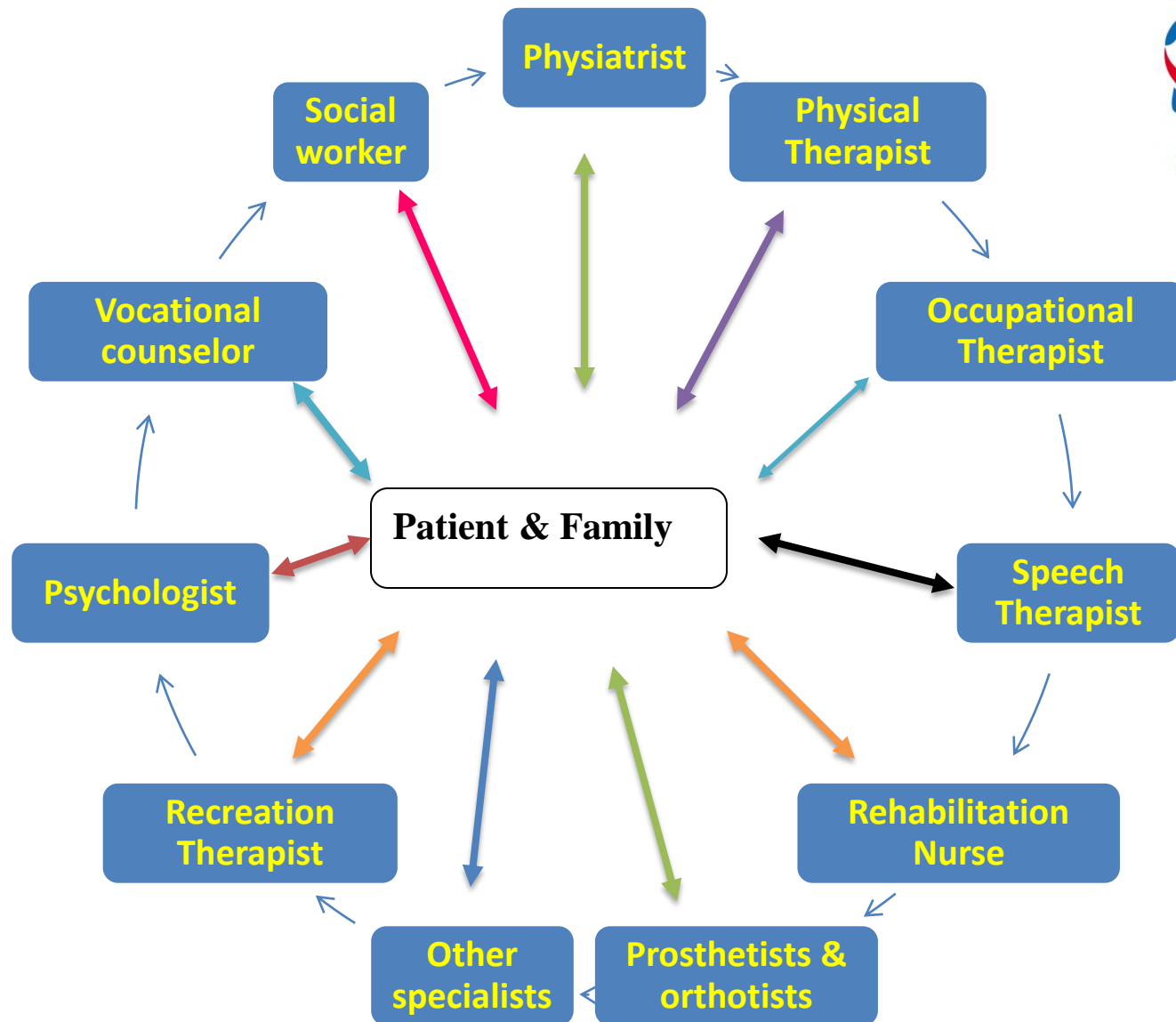
INTRODUCTION

- Stroke is a leading cause of long-term disability and the leading *preventable* cause of disability.
- More than 17 million strokes occur globally every year.
- One in six people will suffer a stroke in their lifetime.
- With more than 6 million deaths annually stroke is the leading cause of death on a global scale.
- Many of the 26 million stroke survivors worldwide live with significant disabilities.
- Almost 30% stroke survivors will die.
- 30% suffer from long term disabilities.
- it is preventable and treatable.
- 70% of people with stroke could lead a functional life with early treatment and rehabilitation.

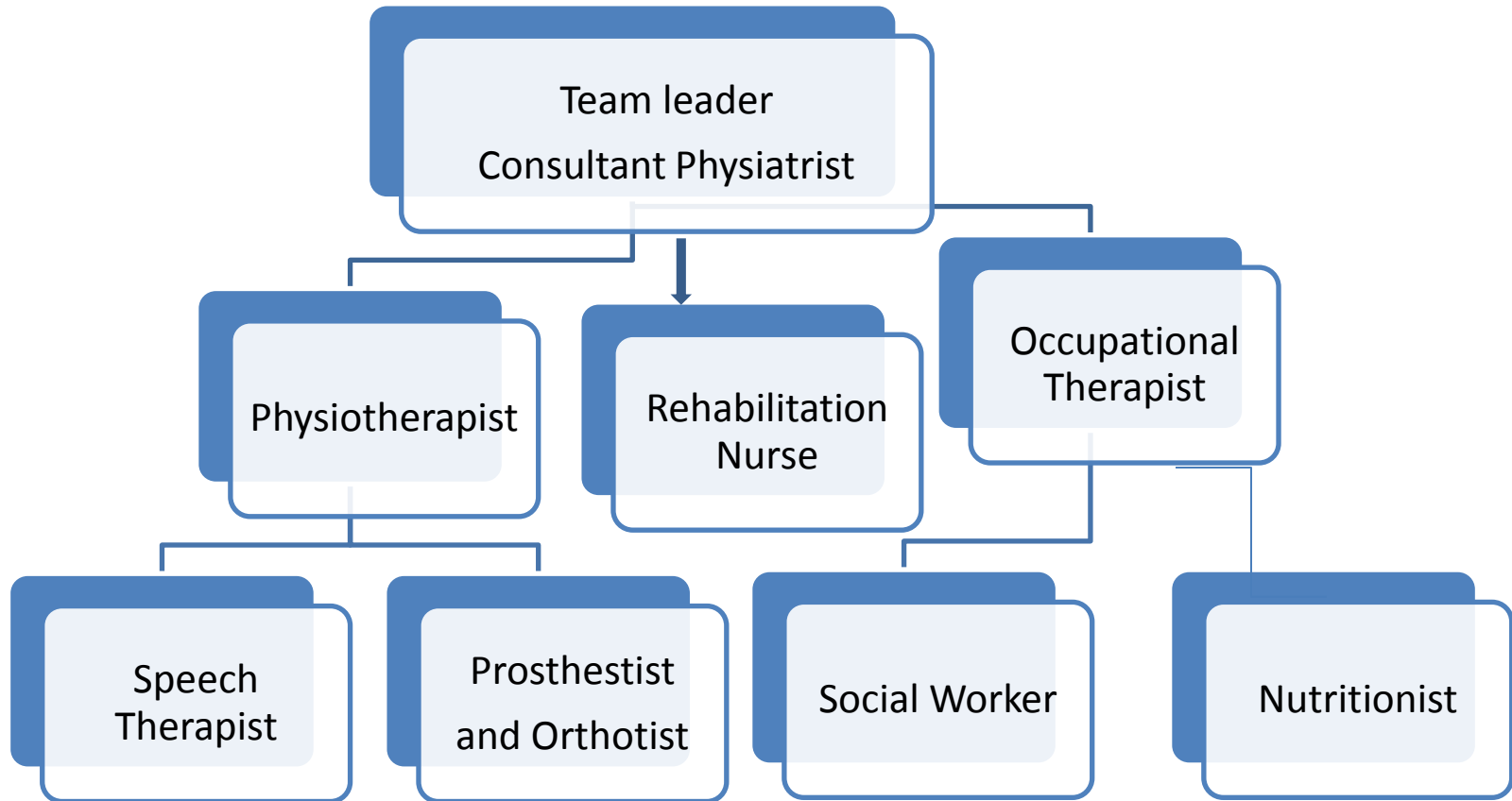
Stroke rehabilitation

- Stroke rehabilitation is the **essential part of treatment process**
- to prevent complications
- to minimize impairment,
- to restore motor function
- to maximize functional capacity and improve quality of life of stroke survivors.

Multi & Interdisciplinary team approach

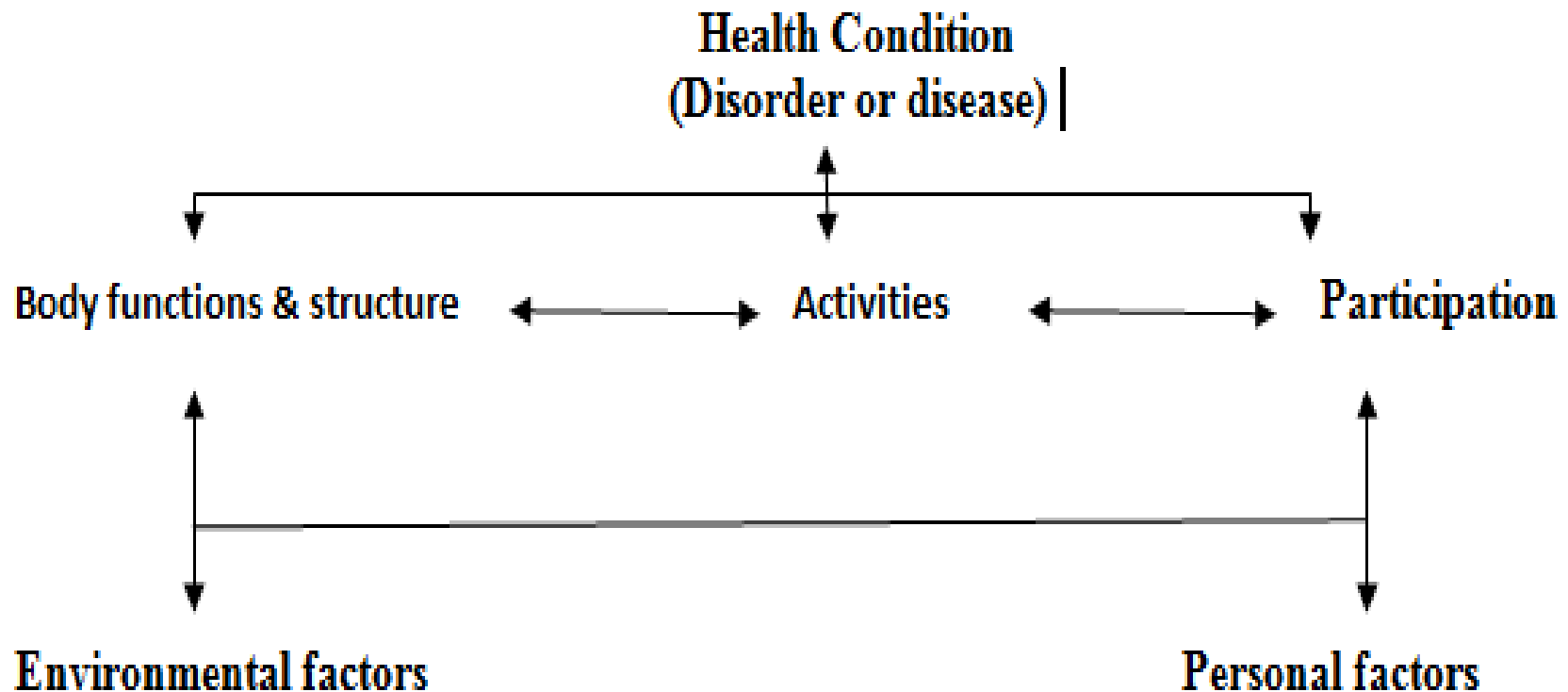


REHABILITATION TEAM FOR STROKE REHABILITATION



Stroke and disability

Representation of the International Classification of Functioning, Disability, and Health Bio-psycho-Social Model (Adopted from World Report on Disability, 2011)



Impairment after stroke

Primary Impairment

- Cognition
- Speech, and swallowing
- Visual Deficits
- Motor Impairment
- Sensory Impairment
- Bladder & bowel
- Spasticity
- Depression and Psychosocial problem
- Gait abnormality

Secondary Impairment

- Shoulder Pain
- Swallowing and Nutrition
- Contractures & deformity
- Venous Thromboembolism
- Pressure ulcers etc.

Common activity limitations

- communication
- bathing and toileting
- dressing and grooming
- eating and drinking
- transferring
- walking and mobility
- participation restriction(e.g. returning to work)
- psychological (e.g. Decision making) etc.

Characteristics of Right and Left Hemiplegic Patients

Right Hemiplegic (Left-Brain Injured)

vs.

Left Hemiplegic (Right-Brain Injured)

- Communication impairment
- Learns by demonstration
- Will learn from mistakes
- May require supervision due to communication problems

- Visual / motor perceptual problems
- Loss of visual memory
- Left side neglect
- Impulsive
- Lacks insight / judgement requires supervision

Types of rehabilitation programs

- Inpatient rehabilitation programs
- out patient programs
- Nursing facilities
- home-based rehabilitation programs

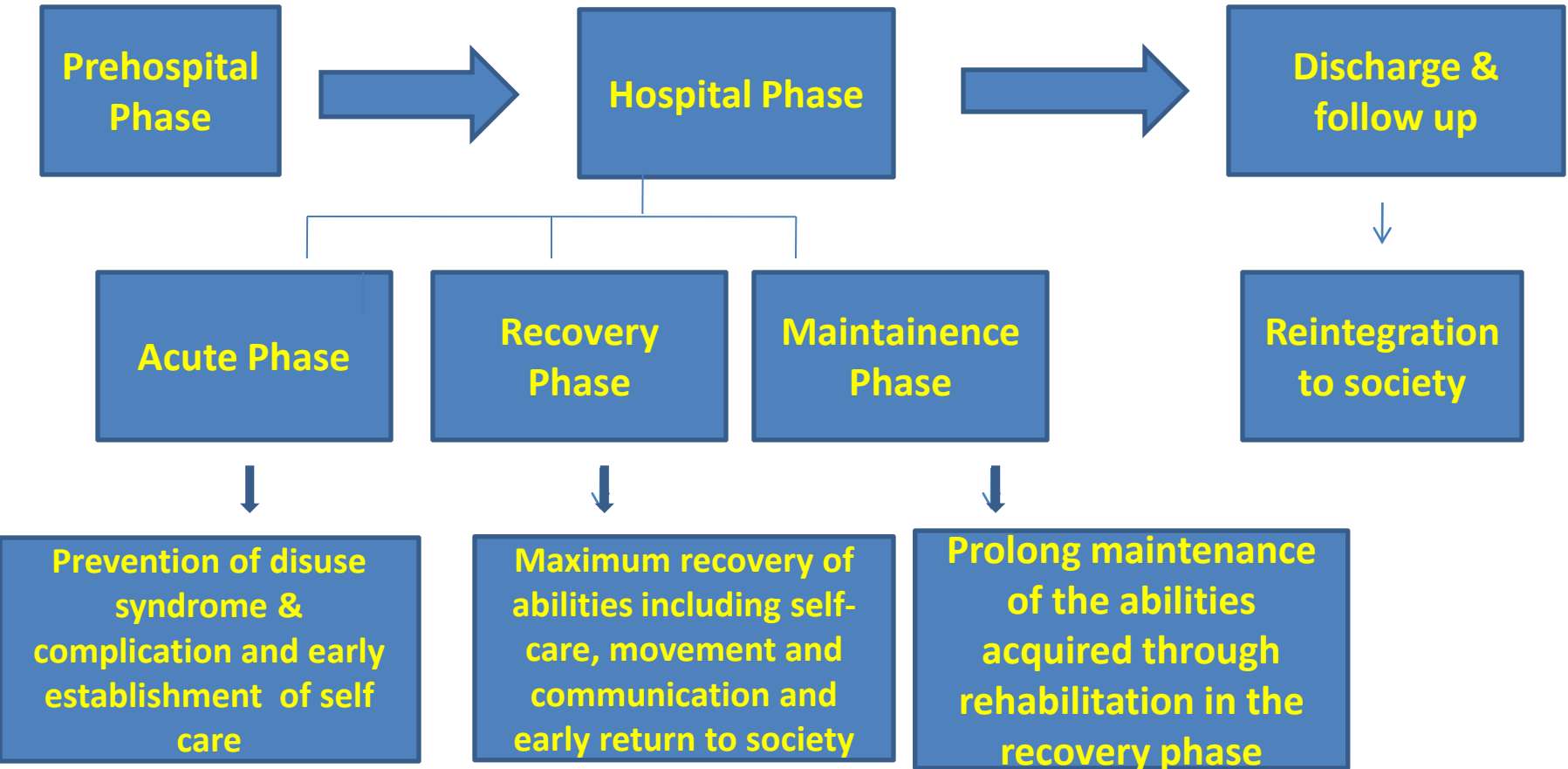
Recommendations: Rehabilitation Interventions in the Inpatient Hospital Setting	Class	Level of Evidence
It is recommended that early rehabilitation for hospitalized stroke patients be provided in environments with organized, interprofessional stroke care.	I	A
It is recommended that stroke survivors receive rehabilitation at an intensity commensurate with anticipated benefit and tolerance.	I	B
High-dose, very early mobilization within 24 hours of stroke onset can reduce the odds of a favorable outcome at 3 months and is not recommended.	III	A

Winstein et al (2016) Guidelines for Adult Stroke Rehabilitation and Recovery
from <http://stroke.ahajournals.org>

Criteria for admission to a comprehensive rehabilitation program

- Stable neurologic status
- Significant persisting neurologic deficit
- Identified disability affecting at least 2 of 5 functions, including mobility, self-care activities, communication, bowel or bladder control, and swallowing
- Sufficient cognitive function to learn
- Sufficient communicative ability to engage with therapists
- Physical ability to tolerate the active program
- Achievable therapeutic goals

Stroke Rehabilitation Pathway



Goals of stroke rehabilitation

- prevent, recognize and manage co-morbid medical conditions and complications
- prevent complications of prolonged inactivity
- prevent recurrent stroke and cardiovascular events and increase aerobic fitness.
- maximize functional independence
- optimize psychosocial adaptation of patients and families
- facilitate resumption of prior life roles and community reintegration
- enhance quality of life

Recovery after stroke

According to the National Stroke Association (USA)

- 10% of stroke survivors recover almost completely
- 25% recover with minor impairments
- 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
- Approximately 14% of stroke survivors experience a second stroke in the first year following a stroke.

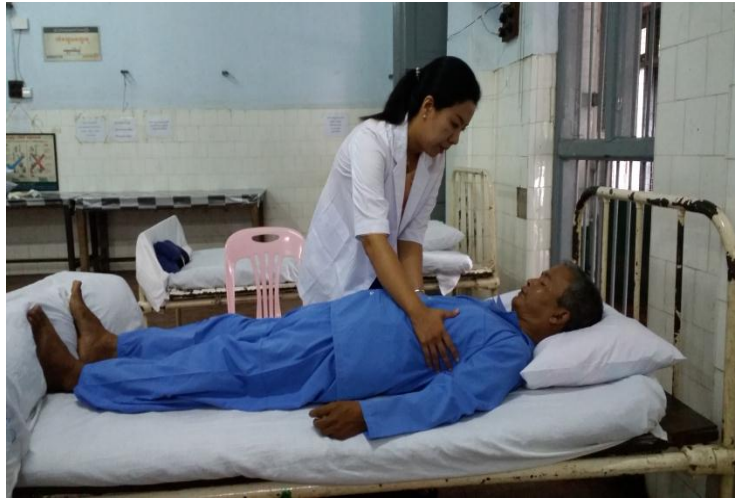
Rehabilitation at acute stage (Proper Positioning)



Conventional physiotherapy

Passive ROM Exercise (On Bed)





**Breathing Exercise
(Assisted)**

Physiotherapy for Sub acute stroke Patients



Sitting Balancing Exercise



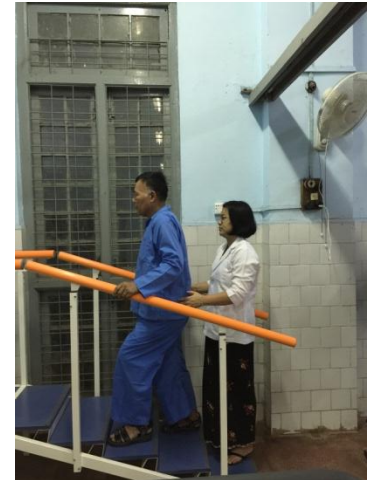
Sitting Balancing Exercise with Medicine Ball



Active Passive Movement Therapy Training



Balancing Exercise for Stroke Patient and Stair Climbing

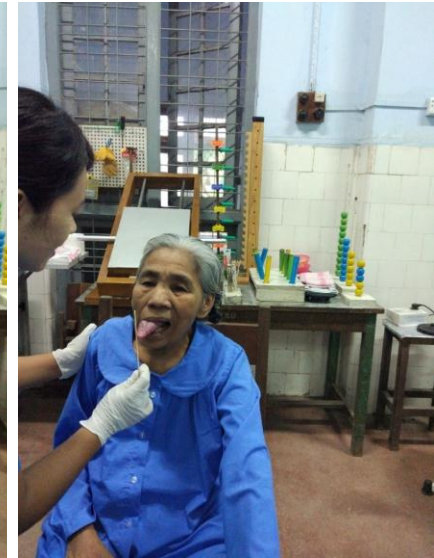


Speech Therapy



Speech Training

Jaw Movement



Tongue Movement



lips Movement

Speech Training

Identifying



Naming



Cognitive Training



Counting The Days



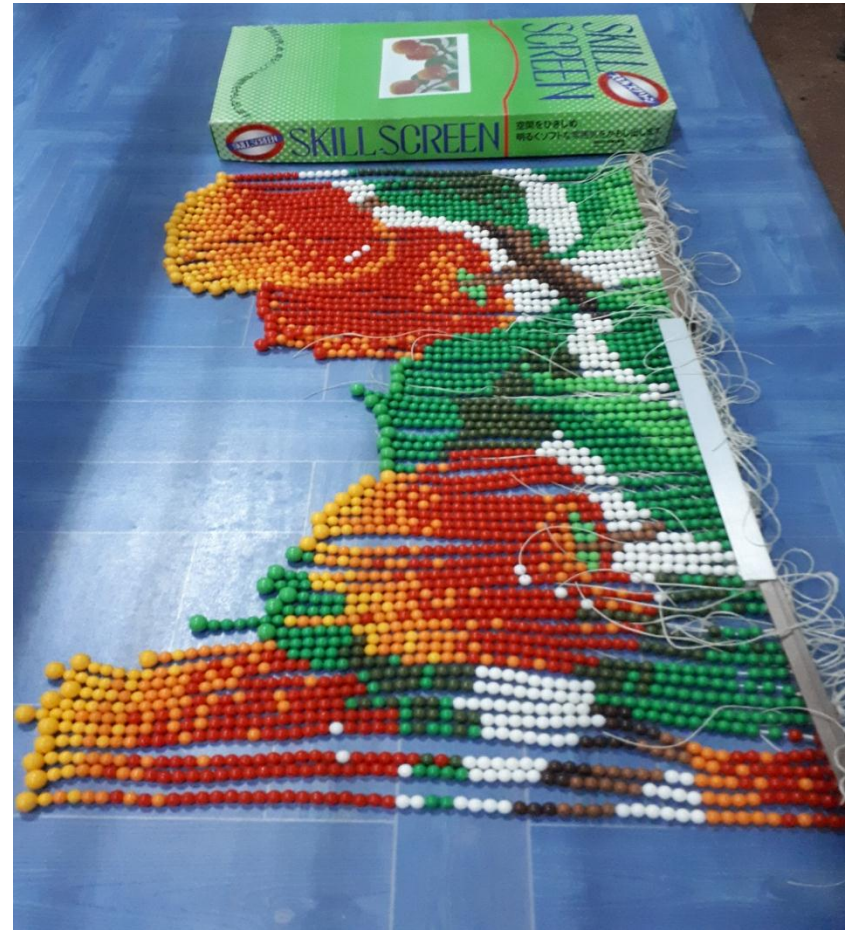
Occupational Therapy



Occupational Therapy



Occupational therapy





What is Neuroplasticity?

- Neurons: Nerve cells in brain
- Plasticity: something that is capable of being molded or reorganized.
- neuroplasticity refers to the process of reorganizing the neurons in the brain. It's the mechanism that our brain use to heal from damage and rewire itself.
- Brain is not a static organ.
- Brain changes throughout life and after injury
- Synaptic connections are continually being modified (re-organisation of circuitry)
 - In response to demand – learning, repetition, after damage to the CNS

How neuroplasticity comes into play ?

- After a stroke, certain parts of the brain can become damaged (depending on what type of stroke and where it occurred) and the functions that were once stored in those parts of the brain become impaired.
- For example, if the part of the brain responsible for motor control on the right side of the body becomes damaged, it will make it hard to move patient's right arm.
- That's when neuroplasticity comes into play.
- Neuroplasticity allows the brain to rewire functions that were once held in damaged areas of the brain over to new, healthy parts of the brain. So with the right arm example, a different, healthy area of the brain is capable of picking up the slack and taking on the task of moving your right arm.
- One important requisite for neuroplasticity to occur is ***repetitions***.
- Patients need to utilize a high numbers of repetitions during their rehab exercises, otherwise it won't work that well.

Mechanisms of Neuroplasticity

- **Axonal Sprouting** - Undamaged axons grow new nerve endings to reconnect damaged neuron links
- **New Neural Pathways** - Undamaged axons sprout to other undamaged nerve cells forming new neural pathways to accomplish a needed function
- **Cortex Changes** – Use of dependent competition among neurons can alter brain network in both the sensory and motor cortex

What can be done to enhance Neuroplasticity and functional recovery potential?

Today rehabilitation protocols are being based on motor learning to induce neural plasticity

- Training should be:
 - task specific
 - meaningful and challenging
 - repetitive and intensive
 - provided in an enriched environment (environments that provide greater opportunity for physical activity and motivation)
 - movements performed in a relatively normal biomechanical position and manner

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Stroke Research and Treatment

Volume 2013 (2013), Article ID 128641, 13 pages

<http://dx.doi.org/10.1155/2013/128641>

Review Article**Rehabilitation with Poststroke Motor Recovery: A Review with a Focus on Neural Plasticity**

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Received 8 February 2013; Revised 9 April 2013; Accepted 10 April 2013

Academic Editor: Magdy Selim

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Abstract

Motor recovery after stroke is related to neural plasticity, which involves developing new neuronal interconnections, acquiring new functions, and compensating for impairment. However, neural plasticity is impaired in the stroke-affected hemisphere. Therefore, it is important that motor recovery therapies facilitate neural plasticity to compensate for functional loss. Stroke rehabilitation programs should include meaningful, repetitive, intensive, and task-specific movement training in an enriched environment to promote neural plasticity and motor recovery. Various novel stroke rehabilitation techniques for motor recovery have been developed based on basic science and clinical studies of neural plasticity. However, the effectiveness of rehabilitative interventions among patients with stroke varies widely because the mechanisms underlying motor recovery are heterogeneous. Neurobiological and neuroimaging studies have been developed to

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Views	31,515
Citations	57
ePub	100
PDF	7,803

Repetitive task training for improving functional ability after stroke

Published:
14 November 2016

Authors:
French B, Thomas LH, Coupe J,
McMahon NE, Connell L, Harrison
J, Sutton CJ, Tishkovskaya S,
Watkins C

Primary Review Group:
Stroke Group

See the full Review on
the Cochrane Library ▶

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PDF

Citation

Review question: What are the effects of repeated practice of functional tasks on recovery after stroke when compared with usual care or placebo treatments?

Background: Stroke can cause problems with movement, often down one side of the body. While some recovery is common over time, about one third of people have continuing problems. Repeated practice of functional tasks (e.g. lifting a cup) is a treatment approach used to help with recovery of movement after stroke. This approach is based on the simple idea that in order to improve our ability to perform tasks we need to practice doing that particular task numerous times, like when we first learned to write. The types of practice that people do, and the time that they spend practicing, may affect how well this treatment works. To explore this further we also looked at different aspects of repetitive practice that may influence how well it works.

Study characteristics: We identified 33 studies with 1853 participants. Studies included a wide range of tasks to practice, including lifting a ball, walking, standing up from sitting and circuit training with a different task at each station. The evidence is current to June 2016.

Key results: In comparison with usual care (standard physiotherapy) or placebo groups, people who practiced functional tasks showed small improvements in arm function, hand function, walking distance and measures of walking ability. Improvements in arm and leg function were maintained up to six months later. There was not enough evidence to be certain about the risk of adverse events, for example falls. Further research is needed to determine the best type of task practice, and whether more sustained practice could show better results.



Q: What are the effects of repeated practice of functional task on recovery after stroke when compared with usual care or placebo treatment?

- Studied 33 studies with 1853 participants; including wide range of tasks to practice, eg. Lifting a ball, walking, standing up from sitting, with a different task at each station. Evidence is current to 2016.

Key results : low evidence for arm function, hand function, and lower limb functional measures. Moderate evidence for walking distance and functional ambulation.

Quality of evidence for each outcome was limited due to poor reporting of study details, inconsistent results across studies, and small no. of study participants.

14 November, 2016

Rehabilitation interventions to enhance neuroplasticity

- Constraint Induced Movement Therapy (CIMT)
- Functional Electrical Stimulation (FES)
- Mirror Therapy
- Use of Tape
- Body Weight Support Treadmill Training (BWSTT)
- Rehabilitation Robotics (Exoskeleton Training)

Constraint Induced Therapy

- Forced use of the affected extremity. (Based on the fact that the patients with upper extremity loss are more dependent on unaffected arm with negative feedback. Repetitive movements, reacquisition of skills and cortical reorganization are included in CIMT)
- Limiting use of non-affected extremity with constraining device
- Parameters to consider include:
 - Amount of day constrained
 - Type of constraining device

Constraint Induced Movement Therapy



Functional Electrical Stimulation

- Electrical stimulation over affected muscle groups
- Combined with practice/activity
- Parameters to consider:
 - Amount of stimulation
 - Which activity
 - Contraindications/precautions

Functional Electrical Stimulator



Mirror Therapy

- Mirror placed in mid-sagittal plane
- Reflecting movements of non-affected side as it were the affected side
- Parameters to consider include:
 - Amount of time per day
 - Use of mirror box or upright mirror

Mirror Therapy in Stroke Rehabilitation

1. Mirror therapy (MT) is a valuable method for enhancing motor recovery in post-stroke hemiparesis.
2. The technique utilizes the mirror illusion created by the movement of sound limb that is perceived as the paretic limb.
3. MT is a simple and economical technique that can stimulate the brain noninvasively.
4. Multiple areas of the brain such as the occipital lobe, dorsal frontal area and corpus callosum are involved during the simple MT regime.
5. Bilateral premotor cortex, primary motor cortex, primary somatosensory cortex and cerebellum also get reorganized to enhance the function of the damaged brain.
6. The motor areas of the lesioned hemisphere receive visuo-motor processing information through the parieto-occipital lobe.
7. The damaged motor cortex responds variably to the MT and may augment true motor recovery. Mirror neurons may also play a possible role in the cortico-stimulatory mechanisms occurring due to the MT.

Procedure

1. A mirror is placed at the mid sagittal plane of the patient so that the healthy side image will be superimposed on the projection of the affected extremity.
2. Thus there is a visual illusion of increased movement ability of the paretic extremity.

- Effect of Mirror therapy in combination with Conventional physiotherapy
- Significant improvements in motor function
- Functional independence of the extremity
- Reduce the spasticity
- Reduce the pain intensity

Mirror Therapy



Mirror therapy



Use of Tape

- Uses for tape in rehabilitation setting:
 - Shoulder subluxation
 - Knee hyperextension
 - Edema
- Types of tape used:
 - Kinesiology tape
- The application of Kinesio Tape (KT) on the foot and ankle in stroke patients may **improve the quality of somatosensory information** and may **activate ankle muscles** which have an important role in postural control and that ultimately balance could be improved in stroke patients.

Kinesio Tex Tape



Body Weight Support Treadmill Training (BWSTT)

- BWSTT provides environment to relearn normative gait
- Aim- to make step movement of the limb and to ameliorate bipedal walking.
- Also good for cardiovascular fitness of patients.
- Parameters to consider include:
 - Amount of weight supported
 - Speed
 - UE support
 - Use of brace



Body Weight Supported Gait Training (Biodex)



New Technologies- Robotics

- **“For people without disabilities, technology makes things easier.**
- **For people with disabilities, technology makes things possible.”**
- The advantages are –
 - Induced passive or assisted movements with body weight support
 - Tactile , and visual feedback and skill acquisition
 - Easy repetition of movements
 - less manpower

Robotic Therapy



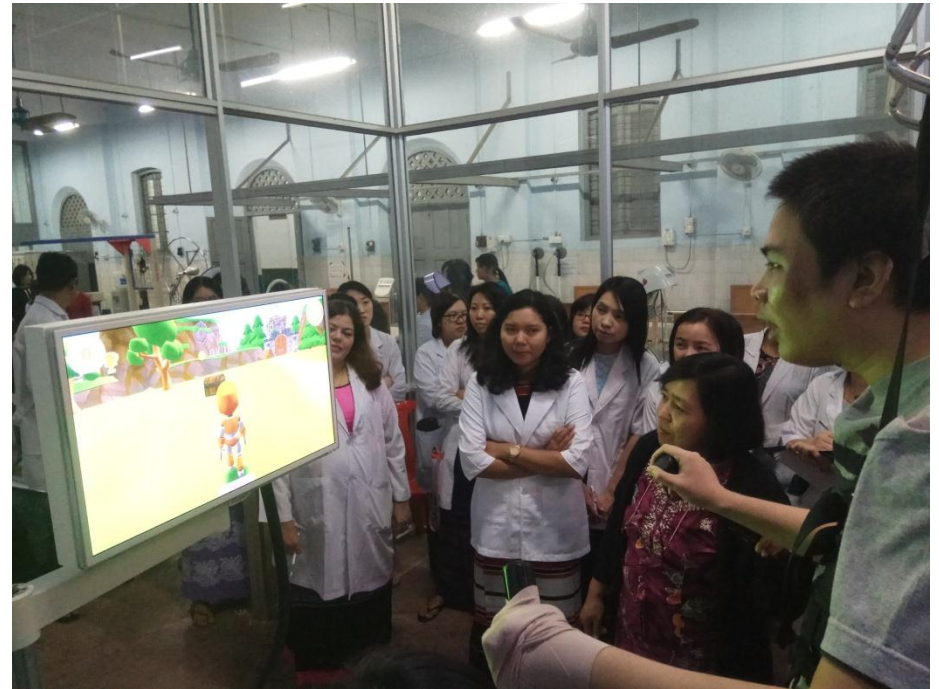
Armeo spring

Robotic Gait Training

Robotic Training for upper limb



Robotic Assisted Training for lower limb (Exo-skeletal Type)



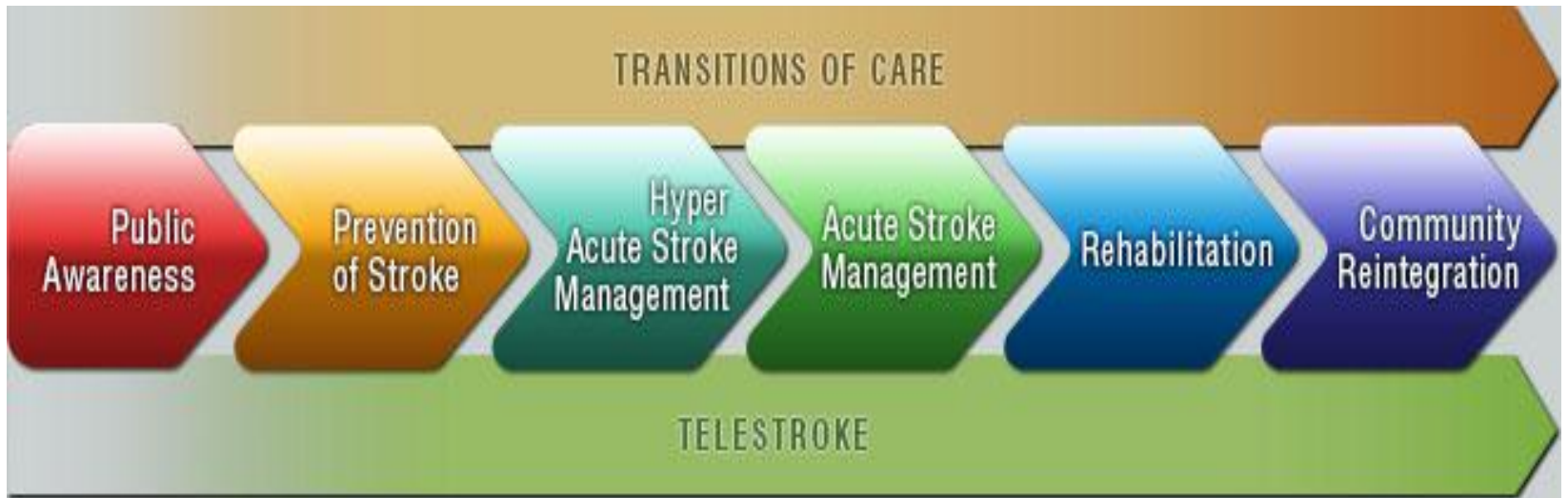
Robotic Assisted Training for lower limb (Exoskeletal Type)



Robotic Training for upper limb



Stroke- Continuum and life long care



Successful Rehabilitation

- Amount of damage to the brain
- Skill on the part of the rehabilitation team
- Cooperation of family and friends. Caring family/friends can be one of the most important factors in rehabilitation
- Timing of rehabilitation – **the earlier it begins the more likely survivors are to regain lost abilities and skills.**
- **Early mobilization**(sitting out of bed, standing and walking 24 hours of stroke onset) has been described as an important component of stroke unit care, and there is direct evidence supporting the practice.

Poor Prognostic Indicators for Stroke Rehabilitation Outcome

- Severe memory problems
- Inability to understand commands
- Medical / surgical instability
- Previous stroke
- Advanced age
- Urinary / bowel incontinence
- Visual spatial deficits

Take Home message

- Rehabilitation therapy should **start as early as** possible, once medical stability is reached.
- Spontaneous recovery can be impressive, but **rehabilitation-induced recovery through enhancing neuroplasticity** seems to be greater on average.
- **The patient and family and/or caregiver** are essential members of the rehabilitation team. **Family members** should participate in therapy sessions.
- Even though the most marked improvement is achieved during the first 3 months, rehabilitation should be continued for a longer period to prevent subsequent deterioration.

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STROKE CAN BE PREVENTED!

THANK YOU