

## MY WAY

A EUROPEAN COLLABORATIVE AND INNOVATIVE PARTNERSHIP  
TO PROMOTE PHYSICAL ACTIVITY AFTER STROKE EVENT



INTELLECTUAL OUTPUT 4  
Training materials

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## A EUROPEAN COLLABORATIVE AND INNOVATIVE PARTNERSHIP TO PROMOTE PHYSICAL ACTIVITY AFTER STROKE EVENT

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# BACKGROUND

## The ERASMUS+ SPORT programme

Erasmus+ is the EU Programme in the fields of education, training, youth and sport, the key areas that support citizens in their personal and professional development. The general objective of the Programme is to equip young people and participants of all ages with the qualifications and skills needed for their meaningful participation in democratic society, intercultural understanding and successful transition in the labour market through high quality, inclusive education and training, as well as informal and non-formal learning and social cohesion. Ultimately the objective is to driving innovation, and to strengthening European identity and active citizenship.

The Programme has the following specific objectives:

- ) promote learning mobility of individuals and groups, as well as cooperation, quality, inclusion and equity, excellence, creativity and innovation at the level of organisations and policies in the field of education and training;
- ) promote non-formal and informal learning mobility and active participation among young people, as well as cooperation, quality, inclusion, creativity and innovation at the level of organisations and policies in the field of youth;
- ) promote learning mobility of sport staff, as well as cooperation, quality, inclusion, creativity and innovation at the level of sport organisations and sport policies.

Erasmus plus is organized as follows:

- ) Key Action 1 - Mobility of Individuals
- ) Key Action 2 – Cooperation among organisations and institutions
- ) Key action 3 – Support to policy development and cooperation

Jean Monnet Actions

MY WAY Project is developed within the KA2: the primary goal of cooperation among organisations and institutions is to allow organisations to increase the quality and relevance of their activities, to develop and reinforce their networks of partners, to increase their capacity to operate jointly at transnational level, boosting internationalisation of their activities, and through exchanging or developing new practices and methods as well as sharing and confronting ideas.

The Actions in the field of sport are expected to result in the development of the European dimension in sport by generating, sharing and spreading experiences and knowledge about different issues affecting sport at the European level.

Ultimately, sport projects supported through Erasmus+ should lead to increased levels of participation in sport, physical activity and voluntary activity.

More specifically:

- ) Increased knowledge and awareness regarding sport and physical activity in Programme Countries.
- ) Increased awareness of as regards the role of sport in promoting social inclusion, equal opportunities and health enhancing physical activity.

- ) Strengthened cooperation between institutions and organisations active in the field of sport and physical activity.
- ) Better participation of sport organisations and other relevant organisations from various Programme Countries in enhanced networks.
- ) Improved sharing of good practices.

In the sport field there are the following specific priorities:

- ) Encouraging the participation in sport and physical activity, the focus is mainly on a) the implementation of the Council Recommendation on health-enhancing physical activity, the EU Physical Activity Guidelines and the Tartu Call for a Healthy Lifestyle b) the support to the implementation of the European Weeks of Sport c) the promotion of sport and physical activity as a tool for health c) the promotion of all activities encouraging the practice of sport and physical activity including traditional sport and games and intergenerational sport.
- ) Promoting integrity and values in sport, the focus is mainly on a) combating the usage of doping b) combating match fixing and corruption in sport c) improving good governance in sport and d) promoting the positive values of sport.
- ) Promoting education in and through sport, the focus is mainly on a) supporting skills development in sport, b) encouraging Dual Careers of Athletes c) promoting the quality of coaching and staff d) using mobility as a tool for improving qualifications e) promoting employability through sport.
- ) Combating violence and tackling racism, discrimination and intolerance in sport and tackling violent radicalisation, the focus is mainly on combating those behaviours that may have a negative influence over the practice of sport and society more in general. Projects contribute to the fight of any form of discrimination and promote equality in sport, including gender equality.

For Sport projects, there is every year a call for proposals for projects, parted in three categories:

- ) Not-for-profit European sport events
- ) Small collaborative partnerships
- ) Collaborative partnerships

MY WAY project is a Collaborative Partnerships which offer the opportunity to develop, transfer and/or implement innovative practices in different areas relating to sport and physical activity between various organisations and actors in and outside sport, including public authorities at local, regional, national and European levels, sport organisations, sport-related organisations and educational bodies.

## MY WAY project

MY WAY project rationale is that the development of new interventions is needed to help stroke survivors to achieve a more active lifestyle and to maintain the functional levels achieved during stroke unit treatment and early post-stroke rehabilitation, but the huge variability in residual impairment after stroke in the different patients and the need to meet the preference of patients to maintain a long-term adherence, justify a tailored counselling for physical activity programs. As far as today long term physical activity in stroke survivors has not been discussed in practical approach. Each patient needs to find his own way to improve his quality of life, contributing at the same time to long-term secondary prevention, taking into consideration, in a realistic way, the solutions available, this is the reason why the project name is: MY WAY.

The Education, Audiovisual and Culture Executive Agency (EACEA) received 728 eligible applications for the call in 2019 and 104 were selected for funding (Collaborative Partnerships). MY WAY Project was funded and received a score of 96/100 mainly because:

*“the project features some innovative aspects because physical activity in stroke survivors has not been discussed in practical approach, partners have been chosen from different European countries to provide a truly supranational approach to the project, including countries from a wide geographic area in the EU and involved partners will also bring different cultural experiences to the project, which will be considered and analyzed in the project data. Finally, all partners seem to already have a commitment to the field of stroke.”*

The team of MY WAY Project is the following:

- Department of Anatomical, Histological, Legal and Locomotor Sciences of Sapienza University, ITALY
- Klaipėda University, LITHUANIA
- Istituto Europeo per lo Sviluppo Socio Economico (ISES), ITALY
- Cerebrum - Association of People with Acquired Brain Injuries and Theirs Families, CZECH REPUBLIC
- Croatian Stroke Society, CROATIA
- Laboratory of Sports Medicine, Aristotle University of Thessaloniki (AUTH), GREECE



The project is organized in work packages as follows:



The outcomes of WP3, WP4 and WP5 are available on project website.

[www.myway-project.eu](http://www.myway-project.eu)

This manual has been prepared for healthcare and physical activities/sports professionals who will be trained through this project to help them organising physical activities with stroke patients.

## Stroke general background

Stroke is defined as an acute onset of focal neurological deficit in a brain vascular territory as a result of the affection of arteries leading to or within the brain. When the blood supply to part of the brain is cut off by blockade with clot or rupture of the artery, brain cells are being destroyed. There are two types of stroke:

- Ischemic stroke - 85%: central nervous ischaemia, a blockage cutting off the blood supply to the brain. With aging body arteries become harder and narrower and more likely to become blocked, however, certain medical conditions and lifestyle factors can speed up this process and increase the risk of having a stroke.
- Hemorrhagic stroke (ICH intracerebral hemorrhage or SAH subarachnoid hemorrhage) - 15%: haemorrhage caused by a bleeding in (ICH) or around the brain (SAH).

Stroke is a medical emergency.

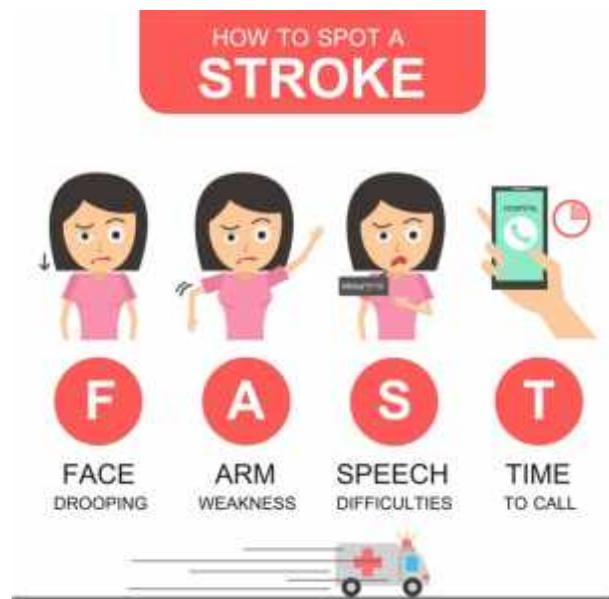
The **FAST** test is used to recognise the signs.

**Facial weakness:** Can the person smile? Has their mouth or eye drooped?

**Arm weakness:** Can the person raise both arms?

**Speech problems:** Can the person speak clearly and understand what you say?

**Time to call emergency number:** if you see any of these signs.



**FASTER** is an updated acronym with two added symptoms:

**F** stands for **Face**, which refers to drooping or numbness on one side of the face versus the other. Ask the person to smile to make the droop more apparent.

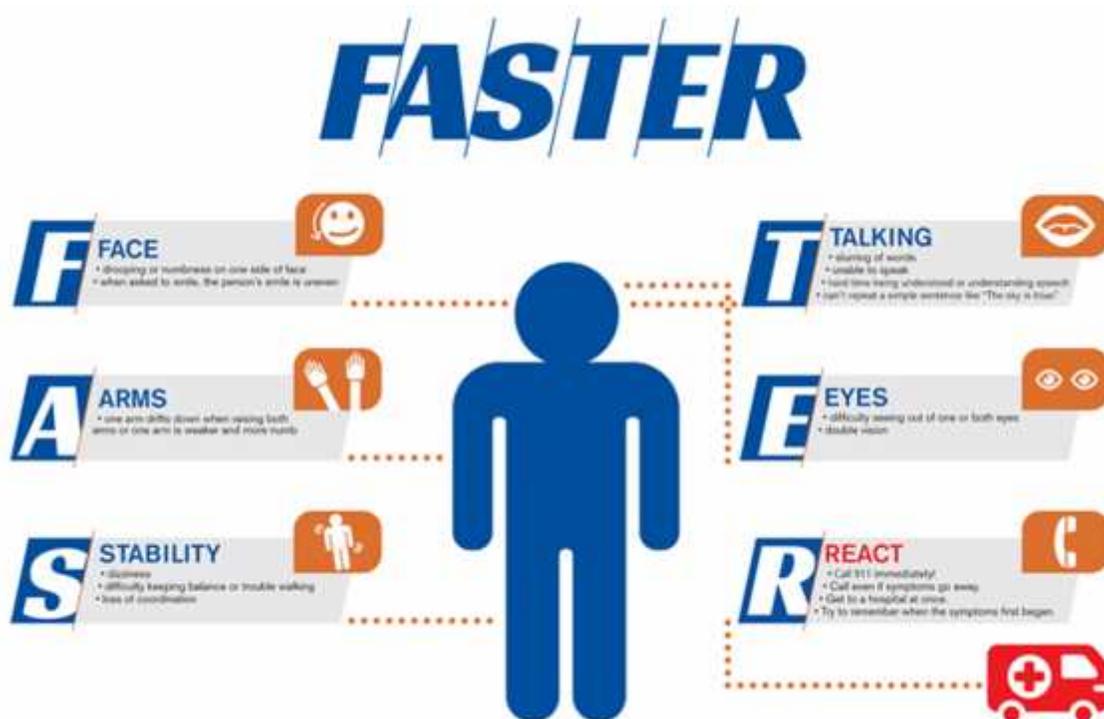
**A** stands for **Arms**, which refers to one arm being weaker or more numb than the other. Ask the individual to raise both arms up and hold them for a count of ten. If one arm falls or begins to drop, then this could be a sign of a stroke.

**S** stands for **Stability**, which refers to steadiness on your feet. Sometimes individuals will fall, feel very dizzy or be unable to stand without assistance. Difficulty maintaining balance, trouble walking and loss of coordination are all possible stroke symptoms.

**T** stands for **Talking**, which refers to changes in speech including slurring, garbled, nonsensical words, or the inability to respond appropriately. Individuals experiencing a stroke may be difficult to understand, or they may have difficulty understanding others. Ask the person to repeat a simple sentence like "The sky is blue."

**E** stands for **Eyes**, which refers to visual changes. These visual changes occur suddenly and can include complete vision loss in one eye, double vision, and partial loss of vision in one or both eyes.

**R** stands for **React**, which is a reminder to call emergency number immediately if you recognize any of these symptoms. Call even if the symptoms go away and try to remember when they first began.



Identifying and reacting to stroke symptoms quickly is crucial to achieving proper treatment for an individual experiencing a stroke. Acute stroke management in specialized wards (stroke units) has been proven to be effective in acute ischaemic stroke. Even with optimal stroke unit care including thrombolysis, less than one third of patients recover fully from stroke.

Disability depends on the area of the brain that is most affected and how quickly treatment was given, therefore the stroke survivors can experience a wide range of negative physical and mental consequences complex and hard to quantify and classify, that are long-lasting, including problems with mobility, vision, speech and memory, personality changes, cognitive impairments, fatigue and depression.

## EU epidemiology

In the European Union (EU), stroke is one of the leading causes of death and a leading cause of adult physical disability.

Stroke affects 1.1 million inhabitants of Europe every year and causes 440.000 deaths.

According to data available in 2017 (latest data collected), there were 1.12 million incident strokes in the European Union, 9.53 million stroke survivors, 0.46 million deaths, and 7.06 million disability-adjusted life years lost because of stroke.

There is great variation in the reported number of strokes between different countries and regions, some of the variation is due to real differences in stroke incidence, nevertheless, some of this variation is also due to the different criteria and methods used to collect the data.

Despite improvement in the treatment of stroke there are still differences in stroke epidemiology with higher rates of stroke incidence and mortality in Eastern and Central European countries in comparison to Western European countries.

Large variations in incidence are also seen within countries (e.g. Italy, Spain, and Sweden).

Possible explanations for these large inter- and intra-country differences include different risk factor profiles (e.g., high blood pressure or cholesterol, smoking, diet, alcohol, exercise), socio-economic and environmental factors (air pollution, deprivation), also standards of and access to healthcare, leading to different levels of risk factor control, and of acute and long term care.

Despite major improvements in primary prevention and acute treatment over the last decades, stroke is still a devastating disease.

At the beginning of the 21st century, the age-standardized incidence of stroke in Europe ranged from 95 to 290/100,000 per year, with one-month case-fatality rates ranging from 13 to 35%.

Stroke registries are available in very few countries across the Europe.

Absolute burden of stroke was increasing and is expected to continue to increase over the next 30 years in most EU countries, particularly in Eastern states.

Using data from the Global Burden of Disease study 2015, and demographic projections obtained from Eurostat, a 34% increase in total number of stroke events in the EU between 2015 and 2035 is predicted.

Although global stroke incidence is declining, rates observed in young adults are on the rise, thus suggesting a need for strategies to improve prevention. In addition, because of the ageing population, the absolute number of strokes is expected to dramatically increase in coming years:

by 2025, 1.5 million European people will suffer a stroke each year. Together with the welcome improvement in survival rates, there are increasing numbers of people living with the effects of stroke.

Given these observations, an urgent development of acute care provision, as well as resources for post-stroke therapeutic strategies, is needed.

Since the onset of the COVID-19 pandemic, reduced or delayed access to care for stroke patients and stretched resources for stroke care delivery have been reported in some countries. This highlights the importance of continuous monitoring of mortality rates after hospital admissions for stroke to assess any impact of COVID-19 in the provision of timely and quality care to stroke patients.

## Clinical presentation

All strokes are different. For some people the effects may be relatively minor and may not last long. Others may be left with more serious problems that make them dependent on other people. Unfortunately, some strokes can be very serious and some may lead to coma or sudden death. Strokes, both ischemic and hemorrhagic, have various presentations depending on the location of the lesion's location and type of stroke.

In case of hemorrhagic stroke: vomiting indicates raised intracranial pressure and is common with cerebellar hematoma, headache is more common with a large hematoma and coma occurs in the involvement of the reticular activating system of the brainstem.

The nature of the symptoms depends on the function the destroyed neurons used to perform. A cortical map can help us match the symptoms with the location.

## Stroke syndromes



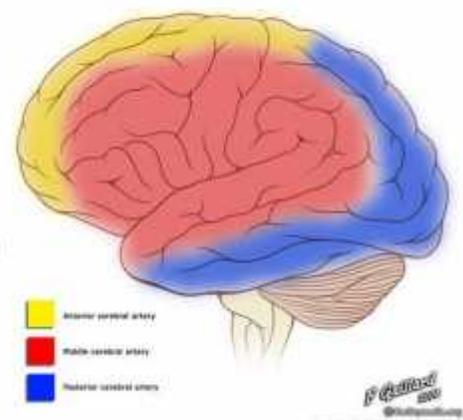
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### Middle Cerebral Artery (MCA) Infarction

1. Contralateral hemiparesis and hypesthesia (Weakness of arm & face is worse than in the lower limb)
2. Gaze towards to side of lesion
3. Ipsilateral hemianopsia
4. Sensory or motor aphasia if dominant hemisphere is affected
5. Dysarthria if non dominant hemisphere is affected
6. Agnosia
7. Inattention, neglect
8. Central facial palsy (lower half of the contralateral side of the face)

Cortical vascular territories



# Stroke syndromes

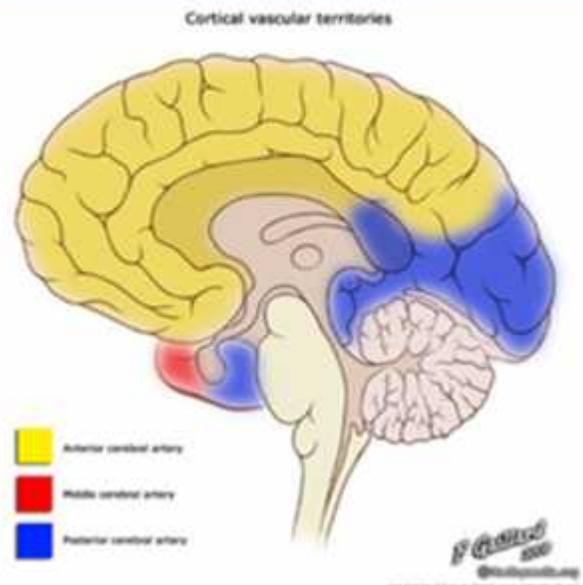


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## Anterior Cerebral Artery (ACA) Infarction

1. Speech is preserved but there is disinhibition
2. Mental status is altered
3. Judgment is impaired
4. Contralateral cortical sensory deficits
5. Contralateral weakness greater in legs than arms
6. Urinary incontinence
7. Gait apraxia



# Stroke syndromes

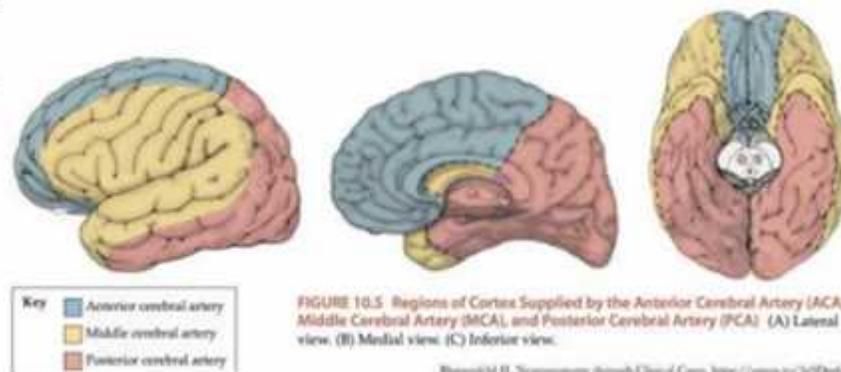


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## Posterior Cerebral Artery (PCA) Infarction

1. Cortical blindness
2. Contralateral homonymous hemianopsia
3. Anton syndrome
4. Altered mental status
5. Visual agnosia
6. Memory impairment



# Stroke syndromes

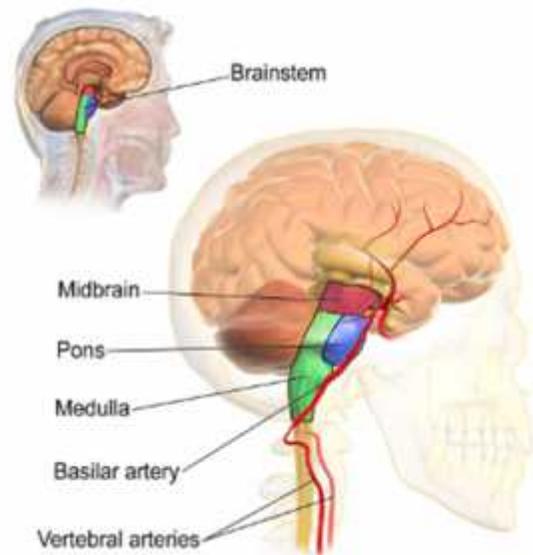


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Vertebral/basilar artery stroke:

1. Nystagmus
2. Vertigo
3. Diplopia and visual field deficits
4. Dysarthria
5. Dysphagia
6. Tetra- or hemi- paresis
7. Facial hypesthesia
8. Ataxia
9. Peripheral facial palsy (entire half of face)



# Stroke syndromes

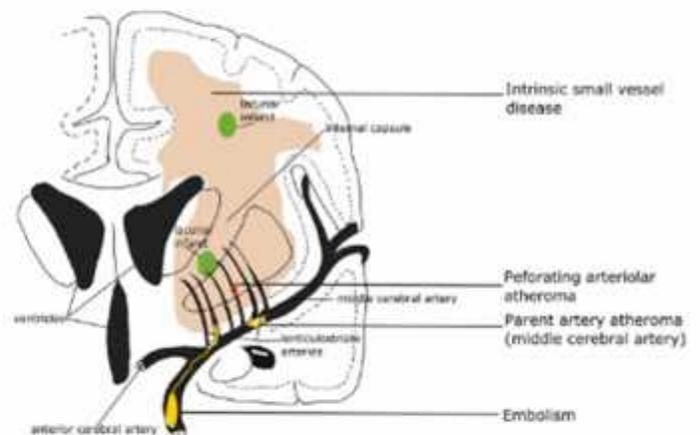


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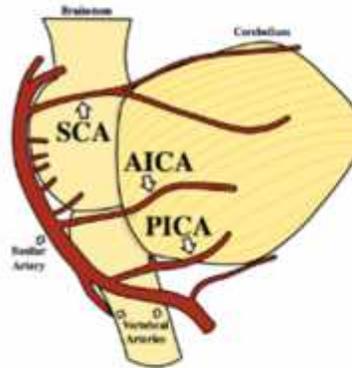
Lacunar stroke (occlusion of a small perforating artery):

1. Pure motor: Isolated contralateral face/arm/leg weakness
2. Dysarthria-clumsy hand: Dysarthria, facial weakness, slight weakness/clumsiness of the contralateral hand
3. Ataxic hemiparesis: Ipsilateral hemibody weakness and limb ataxia (that is disproportionate to the weakness)
4. Hemibody sensory loss of all modalities
5. Hemiballismus



Cerebellar stroke:

1. Ataxia
2. Dysarthria
3. Nausea, vomiting
4. Vertigo symptoms



## Diagnostic-therapeutic path

A stroke is a medical emergency and patient needs to receive the adequate treatment in short time window, for better outcome results chances for a good recovery.

In case of a suspected stroke, physicians carry out tests to confirm the stroke, and checks for health problems that could cause a stroke, such as high blood pressure, where appropriate, giving treatment for these conditions to reduce the chances of having another stroke.

A brain scan (computed tomography CT scan or a magnetic resonance imaging MRI scan) should be performed quickly after symptoms start, to show whether the stroke is due to a clot or a bleed, to localize the lesion and decide the right emergency treatment.

Some people with ischaemic stroke are eligible for a clot-busting medication. The medication aims to disperse the clot (thrombolysis) and return the blood supply to the brain. Not everyone who has an ischaemic stroke is suitable for thrombolysis. After thrombolysis, more patients survive and live independently. Despite its benefits, there is a risk that thrombolysis can cause bleeding.

Mechanical thrombectomy is a treatment that physically removes a clot from the affected brain vessel. It usually involves inserting a mesh device into an artery in the groin, moving it up to the brain, and pulling the clot out. It only works with people where the blood clot is in a large artery of the brain. Similar to thrombolysis, it has to be carried out within few hours of a stroke starting. Only a small proportion of stroke cases are eligible for mechanical thrombectomy.

In case of haemorrhagic stroke, if the bleed is due to a burst aneurysm (weakened blood vessel), a surgical procedure may be indicated for the repair the blood vessel. Surgery is also used to reduce pressure caused by a build-up of fluid. In case of haemorrhagic stroke treatments for

high blood pressure may be given and/or if the patient is assuming anticoagulants medication to reverse the effects and reduce bleeding will be given.

All risk factors of another stroke should be treated if present: high blood pressure, atrial fibrillation, hypercholesterolemia, diabetes, disorders of coagulation.

Depending on severity of the stroke the hospital stay varies from a few days to a few months.

After the stroke, the body needs time to heal and recover. After several assessments the goals of rehabilitation are set. Rehabilitation helps to make the best recovery possible and re-learn skills for everyday life. Patients should be checked for swallowing problems soon after a stroke, to ensure they can eat and drink safely and for any continence problems. Then patients are assessed for physical impairment, for mobility, for help needed with positioning and moving around, for communication and cognitive problems and what help is needed.

Rehabilitation of stroke across European countries today is quite diverse. Geographic distribution of the different rehabilitation centres is homogeneous only in small countries, and big countries face the nonhomogeneous distribution. The wide differences between regions or urban/rural areas can be seen as well. In public or private facilities - assessment, treatment, monitoring, physical therapy facilities for inpatients after stroke are provided in different countries. In addition, the departments of hospitals or private clinics provide rehabilitation therapy programmes that are mainly focused on physical therapy, pool therapy, and speech therapy for outpatients, patients with less severe deficits. Some countries do not have a national rehabilitation program, nor are the national stroke rehabilitation guidelines available.

## Burden of the disease

People living with the effects of stroke need specialist supportive care and rehabilitation, resulting in a growing burden of stroke on families, societies and health care systems with huge direct and indirect costs in the EU. Voluntary organisations support local patients and families with life after stroke. According to data available for year 2015 (latest data available), direct healthcare costs alone added up to €20 billion in the EU, while indirect costs of stroke due to the opportunity cost of informal care by family and friends and lost productivity caused by morbidity or death were estimated to be another €25 billion. A favourable impact on this huge economic exposure would arrive from long-term rehabilitation and physical activity programs aimed to improve patients' autonomy, a faster return of a person to the labour market and to prevent new strokes.

At present, there are several unmet needs in the field of long-term post-stroke rehabilitation at European level: there are few financial resources, the distribution of facilities is not homogeneous through the countries, facilities are not equally available for patients in remote and rural areas and all the modalities of physical therapy are not available in every centre. As a consequence, often there are long waiting lists for stroke patients, no continuous physical therapy after an acute rehabilitation and lack of a long-term rehabilitation plan. Moreover, there are not enough physical therapy professionals, and lack of occupational therapists.

From a scientific point of view, there are no recommendations about long-term physical activity in post-stroke patients and there is very little information on the rehabilitation therapies that stroke survivors receive, especially once they have left the hospital. Few countries audit

rehabilitation services, and there are inconsistencies in the standards used to measure adherence to guidelines, the effectiveness of rehabilitation measures is not assessed. Last, but not least, a cultural shift is necessary: a fatalistic attitude about stroke treatment in the general population (e.g., that the deficit after a stroke cannot be improved) is still present.

### Clinical conditions of post-stroke patients

Stroke has a multi-systems effect. In particular, the ischemic stroke injury acts on the autonomic nervous system and the Hypothalamic-Pituitary-Adrenal (HPA) axis, hyperactivating them. Urinary and digestive system may become dysfunctional and be affected. The immunosuppression induced by stroke (SIIS) increases the risk of infections, mainly at urinary and respiratory level. The microbiota–gut–brain axis is considered a central regulator of the immune system after acute ischemic stroke, with a potential role in determining outcome. The central autonomic dysregulation may cause cardiovascular complications like ischemic and non-ischemic myocardial injuries, left ventricular dysfunctions, electrical abnormalities up to electric sudden death that would act on a heart that is often already affected by hypertension, atrial fibrillation or atherosclerosis. The musculoskeletal system is affected by the functional disabilities, when present.

From a clinical point of view, in the first time after the event, the most frequent complications may be infections, cardiac complications, recurrence, seizures, deep venous thrombosis.

In the long-term follow-up, patients can be affected by several conditions that can interfere with the ability to perform daily physical activity programs.

Physical impairment: diffuse pain, pressure sores, fatigue, post-stroke seizures, urinary incontinence, bowel incontinence.

Movement problems: spasticity and hypertonicity, hemiplegia or muscle weakness, numbness, sensitive problems, sarcopenia with high risk of falls, fractures,

Psychosocial problems: post-stroke depression up to thoughts of death and suicide attempts, anxiety with anxiety attacks, mood/emotional changes mainly low self-esteem (many patients experience intense bouts of crying, feel hopeless and withdraw from social activities), emotional lability with feelings of anger, frustration and bewilderment, feelings of irritability, forgetfulness, carelessness or confusion cognitive impairment. All these symptoms may impact on rhythm sleep-alertness, food intake, decreased energy, difficulty concentrating, remembering, loss of interest or pleasure in hobbies, activities and sex, and even on relationships with other family members and friends.

## European stakeholders

- ESO is the European Stroke Organisation. The mission of the ESO is to reduce the burden of stroke. ESO aims to improve stroke care by providing medical education to healthcare professionals and the lay public. <https://eso-stroke.org/>
- ESC Council on Stroke is the European Society of Cardiology Council on Stroke created in August 2016. The council is a multidisciplinary body for cooperation, education and research on stroke. EUSI is the European Stroke Initiative that is the common body of stroke-related activities within the European Federation of Neurological Societies (EFNS), the European Neurological Society (ENS) and the European Stroke Council (ESC). EFNS and ENS merged together in the European Academy of Neurology in 2014. <https://www.escardio.org/Councils/Council-on-Stroke>
- SAFE is the Stroke Alliance for Europe – The stroke patient voice in Europe. SAFE is a non-profit-making organisation that represents a range of stroke support organisations from across Europe. The goal is to drive stroke prevention up the European political agenda and prevent the incidence of stroke through education. <https://www.safestroke.eu/>
- ESPRN is the European Society of Physical & Rehabilitation Medicine composed by 39 National Societies of Physical and Rehabilitation Medicine and, as individual members, physicians specialized or trainees in Physical and Rehabilitation Medicine. Within ESPRN there is a Special Interest Scientific Committees in Stroke with the goals to provide clinical information of stroke rehabilitation service in European countries, to set up appropriate educational programs and to harmonize the education on stroke rehabilitation among European countries, to promote scientific collaboration within Europe and with other scientific societies/organizations, to promote collaboration of non-profit patient organizations. <https://esprm.eu/>
- ESN is the European Society of Neuroradiology. Its mission and vision are to promote and defend diagnostic and interventional neuroradiology, to demonstrate its value in healthcare and to society, and to promote and enhance education, training and research of this radiological subspecialty for the ultimate benefit of the patients. <https://www.esnr.org/>

# PRACTICAL ASPECTS

## Risk stratification

The first step before starting the physical activity session is the risk stratification of post-stroke patients and an evaluation of benefits/risk. People post-stroke should undergo thorough screening for cardiovascular risk factors that may pose safety concerns. Five-year risk after stroke or transient ischemic attack (TIA), the risk of major cardiovascular events, acute coronary syndrome, or death is 12.9%, while the risk of a new stroke is 9.5%. There are different guidelines on cardiovascular disease prevention (ESC) or stroke prevention (AHA/ASA). The first step is to define the type of stroke, when possible, ischemic stroke etiology and to identify targets for treatments in order to reduce the risk of recurrent stroke. Management of risk factors is crucial in secondary stroke prevention including, but not limited to diabetes (recommended goal HbA<sub>1c</sub> < 7%), lipids (recommended goal LDL-C <70mg/dl), hypertension (recommended goal < 130/80mmHg), but also lifestyle factors such as smoking, obesity, physical inactivity and stress. Atrial fibrillation remains a common and high-risk condition for a recurrent ischemic stroke, 1 in 4 embolic stroke survivors will have another stroke, but several devices can be used for atrial fibrillation detection. Extracranial and intracranial carotid artery disease or patent foramen ovale can be cause of stroke, with different therapeutical approaches in secondary prevention.

The management of risk factors should be performed by multidisciplinary teams.

Exercise in post-stroke patients is a safe intervention.

## Definition of patients PA program (tailorization)

During the rehabilitation phase, a full medical assessment of the person with stroke: cognition (attention, memory, spatial awareness, apraxia, perception), vision, hearing, tone, strength, sensation and balance is performed. Moreover, a comprehensive assessment of a person with stroke should take into account: previous functional abilities, impairment of psychological functioning (cognitive, emotional and communication), impairment of body functions, including pain, activity limitations and participation restrictions and environmental factors (social, physical and cultural).

Rehabilitation goals must be clearly defined, relevant to the patient, must be achievable, organized in short-term and long-term goals, set as a challenge and focused on activity and participation.

Physical activity and exercise are highly recommended in the chronic phase to sustain functions gained in rehabilitation and as part of long-term secondary prevention to reduce the risk of recurrent stroke and other vascular events.

In evaluating physical activity in stroke survivors, it can be discussed if is it correct to apply healthy ageing recommendations. The World Health Organization (WHO) recommends for adults aged 65 years and above to do a minimum of 150 min of moderate-intensity physical activity or 75 min of vigorous physical activity per week in addition to muscle strengthening

activities. WHO expresses its recommendations also with regards to adult living with disability: the precondition is that adults living with disability may need to consult a health-care professional or other physical activity and disability specialist to help determine the type and amount of activity appropriate for them. There are no major risks to adults living with disability engaging in physical activity when it is appropriate to the individual's current activity level, health status and physical function. All adults living with disability should undertake regular physical activity, adults living with disability should do at least 150-300 minutes of moderate-intensity aerobic physical activity; or at least 75-150 minutes of vigorous-intensity aerobic physical activity; or an equivalent combination of moderate- and vigorous-intensity activity throughout the week for substantial health benefits. Adults living with disability should also do muscle-strengthening activities at moderate or greater intensity that involve all major muscle groups on 2 or more days a week, as these provide additional. As part of their weekly physical activity, older adults living with disability should do varied multicomponent physical activity that emphasizes functional balance and strength training at moderate or greater intensity on 3 or more days a week to enhance functional capacity and prevent falls.

Anyhow, it is important to remember that doing some physical activity is better than doing none and if adults living with disability are not meeting the above mentioned recommendations, doing some physical activity will bring benefits to health. Adults living with disability should start by doing small amounts of physical activity, and gradually increase the frequency, intensity and duration over time.

For people with a history of stroke, physical activity should be addressed in improving physical function, notably upper limb function, sensory motor function of the lower limb, balance, walking speed, distance, ability and endurance, cardiorespiratory fitness, mobility and activities of daily living. Existing evidence suggests that physical activity may also have beneficial effects on cognition.

An additional point refers to sedentary behaviour, so common among post-stroke patients. In people living with disability, sedentary behaviour is defined as time spent sitting or lying with low energy expenditure, while awake, in the context of educational, home and community settings, and transportation. It is possible to avoid sedentary behaviour and be physically active while sitting or lying, through, upper body led activities, inclusive and/or wheelchair-specific sport and activities. In adults, higher amounts of sedentary behaviour are associated with the following poor health outcomes: all-cause mortality, cardiovascular disease mortality and cancer mortality, and incidence of cardiovascular disease, cancer and type-2 diabetes. Therefore, it is recommended that: adults living with disability should limit the amount of time spent being sedentary. Replacing sedentary time with physical activity of any intensity (including light intensity) provides health benefits. To help reduce the detrimental effects of high levels of sedentary behaviour on health, adults living with disability should aim to do more than the recommended levels of moderate- to vigorous-intensity physical activity.

As described in the premises of MY WAY project, the residual impairment of post-stroke patients may vary a lot.

The milestone of tailorization is that long-term physical activity in post-stroke patients has to drive to an high impact on outcomes that are important to the patient, to his/her individual goals,

according to patient choice, therefore guaranteeing minimal variation and maximum possible adherence, leading to a more efficient use of healthcare resources.

One-sided weakness (paralysis) or hemiparesis, the most common symptom, causes difficulty in sitting, standing, balancing, or walking. Thus, patients with stroke are at high risk for forward, backward, or even lateral falls owing to their poor balance. Patients suffering from hemiplegia (a severe or complete loss of strength or paralysis on one side of the body) suffer not only for limited muscle function but also for antagonist muscle hyperactivation, which decreases muscle strength. Patients with hemiplegia after a stroke are more likely to bear their weight on the contralateral lower extremity, which can result in poor postural control and increased risk for falls. Cardiorespiratory training and, to a lesser extent mixed training, reduce disability during or after usual stroke care but this could be mediated by improved mobility and balance. There is sufficient evidence to incorporate cardiorespiratory and mixed training, involving walking, within post-stroke rehabilitation programs to improve fitness, balance and the speed and capacity of walking. The effects on secondary vascular risk factors are difficult to proof, but aerobic exercise intervention may reduce both systolic and diastolic blood pressure.

To improve physical activity levels after stroke, lifestyle interventions that specifically encourage increasing physical activity rather than general lifestyle interventions may be more effective.

From a logistic point of view, at the end of the rehabilitation hospitals path a physical activity-based-program implemented in a fitness center, carried out in close coordination between hospitals and local fitness centers, training by skilled adapted physical activity instructors are effective in improving physical fitness and quality of life in people suffering from stroke. Group activities are critical determinants of successful participation. The tailorization of long-term physical activity in post-stroke patients means that training sessions are timetabled into their working week, and, where appropriate, with their carer needs.

## Type of exercises

Post-stroke physical activity is multifactorial and programs targeting physical activity post-stroke need to address multiple domains.

The first aim is secondary prevention of a cardiovascular event and reduction of risk factors, the second is to maintain and improve the abilities recovered during the rehabilitation phase at the hospital and as outpatients.

Patients with hemiparesis exhibit ipsilateral hip flexor, gluteus maximus, hip abductor, and knee extensor weakness or changes in muscle tone that may cause abnormal gait and consequently increase the risk for falls during walking. Patients with hemiplegia during clinical rehabilitation, perform gait training on flat ground, generally followed by stair walking training, to make patients able to afford individuals' daily routine and this issue should be maintained during long-term physical activity programs.

**Aerobic exercise** with a cycle ergometer for the lower limbs improves functional and aerobic capacity, distance travelled, muscle strength but also motor function, muscle tone, muscle function, trunk control, gait performance and gait speed in post-stroke patients. Although cycling is not the most obvious intervention when seeking balance improvement, the patient even in the sitting position performs upper and lower limb movements that will radiate to the trunk, and good trunk control may be considered a requirement important for the control of more complex and

functional activities such as maintaining static and dynamic balance; therefore, cycling treatment seems to be a good option.

Locomotor high-intensity interval training (HIIT) is a promising strategy for stroke rehabilitation that seeks to maximize exercise intensity by using bursts of fast walking alternated with recovery periods. Compared with other forms of treadmill training, adding treadmill HIIT to conventional inpatient stroke rehabilitation has been shown to provide significantly greater improvements in gait function. In chronic stroke, preliminary studies suggest that treadmill HIIT can improve both gait function and aerobic fitness, possibly to a greater extent than traditional moderate-intensity continuous exercise. HIIT protocols may vary widely:

1. low-volume HIIT (aka sprint interval training) generally involves short maximal-speed bursts and long passive recovery (e.g., 30 second max-speed bursts with 2-minute resting recovery).
2. short-interval HIIT similarly involves short maximal speed bursts, but uses shorter recovery (e.g., 30 second max-speed bursts with 30–60 second resting recovery).
3. long-interval HIIT uses heart rate (HR) response to determine training speed and includes active recovery. Bursts are performed at vigorous aerobic intensity and recovery involves walking at a moderate intensity (e.g., 4 minute bursts with a HR target of 90% HR peak and 3 minute recovery with a 70% HR peak target).

Based on the current data overground and treadmill short-interval HIIT may be optimal if primarily targeting gait speed, overground long-interval HIIT may be optimal if primarily targeting gait endurance, and any combination except overground short-interval HIIT may be optimal if primarily targeting aerobic fitness.

In general, for aerobic exercise the frequency ranges between 3 and 5 days/week and should generally start with 3 days per week and progress toward 5 days per week over time. The duration of the exercise bouts ranges between 20 and 40 minutes, with a gradual progression from 20 to 40 minutes as tolerated. If the duration of 20 to 40 minutes of continuous exercises cannot be achieved in a single bout, it can be obtained through multiple 10-minute bouts across the day. The intensity should be moderate and range between 12 and 13 on the 20-point RPE (Rate of Perceived Exertion) scale and 40 to 59% heart rate reserve (HRR).

**Resistance**, nowadays, in any physical activity program, even for people with disability, represents an essential milestone. Defining for resistance exercise is any form of active exercise in which dynamic or static muscle contraction is resisted by an outside force applied manually or mechanically. When the direction of contraction is opposite to movement the contraction is defined as concentric, when the direction of contraction is towards the movement the contraction is eccentric. Resistance training is based on the principle of overload: a load that exceeds the metabolic capacity of the muscle must be applied; muscle must be challenged to perform at a level greater than to which it is accustomed. Overload can be applied by increasing the intensity (strength training) or volume (endurance training). The adaptations achieved through resistance exercise are reversible because persist as long as the resistance exercise is performed regularly and go back gradually to the pre-exercise levels once the training is stopped. The response, to resistance exercise starts with neural adaptation within 4 weeks of regular training, while between 4-8 weeks there are skeletal muscle adaptations such as hypertrophy of the muscle

bulk without increase in the number of muscle fibers, due to increased protein synthesis and hyperplasia with increase in the number of muscle fibers by longitudinal splitting. Finally, resistance training allows also vascular & metabolic adaptations and maintenance of bone mineral density. In both acute and chronic stroke patients' progressive resistance training improves and gait, muscular force, motor function and mobility limitations; in addition balance and postural control and therefore independence get better. Resistance training is superior to other therapies on muscular force and motor function of lower and upper limbs, health related quality of life, independence and reintegration and other health-relevant physiological indicators; the type of resistance training protocol significantly impacts its effect, leg press is more efficient than knee extension and high intensity training is superior to low intensity training. To prescribe resistance exercise is important to define if strengthening is needed and appropriate and to perform periodic reassessment; after a general physical examination, the evaluation of functional performance, of strength and range of motion the regime should be planned according to the need and the equipment available. After explanation and demonstration of the exercises, and supply of appropriate clothing, diet, hydration. The resistance exercise should be preceded by the warm-up session and a cool-down session at the end. Contra-indications to resistance exercise are pain in free active movement, acute pain in resisted isometrics or pain that cannot be eliminated by reducing the resistance, acute inflammation in muscle or inflammatory neuro muscular pathology, inflammation of the joint for dynamic exercise or loss of joint integrity, severe cardiopulmonary disease.

For resistance training, the frequency ranges between 2 and 3 days per week and should generally start with 2 days per week and progress toward 3 days per week over time. At the early stages of the program, resistance training should target major muscle groups and include 8 to 10 exercises with 1 to 3 sets between 10 and 15 RM (repetition maximum) per exercise, performed at 30 to 50% one-repetition maximum (1-RM). At later stages, the training intensity can be set within 50 to 80% 1-RM as tolerated. There should be a day of rest between resistance training sessions, but the sessions can be performed on the same day as aerobic exercise training, depending on tolerability.

From a practical point of view, heart rate monitoring should be undertaken and occasional blood pressure monitoring should be carried out. Regarding risk of falls or balance concerns, people post-stroke might perform both aerobic and strength exercises in seated position (e.g., recumbent bike, weight machines, and a body weight support system can be used in conjunction with the treadmill).

With an emphasis on the benefit and volume of aerobic training, lifestyle physical activity is encouraged through short bouts of indoor/outdoor walking that might be complemented with activity monitors (e.g., pedometer, accelerometer) for motivating and self-managing behaviour change among participants. In fact, one of the most important ability to recover is walking: however, understanding what domains need to be addressed in such programs requires the study of a comprehensive set of variables representative of multiple domains, including walking ability, physical health, biopsychosocial factors, cognition, and the environment. Impaired cognition and lower socioeconomic status in individuals with stroke seem to be associated with greater disability and worse health-related quality of life, respectively.

## Further activities

As described in the title of our project, different approaches can be admitted. The objectives are clear: to promote physical activity in all post-stroke patients going towards patients' preference to enhance motivation and ensure long-term adherence.

Historically a positive overall effect of aquatic therapy on balance, walking speed, and mobility has been demonstrated. Possible barriers may be lack of structures and the need of adequate training and education packages.

In addition to gym and swimming, activities to be performed in the open air and/or in group as playing with balls, team games, group walking, nordic walking, would be recommended.

Patients with poor mobility should participate in physical activity to enhance balance and reduce the risk of falls, leading to greater health benefits with safety and enjoyment being key. Tai Chi is one form of light-to-moderate aerobic physical activity that may be appealing for many adults. It is a form of physical and mental training combining Chinese martial arts and meditative movements involving a series of slowly performed, continuous, and rhythmic movements that put minimal impact on the joints of the body. Tai Chi comprises mental concentration, physical balance, muscle relaxation, and breathing that is coordinated with whole-body movement, and is thought to assist in finding balance between one's body and mind. Tai Chi is relatively easy and inexpensive to implement in diverse community settings, including socioeconomically-disadvantaged and mixed-ethnicity communities with older adults, usually with high levels of enjoyment and high adherence rates among participants.

Another important issue is the ability to relax, to improve the awareness of one's body that can be improved through Yoga, and mindfulness techniques.

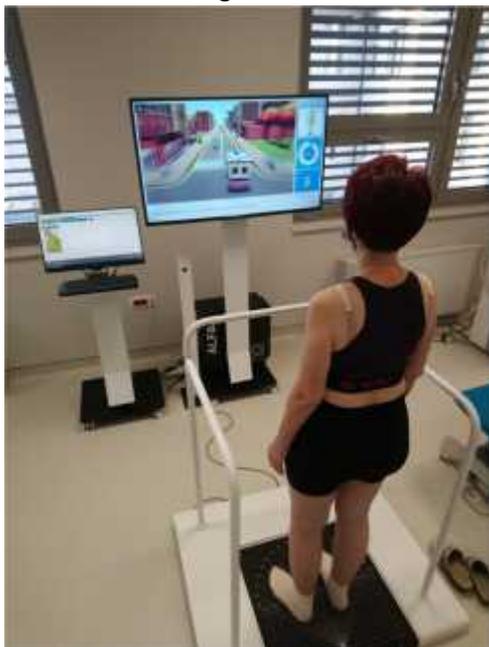
A subgroup of activities as dancing (zumba, all types of dances, and traditional dances), singing and playing musical instruments are particularly important because the rhythm is very useful to improve residual functions in post-stroke patients, to the point where aphasiac patients may follow the rhythm and even sing.

And finally there some leisure activities that are not usually considered as physical activity, that can be very stimulating and useful in post-stroke patients such as gardening or walking in the woods and looking for mushrooms, or take care of pets, daily walking with them, grooming them, but also cooking, knitting, sewing and engaging in art activities.

Here's some pictures of activities carried out by post stroke patients.

CROATIA

Balance training

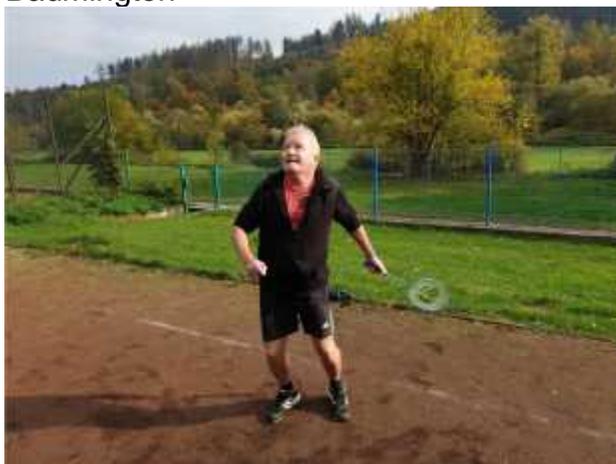


Exercise with weights



CZECH REPUBLIC

Badminton



Archery



Communication game



Disc golf



Bicycle



Rafting



Fishing



Swimming



GREECE

Greek traditional dances



Strenght training with elastic bands



Balance assessment



## Monitoring and follow up

Ideally the main goal for stroke survivors is full recovery and return to the previous life. Unfortunately this is not always possible. Therefore for monitoring it is important to define what to monitor and how, but also to identify mechanisms of success.

Valid, reliable tools to be used on follow-up periodically during longterm rehabilitation are:

- National Institutes of Health Stroke Scale (NIHSS)
- Barthel Index  
(if applicable)
- Activities of daily living (ADL) and instrumental activities of daily living (IADL)
- Fugl-Meyer assessment (FMA)
- Modified Rankin Scale (mRS)
- 6 minute walk test
- Chair stand test

Moreover, different areas should be monitored and the impact of stroke on the person's family, friends and/or carers should be taken into consideration.

### Internal

- Pain
- Movement
- Self-care
- Communication
- Cognitive functioning
- Emotional functioning (mood)
- Vision
- Swallowing

### External

- Return to work
- Long-term health and social support
- Providing support and information
- Planning and delivering long-term stroke rehabilitation
- Organising health and social care for people after stroke

As well known, in the long-term, the main problem is the adherence; this is the reason why is important to study all the factors likely to affect the outcome of the intervention in clinical practice (if the interventions are delivered as intended, were modified to suit the local context, were individually tailored, were supported by methods to maintain adherence). In addition to this, adherence may depend on individual factors (patients beliefs, therapists knowledge and personal attributes), on the setting (cultural, network and communicative factors) or on the environmental factors (policies, resources, facilities).

Patients should always have details of a professional to contact, for advice and treatment if necessary.

Patients should have follow-up appointments 6 months and 1 year after stroke, and then every 6 months/once a year. At these appointments, their healthcare professional should ask them how they are managing and whether they are still making progress towards their individually set

goals. In case of continuing difficulties or the need for further information, corrective actions should be implemented.

During the regular meetings, the milestones in the achievement of short and long term goals should be discussed and the team should inform the patient regularly about his/her own progress.

Specific reasons that may lead to inadequate adherence i.e.: depression, fatigue, lack of interest, negative belief systems concerning exercise, fear of falling, fear of subsequent stroke and other adverse events, lack of family or other social supports should be addressed, discussed and, where possible, resolved.

# COMMUNICATION TOPICS

## How to communicate to the patients

Stroke occurs suddenly and unexpectedly, and its consequences can mean the edge between life and death, destroying patients' abilities, changing their lives, leaving them with impaired functions. Patients' reactions may follow the different phases of the grief cycle (E. Kübler Ross), i.e., denial, anger, bargaining, depression and acceptance.

The patients might not be able to cope with much rehabilitation in the early days, as they feel stronger, they can do more. It is important to give patients achievable goals, to set goals to broke down into small, manageable steps, to encourage patients to keep a record of their progress (diary, graphs, etc...) and celebrate their successes. An active listening is the best way to communicate.

Problems and activities once tackled easily may be difficult or impossible, while other tasks are unaffected, patients may have problems in memory and thinking, it may be difficult to follow instructions, or find one's way around new places, patients may find difficult solving simple problems, reasoning through a task or organising themselves, needing extra supervision and guidance. Therefore, it is important to allow patients time to re-learn things, to provide them notes, prompts or other devices.

With regards to personality of the patients, people may become confused, self-centred, uncooperative and irritable, and may have rapid emotional lability and mood changes. In particular, after stroke patients may not be able to adjust easily to anything new and impaired ability to initiate an activity. Post-stroke patients may become anxious, annoyed or tearful over seemingly small matters, patients may have many fears, uncertainties and altered feelings about themselves, as well as experience losses in social activity, ponder questions about future prospects, financial security and returning to work, even may see little purpose in living and express thoughts of death. It is well known that depression may become an obstacle to rehabilitation, therefore patients need reassurance, gentle guidance, support and encouragement, prompting, time and understanding and those who talk of dying may be signalling for assistance, for someone to listen and share their problems.

## Educational programs

A deep and intense patient education programme is important to explain physical and psychological benefits of long-term exercise-based interventions, to reassure about the safety of the programme, and to highlight the importance of long-term adherence and the patient's leading role as driver of his/her recovery programme. Educational sessions should be collective/group based.

Patients have to be well informed and taught about the possibilities of exercise and adapt to new ways to increase performance.

## How to motivate patients in the long term

The rehabilitation starts early in the hospital with daily sessions with different therapists. The quickest recovery takes place in the days and weeks after a stroke. But recovery can continue for months and years after a stroke. When patients are ready to leave hospital, the stroke team put together a discharge plan and agree on what support the patient needs at home, covering all the arrangements for the continued rehabilitation and care at home, including the community services that may help the patients and any aids or equipment needed.

Enhanced motivation of stroke patients is necessary to promote long-term adherence to the exercise-based programme, as it can be challenging for individuals with stroke.

The long-term exercise-based intervention needs physical, but also psychological objectives to grab out the patients from their home and give them a new social role. For a successful activity it is very important providing a suitable environment, involving family members, relatives, friends or colleagues, creating physical exercise group, keeping a routine, providing written instructions and self-management strategies. Periodically through telephone conversations or a joint visit with the provider and the person with stroke, objective outcomes to determine the effectiveness of the plan should be measured, clinical findings, including pain should be assessed and motivation should be valued.

## Patients empowerment

The final goal of the recovery path of stroke patients is their empowerment. Walking and balance are important target empowerment of the exercise protocol functions to recover after stroke. Independent walking is one of the major objectives of stroke rehabilitation, to be enhanced in the long-term phase through activities such as patients' walking groups etc. Strengthening the trunk muscles leads to a daily activities improvement, including trunk performance and balance. Moreover, for these abilities, long-term phase could foresee amazing physical activity to be performed in group, possibly outdoor.

Exercises and activities help patients to re-learn skills, to do things in new and different ways such as dressing with one arm instead of two.

It can take a lot of effort and determination, it can be very hard work, physically and mentally, but many people find it helps them make vital progress with speaking, walking and other key skills.

# THE VILLAGE

## The role of family, friends, local community, patients association

After discharge, the patient's family members and friends usually have to arrange any practical help needed at home, in cooperation with physicians have to organize the long-term treatment process (where and how), to understand what is going on now and what will happen next, what social support patients are entitled to receive from the state or community. Family members and informal caregivers are very often exhausted and tired of the situation which they never expected. However, the patient's social group has a very important role in the rehabilitation process, it is the part of the interprofessional team and should be involved in care planning. The family members and friends are important as the support and assistance. They have an irreplaceable role in community rehabilitation in the patient's home environment.

Some people find it useful to get their family members and friends also involved in physical activity programs and the help from other people can make it easier to practise regularly. The support is crucial in the long-term phase of rehabilitation. The patients, their families and friends should be involved in educational programme and meetings to be aware about effectiveness, safety and importance of adherence to long-term exercise-based interventions.

In addition to family and friends, various types of patient services are also offered by social services, non-profit organizations and self-help organizations and services. The role of patients association is mainly to build a communication bridge between patients, caregivers, hospital personnel and regional healthcare authorities and rehabilitation services for after-care treatment after discharge from hospital: for social support (how to apply and where to get them), for queries about physical activity aftercare (what kind of exercises, when, how to apply), about leisure time suitable for stroke survivors.

Considering the important burden of assistance of some stroke patients, patients and families should be supported by voluntary associations/organizations during long-term exercise-based stroke interventions.

The role of the community is to support family and patients with information about next kind of life and lend a given hand in various topics such as how to organize daily living. The community help can involve experienced survivors called „peers“ into the process.

In the long-term physical activity the community may invite family to the community life, activities, adequate sports event, encouraging them to „go out“. The productive cooperation of patients, their family members, local community, patient organisations, therapists and other specialists guarantees the achievement of maximum improvement and therapy results.

## Importance of multidisciplinary

The stroke management requires a high degree of multidisciplinary in all the diagnostic-therapeutic steps: from the stroke unit that includes a number of different health professionals who all have specialist training and experience in stroke, to the rehabilitation ward with physicians, pharmacists, nurses, clinical nurse specialists and healthcare assistants, physiotherapists, speech and language therapists, occupational therapists, rehabilitation assistants, social workers, dietitians, other medical specialists, clinical psychologists. Like in the hospital also the community team that helps the patients to continue care and rehabilitation once they leave hospital should be made up of different healthcare professionals, including consultant physicians, community stroke nurses, physiotherapists, speech and language therapists, occupational therapists, social workers, dietitians, clinical psychologists and kinesiologists / sport specialists in long-term rehabilitation. Such teams are directed under the leadership of physicians trained in physical medicine and rehabilitation (physiatrist) or by neurologists who have specialized training or board certification in rehabilitation medicine.

Long-term exercise-based intervention is a complex process requiring a multidisciplinary approach to obtain patients' maximum independence and possible self-reliance. Depending on the different patient's residual impairment(s), several health care professionals (HCP) are involved in their recovery path. In the long-term exercise-based intervention setting, the collaboration among highly specialised professionals, between different healthcare centres and adequate non-medical structures is mandatory. From these points of view, a strong connection between the clinical setting and territorial sport facilities is necessary. In long-term stroke rehabilitation interdisciplinary teams work together to maximize the individual's recovery with the aim that the person continues the programme independently based on the physiotherapist's instructions: physiotherapists should supply any necessary information about interventions and adaptations so that where the person is using an exercise provider, the provider can ensure their programme is safe and tailored to their needs and goals.

The quality of integrated stroke care depends on smooth team functioning. Various professional groups, which are involved in stroke rehabilitation, express highly positive professional interest in reorganised stroke rehabilitation concerning patients, professional practice and inter-sectoral relations. Even the research highlights the advantages of involving patients and patients' associations in making decisions on stroke rehabilitation, mainly long-term rehabilitation meeting their health services needs.

## The role of new technology

In post-stroke long-term perspective the role of new technology is wide. Considering possible motor impairment(s) and the need for a caregiver support, home based or individualised or group remote controlled activities can provide an alternative. IT tools/devices are useful: following patients both at home and during outdoor training providing also exercise group. The opportunity to monitor health conditions and training enhancement with an easy, individualised follow up may minimize barriers, side-effects, complications and minimize discontinuation. In the long-term patient's adherence is the goal and drop out should be avoided.

Recent advances as in wearable sensor technologies enable follow up of treatments, objective and long-term monitoring of motor activities even in a patient's habitual environment or reproducing activities of daily life.

People with mobility impairments require appropriate data processing algorithms that deal with their altered movement patterns and determine clinically meaningful outcome measures. Unfortunately, limitations are poor accessibility and high operational cost.

Today is possible to obtain a lot of information and the same parameters we would get in the motion analysis lab laboratory but using inertial movement sensors and specific algorithms. Inertial measurement unit (IMU) are electronic devices that measure and report a body's specific force, angular rate, and sometimes the orientation of the body, using a combination of accelerometers (measure the force imparted to a mass and consequently a linear acceleration), gyroscopes (measure the angular velocity of a body), and sometimes magnetometers (measure the earth's magnetic field). The device provides three angles of rotation around three axes, acting like a microscopic compass.

For efficient remote monitoring patients may be provided with a kit containing an inertial sensor and a set of elastic bands to connect the device to the various parts of the body, a mini computer that is connected to the television through the HD cable and a software application accessible from any browser regardless of the operating system used. It is possible to provide motor therapy, cognitive therapy, interaction with operator in respect of data security, certified according to European legislation (GDPR) on the protection of personal data.

So far, we have only presented the advantages of technological innovation, but it is correct to list and also examine the possible criticalities. Despite the theoretical advantages of telerehabilitation over conventional rehabilitation, few studies have evaluated patient satisfaction or acceptance of this type of rehabilitation, and those studies have found conflicting results for this variable. It is imperative also to consider the patient's perspective, given that individuals might be distrustful of telerehabilitation, due to their discomfort or objective difficulty with using new technologies or their lack of knowledge (during the pandemic these difficulties also emerged in some cases for simple tools such as sending medical prescriptions via e-mail, especially for older people).

On the other hand, there are patients' negative expectations, in fact one of the limitations of telerehabilitation is patient scepticism about remote interaction with therapists.

Finally, there may be the impossibility for the patient to access technological systems and infrastructures that meet at least the minimum technical requirements for a correct and safe use of the tele-rehabilitation service.

Most telerehabilitation systems used telephone contact or video conferencing. However, a number of these systems employed more complex technologies that required virtual reality devices or inertial sensors, requiring patients to have sufficient infrastructure to perform the therapy, which can be difficult and increase costs due to the use of more complex technologies, which limits access to telerehabilitation services. In addition, health professionals also need adequate training to properly use these technologies.

Aspects such as privacy and data protection also need to be considered when applying this rehabilitation model.

Social education is therefore needed to standardize and enhance the value of telerehabilitation as a safe and effective model in health care, and health professionals and health authorities need to be involved.

The high costs of in-patient rehabilitation programs and the evidence of poor continuity of care while patients are transferred to home have pushed towards the development of home-based rehabilitation programs, particularly suitable option for rural and underserved areas or patients. An effective, highly interactive, non-intrusive model can be structured as follows: starting with face to face visit as outpatients with physical therapists, video recording of physical performance abilities, then patients may perform physical activity sessions at home contributing to their motivational process of rehabilitation with telecon and video call for supervision on request. Then after the first ten sessions a new visit to the physical therapist to supervise the patients and their family or care-giver, to correct the wrong exercise methods, to check the patient's complaints and activity limitations in the house and suggest solutions may be planned. Afterwards, exercise sessions will follow, with regular tele-counseling and video call for supervision.

During the SARS-CoV2 pandemic, home-based telerehabilitation in post-stroke patients has demonstrated reduction of their risk of infection, effectiveness comparable to in-clinic rehabilitation in terms of improving motor, language, and cognitive functions. Patients were able to receive prescriptions for medication and counseling for psychological stabilization without visiting the hospital - such a service could significantly improve the mental health of stroke patients during the COVID-19 pandemic; with telerehabilitation, a physician could also determine whether a patient needs to be tested for COVID-19. If it is determined that there is no need for a COVID-19 test, then unnecessary hospital visits can be avoided, for stroke patients with COVID-19 who are asymptomatic or have mild symptoms and are in self-quarantine at home, telerehabilitation could be used to check for changes in symptoms and quickly detect symptom exacerbation to ensure they receive on-time treatment.

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