World Stroke Organization

Lay summary

Pragmatic solutions to reduce the global burden of stroke:

a World Stroke Organization – Lancet Neurology Commission

Background

Lancet Neurology has commissions that identify the most pressing issues relevant to neurology. In October 2023, together with the World Stroke Organization (WSO), they published "Pragmatic solutions to reduce the global burden of stroke: a World Stroke Organization–Lancet Neurology Commission".

WSO produced this version for lay readers.

Introduction

The number of people who die from stroke or are disabled by it has almost doubled in the last three decades and, worldwide, stroke is:

- The second leading cause of death
- The third leading cause of disability
- One of the main causes of dementia

While stroke is largely preventable and treatable, the quantity and quality of stroke prevention, treatment and rehabilitation varies widely between regions, between rich and poor countries and also within countries. Pragmatic Solutions to Reduce the Global Burden of Stroke, discusses the practical steps that need to be taken globally, and in each region and country to reduce inequality in stroke prevention and care.

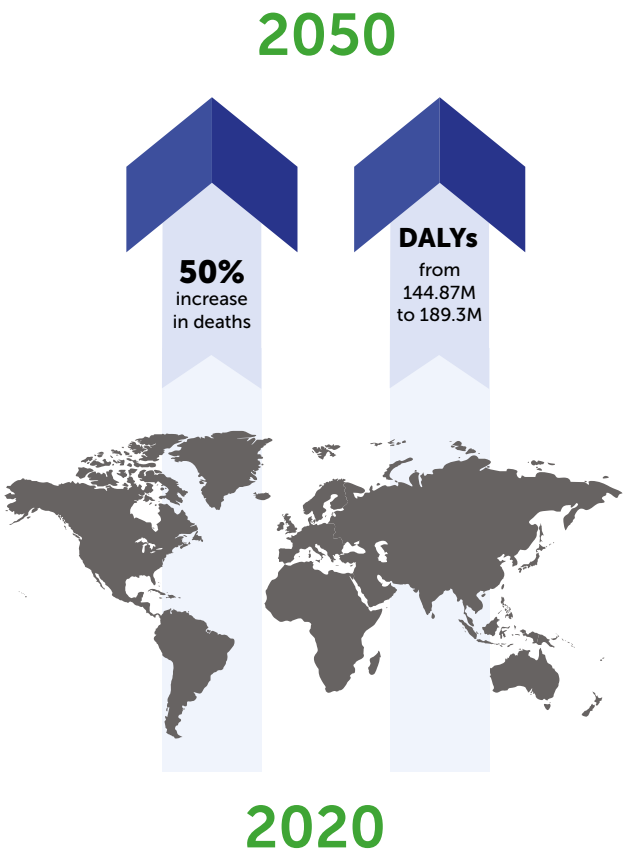
WORLDWIDE, STROKE IS:

Forecasts of the future burden of stroke

The Commission forecasts that globally, between 2020 and 2050, deaths from stroke will increase by 50% (from 6.6 million people per year to 9.7 million). The number of people impacted by stroke will also rise dramatically - disability-adjusted life-years (DALYs) will rise from 144.87 million in 2020 to 189.3 million in 2050.

Key drivers for this rise are the projected growth in the global population and an increase in the numbers of older people. But the analysis also suggests that a lack of, and unequal access to, high quality prevention, acute and rehabilitation services will be significant, especially in low- and middle-income countries.

There is also a lack of easily accessible high quality health services in many countries. A bigger proportion of strokes occur at a younger age in poorer countries and a greater proportion are haemorrhagic. Low and middle-income countries also struggle to gather information and data about stroke risk factors, the numbers of strokes and their impact.



While the rate of decreases in the incidence of stroke is slowing and stroke incidence rates in people younger that 70 years is increasing, the number of people having strokes will continue to rise. The growing burden of stroke will have a huge impact on individuals, families and communities and on the health systems and economies of all countries, but especially low- and middle-income countries. Across the world, we need improvements in stroke prevention, acute treatment, rehabilitation and stroke support.

Implications

- The burden of stroke will continue to increase worldwide and will disproportionally affect low- and middle-income countries. The differences in stroke burden between high-income countries and low- and middle-income countries are projected to increase.
- Current prevention strategies are insufficient, and the Sustainable Development Goals related to reducing the global burden of stroke will not be met.
- Urgent measures are needed, with an emphasis on low- and middle-income countries, to increase a trained health-care workforce to implement effective primary prevention.
- Effective interventions could result in substantial economic gains (due to reduced treatment and rehabilitation costs). Achieving the Sustainable Development Goals and World Health Organisation targets with low-cost interventions—e.g., early detection and adequate control of hypertension, reduction of salt content in processed foods, and smoking cessation campaigns— could reduce mortality from stroke and ischaemic heart disease by about 10%.
- It is estimated that for every $1 spent on stroke and cardiovascular disease prevention, there is a more than $10 return on investment. Additionally, stroke primary prevention efforts would probably yield large gains because of also reducing risk of heart disease, type 2 diabetes, dementia, and some types of cancer that share common risk factors.

Research priorities

- Monitoring and forecasting the global burden of stroke at regional, national, and sub-national levels.
- Developing interactive tools (including maps and data plots) showing the expected short-term and long-term effects of stroke prevention, treatment, and rehabilitation on global, regional, and national burden (incidence, prevalence, deaths, years of live lost, years lived with disability, disability-adjusted life-years, and economic benefits).
- Calculation of the effect of the burden of stroke on brain-health burden at global, regional, and national levels.

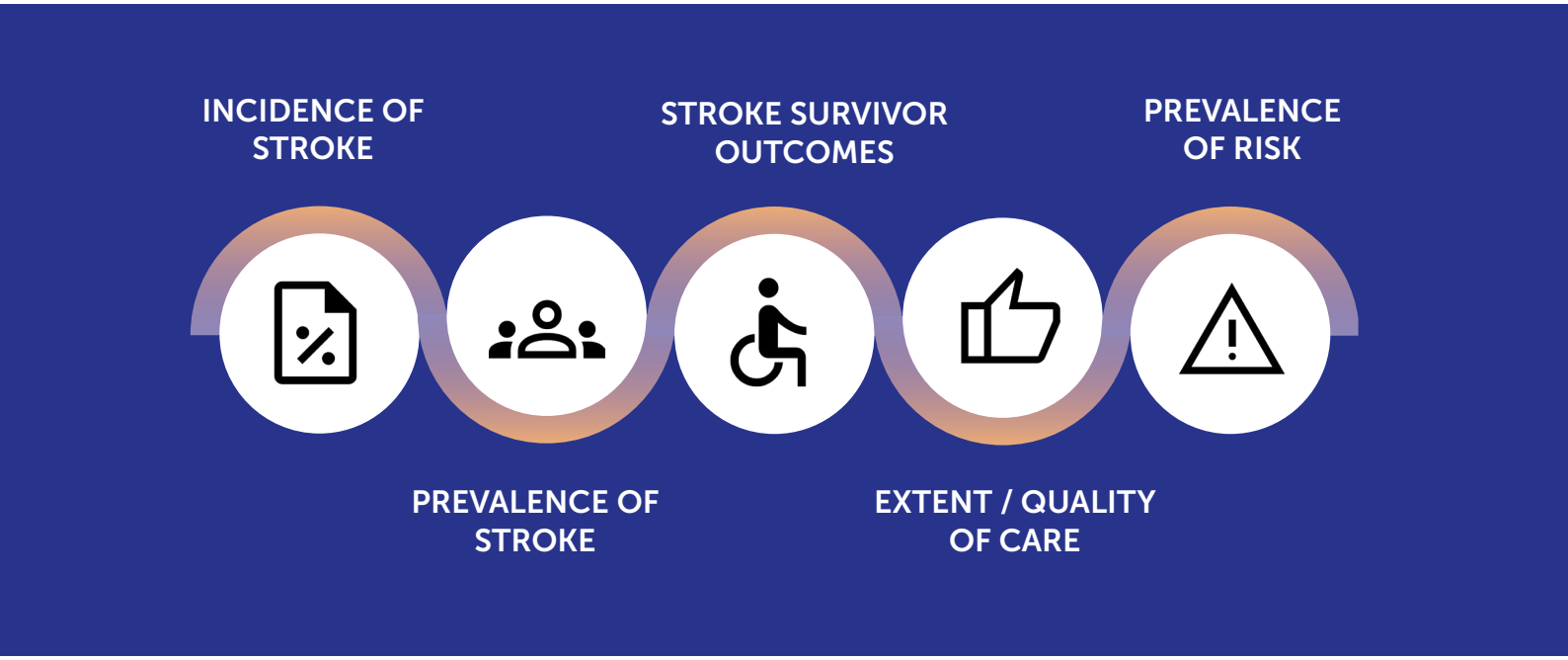
The four pillars of the stroke quadrangle

The Commission analysed the future burden of stroke from four perspectives, referred to as the four pillars of the stroke quadrangle, to reduce the burden of stroke worldwide:

Stroke surveillance

To reduce the number of strokes worldwide and to build better stroke care, we need information: data about the numbers of people at risk of stroke, how many have a stroke and the outcomes from their strokes. This understanding can be used to develop, implement and assess prevention, acute care and rehabilitation. The gathering of this information is known as epidemiological surveillance. It is a key element recommended by **WSO's Global Stroke Care Guidelines** and by other initiatives, including WHO's Intersectoral Global Action Plan (IGAP) on epilepsy and other neurological disorders 2022–2031.

Ideally the following information should be available:



Population-wide monitoring of risk factors is needed. Where resources are limited, efforts should be focused on collecting high-quality data for risk factors that:

- strongly predict stroke (eg, blood pressure, physical activity, lipid profile, diet, bodyweight, psychosocial factors, smoking, diabetes)
- are highly prevalent
- are amenable to individual-level or population-level intervention
- and are relatively easy and cheap to monitor.

National stroke registries can be a relatively inexpensive way to monitor the numbers of fatal and non-fatal strokes. But only 31 (14%) of 216 WHO member countries and territories have national stroke registries. Achieving national coverage and guarding against errors in the data can be major challenges but should not stop their development.

Facilitators and barriers to surveillance

Countries with good stroke surveillance have well-funded and trained workforces, can establish nationwide registries to monitor treatment and outcomes, and have regular risk factor surveys linked with population-based approaches, such as integration into censuses. By contrast, countries with poor surveillance capacity do not have nationally representative or standardised data available for stroke treatment or outcomes, generally because efforts are not nationally coordinated at the government level, with stroke surveillance activities instead managed by individual institutions or academic research networks.

Information technology affects the ability to deliver high-quality stroke surveillance services. Countries with strong health information systems tend to have good stroke surveillance. Internet-based systems allow data collection in real-time, which improves data quality. Digitalisation of medical records, mortality data, and other health databases enables and enhances analysis of stroke and risk factor data to inform policies. Electronic databases also increase access to data and enable data linkage to do complex studies on the epidemiology of stroke.

Strong governance facilitates the successful operation of high-quality national stroke surveillance systems. It requires political commitment, adequate funding, and independent advisory bodies. Countries with strong governance often have strong health information systems to enable data-driven decision making. Stroke surveillance activities are often government-led, with technical support from experts. A lack of government commitment to stroke surveillance hinders establishment of strong stroke surveillance systems.

There are three international tools which can help countries to improve stroke surveillance:

- WHO STEPS is a valid and reliable system for surveillance of risk factors, which emphasises high-quality collection of a few variables, rather than large amounts of poor-quality data.
- The Demographic and Health Surveys program is largely funded by the United States Agency for International Development.
- The European Health Interview Survey is a collaborative effort between all EU member states in which validated instruments are used to collect standardised self-reported health data.

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Research priorities

- Future research should focus on the development, implementation, and assessment of national stroke surveillance systems, including measures to monitor health-care quality.
- There is a need to develop and validate methods for calculation of incidence, prevalence, and outcomes of stroke based on administrative data.
- Mixed-methods research focused on the implementation and assessment of models to improve stroke surveillance is necessary and should also explore how these data for stroke and its risk factors can be used to improve stroke prevention and management.
- Validation studies are needed to assess the quality and coverage of data for risk factors available in administrative datasets.
- Surveillance systems should be able to incorporate data on stroke genetics to facilitate the development of novel prognostic biomarkers and prevention strategies.
- Novel digital tools for population-wide surveillance of stroke and its risk factors should be developed and validated.

Mixed-methods research focused on the implementation and assessment of models to improve stroke surveillance is necessary

Key messages: stroke surveillance

Governments need to establish nationwide systems for monitoring the burden of stroke, through registries, electronic health records, and vital statistics systems. These systems must achieve near-universal surveillance of indicators of stroke burden and risk factors, to reliably inform programmes for stroke prevention, acute care, and rehabilitation. Surveillance systems must be part of national stroke plans and monitoring systems for non-communicable diseases, which should identify stroke cases in the community.

Surveillance systems should assess the incidence, prevalence, management, and control of cardiovascular risk factors at the population level, and should be based on reliable measurements—e.g., measurement of blood pressure rather than self-reported hypertension. Surveillance systems should include capacity building of personnel to ensure enough adequately trained people to collect and analyse the data.

Governments should establish national stroke registries of hospitalised, non-hospitalised, fatal, and non-fatal strokes and transient ischaemic attacks. Such registries should be facilitated by linkage of population data for risk factors to hospitalisation and national death registries, which would enable clarification of the relationship between the burden of risk factors and stroke burden at a population level and could provide a near-complete overview of the burden of stroke.

Every country should have electronic health-information systems, with interoperability between systems to prevent duplication of data. In countries with established electronic or web-based platforms for data collection, the data collection for stroke and risk factors should be encouraged and incentivised to increase coverage. Large-scale collection of data via electronic systems that enable ready exchange of health information could, in turn, facilitate the use of this data for surveillance purposes. For such platforms to be valuable and sustainable, staff training is needed to ensure appropriate documentation and coding, and the secure handling of electronic health data.

Irrespective of surveillance system, consultation with communities, health-care providers, policy makers, health insurers, and implementation partners at each stage of development is essential. This will ensure consideration of legal, ethical, and socioeconomic factors, and that the system will meet the needs of the local community.

Stroke prevention

Globally, one in four individuals older than 25 years will have a stroke, which means that the lifetime risk of stroke is 25%. Therefore, effective primordial, primary, and secondary prevention programmes are crucial to reduce lifetime risk and the effects of the disease.

Primordial prevention is aimed at preventing the emergence of stroke risk factors whilst primary prevention involves early detection and control of risk factors, such as hypertension, dyslipidaemia, obesity, and diabetes.

Secondary stroke prevention is the prevention of stroke in people who have already had a stroke or a transient ischaemic attack. These account for 20–30% of strokes. People who had a stroke or a transient ischaemic attack are at increased risk of recurrent stroke particularly within the first few days. These recurrent strokes tend to be more disabling and to have poorer outcomes than the first stroke. Evidence suggests that 45–80% of recurrent strokes and transient ischaemic attacks could be prevented.

Primordial prevention

- Improving socioeconomic conditions and reducing poverty
- Building healthy cities and homes
- Universal health coverage
- Provision of affordable healthy food and facilities for physical activity
- Reducing air pollution, tobacco use, and consumption of salt, sugar, trans fat, and alcohol

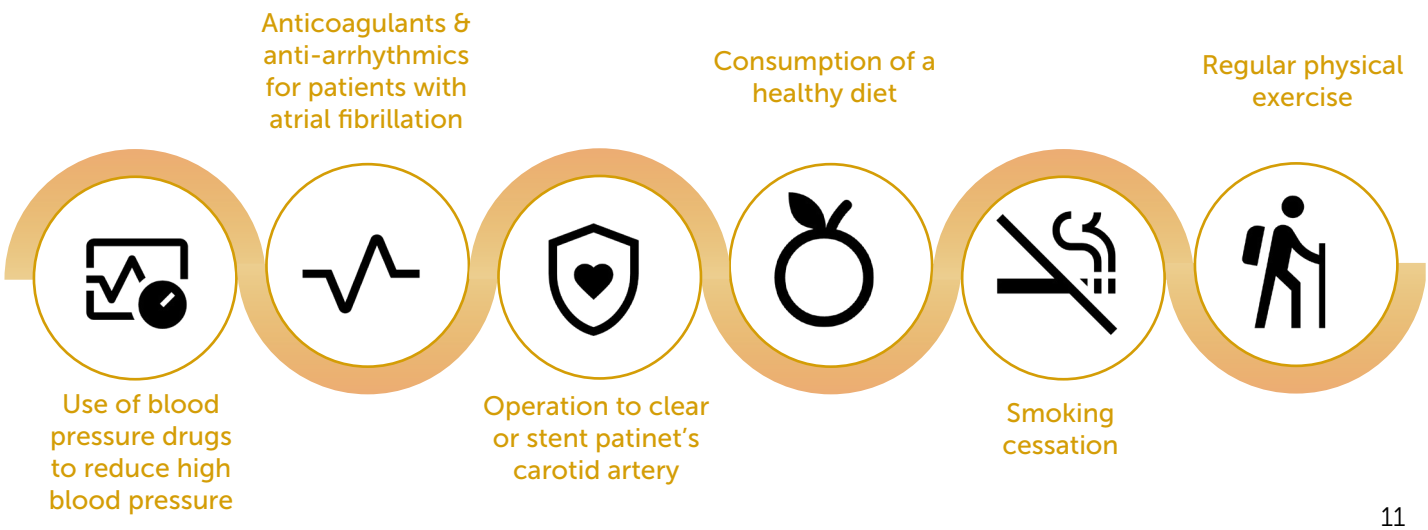
Primary prevention

- Screening for cardiovascular risk factors
- Risk factor control in all people at any increased risk of stroke
- Interlinked eHealth tools for lay people and clinicians
- Polypill and anticoagulation (when indicated)

Secondary prevention

- Adequate treatment of stroke and transient ischaemic attack, including antithrombotic therapy, use of polypills, and cartoid revascularisation

The evidence-based components of secondary stroke prevention comprise both medical and lifestyle interventions that are targeted to the cause of the first stroke and are aligned to the risk of recurrent stroke. Examples of medical and lifestyle interventions include:



Facilitators and barriers to high-quality stroke prevention services

Factors that affect the availability of high-quality stroke prevention services include system capacity (i.e., distribution of services, the continuum of these services, and availability of a trained health workforce), universal health coverage, and governance.

Lack of trained health-care staff is a major barrier to providing primary and secondary stroke prevention. The unequal distribution of health-care staff and socioeconomic differences between urban and rural areas create inequalities in access to services, and negatively affect health literacy. Countries with a wide network of service delivery by a mixture of staff (eg, doctors, nurses, community health workers) with stroke-specific training can provide a wide range of stroke prevention services.

Universal health coverage influences access to stroke prevention services. Countries with universal health coverage can provide a wide range of stroke prevention services free or at low cost. The absence of universal health care exacerbates inequalities in access to stroke prevention services, and people tend to prioritise out-of-pocket costs for treatment rather than prevention, with few or no regular health checks for stroke risk factors.

An absence of government-led primary stroke prevention activities is linked to low population health literacy about stroke prevention. Strong governance in stroke prevention facilitates high-quality services. A political commitment to stroke prevention and a national strategy to control risk factors enhances both primary and secondary stroke prevention.

Active participation of stroke organisations enhances governance. Countries with strong governance use health data for decision making, whereas a lack of government commitment to prevention of cerebrovascular diseases or clear national prevention guidelines hinders prevention.

Lack of trained health-care staff is a major barrier to providing primary and secondary stroke prevention.

Research priorities

- Further research is needed to identify the best balance between population-wide and individually targeted prevention strategies for stroke and cardiovascular disease, to maximise cost-effectiveness and minimise inequalities.
- We need more research into pragmatic, scalable, and cost-effective primary and secondary prevention interventions.
- Implementation research is also needed to scale up evidence-informed primordial, primary, and secondary stroke prevention strategies in different populations, including testing of low-risk preventive interventions in routine clinical care.
- Basic science and translational research leveraging genomics and precision medicine to develop prophylactic interventions is also needed. These approaches should include participants from overlooked populations in low- and middle-income countries and of different ethnicities, to ensure that the interventions are globally applicable.
- We need to develop motivational strategies to improve adherence to medication and lifestyle interventions should be investigated.
- There is an urgent need to develop and update national guidelines for stroke prevention and increase the involvement of key stakeholders, including stroke organisations.
- The best balance of population-wide and individual risk-targeted primary prevention strategies for stroke and cardiovascular disease should be identified to maximise cost-effectiveness and minimise inequalities.
- Validation studies should be done to establish the effectiveness of the four primary stroke and dementia prevention strategies recommended by WSO in different populations: population-wide prevention; motivational mobile or digital technologies; provision of low-dose combinations of generic antihypertensives and lipid-lowering drugs in a polypill for middle-aged and older adults; and facilitation of primary prevention strategies on the individual level by community health workers.
- Implementation research is crucial to discover and test novel lifestyle interventions, drugs, and other interventions for primordial, primary, and secondary prevention of stroke and related cardiovascular and other non-communicable diseases.
- The causes (including socioeconomic causes) of ethnic and racial disparities in stroke risk (including pathological types and causative subtypes) should be investigated, and culturally appropriate primary and secondary prevention strategies developed.
- High-quality population-based epidemiological studies are needed to measure global, national, and regional changes in the burden and distribution of risk factors for stroke.

There is an urgent need to develop and update national guidelines for stroke prevention and increase the involvement of key stakeholders, including stroke organisations.

Key messages: stroke prevention

Access to affordable medications for primary and secondary stroke prevention should be improved, with a focus on essential medications and tools. Essential drugs for primary and secondary prevention should be subsidised and available at hospitals and clinics.

Protocol-based and regulated shifting or sharing of tasks from highly trained health-care professionals such as physicians and nurses, to supervised and trained paramedical health-care workers, particularly community health workers, and free use of evidence-based WSO endorsed Stroke Riskometer app should be emphasised to facilitate primary stroke prevention at the individual level. Incentives for health-care staff in rural areas should be improved to encourage relocation and retention.

A continuum of care for stroke prevention should be established. Preventative strategies, with emphasis on lifestyle modification, should be implemented for people at any increased risk of stroke or cardiovascular disease.

Primary and secondary stroke prevention services should be freely accessible. Governments need to devote a fixed proportion of the annual health budget to stroke prevention. Funding could come from taxation on tobacco, salt, sugar, and alcohol.

Population health literacy on stroke prevention should be improved.

Acute stroke care

Acute care refers to the healthcare of patients within the 24–72 hours after the onset of stroke symptoms. The main evidence based clinical components of acute stroke care are:

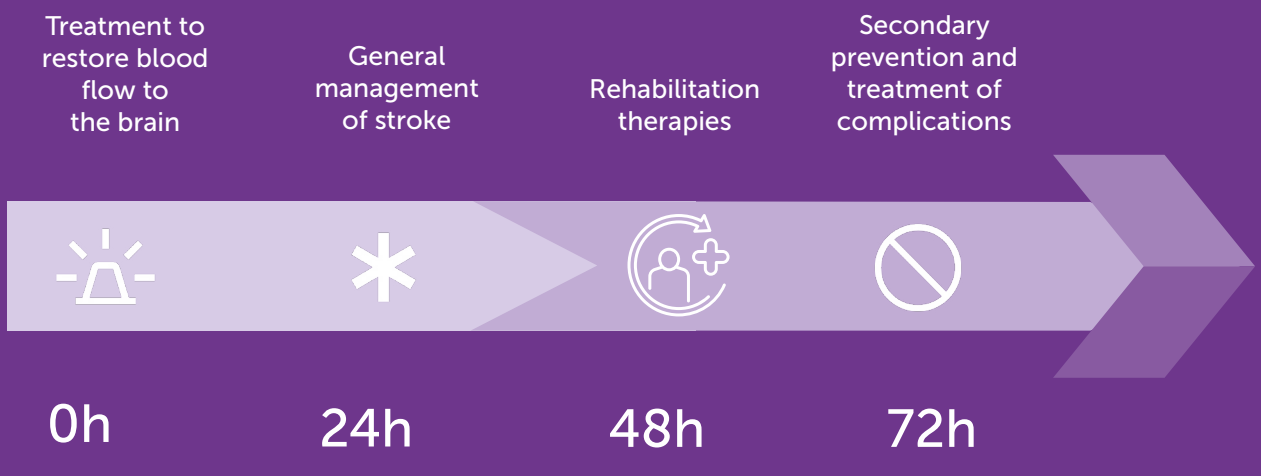
- reperfusion treatments for ischaemic stroke (i.e., treatments to restore the blood supply to the brain as quickly as possible)
- general management for acute stroke
- and secondary prevention and treatment of complications in all patients

These must be delivered as soon as possible after symptoms onset by a multidisciplinary team in a dedicated stroke unit. Rehabilitation therapies should be started in most cases within 24–48 hours of stroke onset. General care for all patients with stroke is fundamental and includes management of blood, blood glucose, body temperature, and oxygen levels. It is crucial that secondary stroke prevention and prevention and management of complications begin immediately after symptoms onset, and that rehabilitation is included in acute care. The implementation of such coordinated acute stroke management through a multidisciplinary team is key to improving long-term outcomes.

There are a variety of quality indicators for acute care in different guidelines. It is essential to implement a minimum number of these indicators to monitor stroke care—at least at the individual hospital level, but ideally at a national level. Collection of data from all patients in a stroke registry to monitor the quality of stroke care is the ideal but is very difficult, particularly in low- and middle-income countries.

Experts from the European Stroke Organisation and the WSO devised several main quality indicators that can be collected easily and that address the process of care (e.g., time from arriving at a hospital to treatment, swallowing assessment), the use of treatments for reperfusion and prevention, and the main outcomes after stroke.

ACUTE STROKE CARE BY MULTI-DISCIPLINARY TEAM, IN DEDICATED STROKE UNIT:

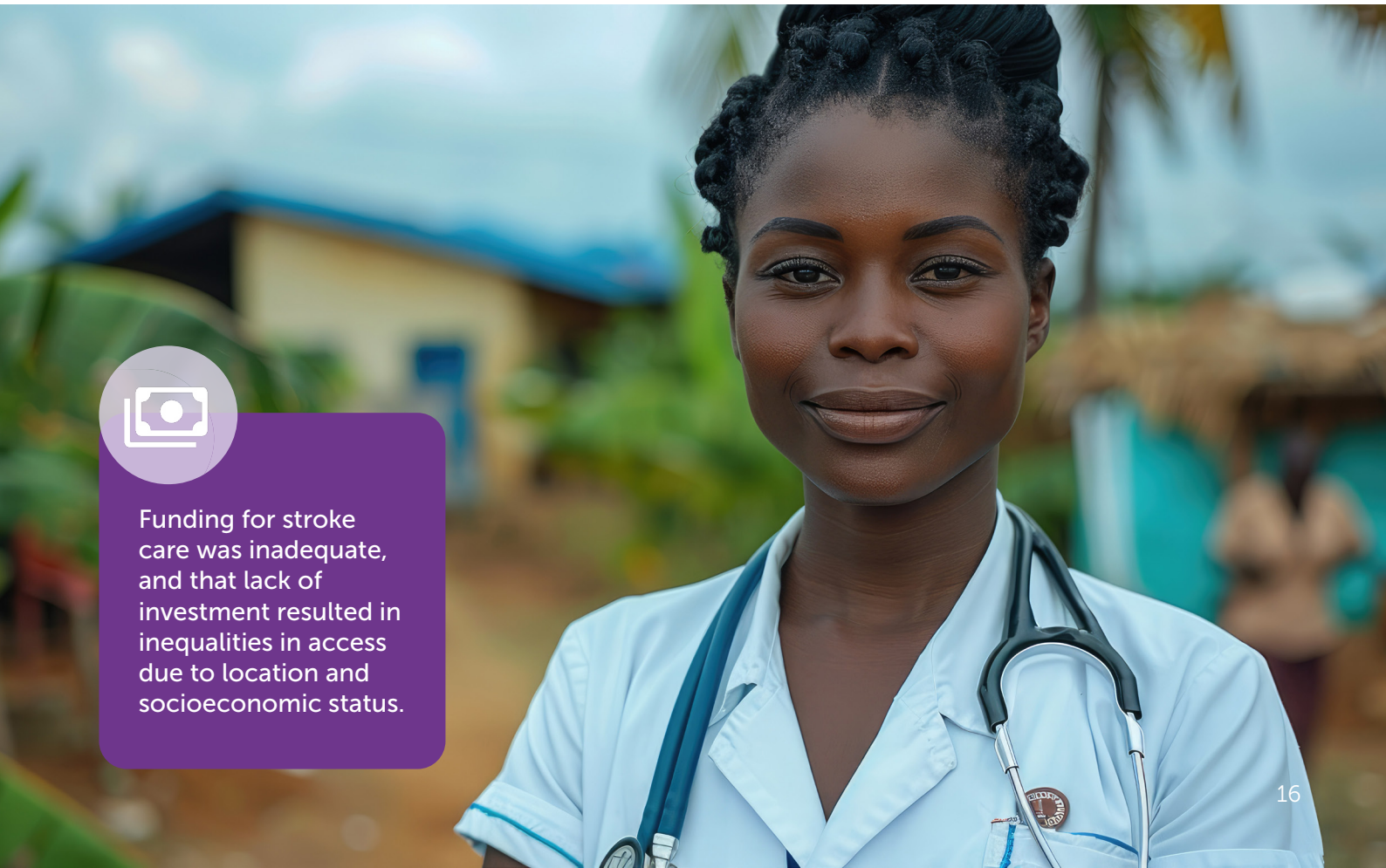


The drugs used in thrombolysis and the devices used in thrombectomy are on the 2021 WHO list of essential medicines and of priority devices. Despite this, even in well-resourced and organised health-care systems, only around 20% of patients with ischaemic stroke are treated with thrombolysis. In low- and middle-income countries, less than 1% of patients are treated with thrombolysis.

Facilitators and barriers to acute stroke care

Interviews with experts from nine countries by the Commission identified barriers and facilitators for acute stroke services. The major barriers were related to awareness, investment, and strategy.

- Awareness refers to lack of understanding of acute stroke care, which affected availability and access. There was agreement that low community awareness of stroke decreased access to evidence-based care. Lack of awareness among policy makers about stroke care resulted in low prioritisation and funding of stroke services. Health professionals, particularly generalists, receive little stroke-specific training, which possibly precludes access to the best care.
- All respondents agreed that funding for stroke care was inadequate, and that lack of investment resulted in inequalities in access due to location and socioeconomic status. The best care was almost always available only in major towns with populations of more than 100,000. In many countries, people outside major cities, and unable to pay out of pocket, have little access to stroke units, thrombolysis, or thrombectomy.
- Many countries do not have a national strategy or guidelines for stroke care. Respondents said that countries often did not have organisations for health-care professionals interested in stroke, which meant that no national approach to training, accreditation, and advocacy on stroke is available.



Funding for stroke care was inadequate, and that lack of investment resulted in inequalities in access due to location and socioeconomic status.

The provision of regular, structured training was viewed by respondents as essential for building a stroke care workforce

The major facilitators for the delivery of high-quality acute care services were related to training, innovation, and networks.

- The provision of regular, structured training was viewed by respondents as essential for building a stroke care workforce. The best training services, according to respondents, are interdisciplinary, targeted at health-care professionals who do not specialise in stroke care (but who provide most in-hospital care), and supported by public and private funding. The increasing demand for thrombectomy has created an urgent need for more interventionalists. Some countries have addressed the growing demand for specialists that can perform thrombectomy by training people from different specialties—e.g., cardiology—to perform endovascular clot retrieval. In other countries, tight restrictions on who can perform this intervention means that access to thrombectomy is scarce.
- Innovation can occur via both formal (e.g., government-funded) and informal (e.g., WhatsApp groups, telehealth networks providing connected, regionalised stroke care) channels. Governments in some regions are investing in mobile stroke units to increase coverage of care. Innovations in data collection for stroke care are driving quality improvement, with public recognition of high-performing centres viewed as important.
- Networks are facilitators of acute stroke care because well organised national bodies for stroke care, with strong leadership, increase access to high-quality care, according to respondents. The most effective networks were connected to governments through clear reporting structures (e.g., to a minister of health), resulting in endorsed guidelines and funding. Living guidelines provide the potential for harmonised, internationally recognised stroke care guidelines that could be locally adapted.

Research priorities

- Assessment of disparities in access to stroke care and prevention within and among countries and regions.
- Further investigation of the use of telemedicine to increase access to specialised stroke treatment in low- and middle-income countries.
- Development of optimal strategies to increase early recognition, early hospital admission, and access to acute stroke care in low- and middle-income countries.
- Assessment of triage strategies in pre-hospital settings and strategies to distribute patients to stroke centres in different health-care systems.
- Assessment of the best approach to manage hypertension in hyperacute and acute patients in resource- constrained settings.
- Development and assessment of treatments for dysphagia.
- Clarification of the underlying causes of stroke and risk factors, to unravel new targets for diagnostic and prognostic tools and new treatments.
- Development and assessment of neuroprotective drugs.

Key messages: improving acute stroke care

Funding agencies, professional societies, and health-care authorities should prioritise and fund research in stroke, especially in low- and middle-income countries.

Organisation of acute stroke care starts by recognising local gaps in structures and care. Many countries, particularly low-income and lower-middle-income countries, have huge intra-country disparities in access to care, and interventions should be tailored to address local needs. The WSO roadmap can help in the assessment of available services.

Discuss identified gaps and recommendations on how to close them with directors of hospitals and local or national health authorities, and develop action plans. It is crucial to surmount the barriers to availability and affordability of reperfusion treatments.

Acute stroke care requires well trained staff in ambulances and emergency services for early recognition of stroke signs and rapid transfer of patients to a stroke centre, rapid assessment in emergency departments, initiation of acute stroke treatments in a timely manner, admission to a stroke unit, management by a multidisciplinary team, and early initiation of the rehabilitation interventions.

Efforts should be made to provide enough alteplase worldwide and reduce its cost in resource-limited settings. Stroke care should be included in universal health coverage packages in WHO member countries. Expensive treatments like thrombolysis and mechanical thrombectomy should be made affordable. Governments can negotiate with pharmaceutical companies and medical device companies to reduce these costs.

In areas without trained stroke specialists, telemedicine can be used to increase access to acute care.

Initiatives such as the Latin American Stroke Ministerial Meeting and Global Stroke Alliance should be organised in all regions of the world to bring together health-care managers, including ministers of health, to discuss and formulate action plans.

We need more stroke units with a multidisciplinary approach (the WSO suggests at least 50 stroke unit beds per 1 million people). Implementation of evidence-based acute treatments is essential (thrombolysis as a first step, followed by thrombectomy in advanced centres).

We recommend the establishment of advanced stroke centres, with at least one centre per 2 million people. The multidisciplinary team should include at least a physician, a nurse, a nurse assistant, a physiotherapist, and a speech therapist.

Training of health professionals is fundamental for effective implementation of stroke care guidelines. There are large disparities in the availability of neurology training between high-income countries and low-income and middle-income countries.

Digital-based training should be used to build capacity among physicians and nurses, especially in remote areas without access to trained professionals.

Practical, hands-on and simulation-based training for neuro-interventionalists is fundamental to develop mechanical thrombectomy skills and to improve the quality of the procedure and patient outcomes.

A lack of speech therapists is quite common in low- and middle-income countries, but nurses or physiotherapists can be trained to do swallowing assessments in the acute phase of stroke care and during rehabilitation.

Rehabilitation

Stroke is the third leading cause of disability worldwide. Although the extent of a person's disability after a stroke depends on a wide variety of factors, access to rehabilitation therapy is key to recovery.

The proportion of people with disability varies – from around a quarter among those who have minor strokes, about half of those with moderate strokes and over one in five among those with severe strokes. After ten years around half of all stroke survivors are disabled with a range of issues including motor, sensory, visual, cognitive and psychological impairments. People can struggle to swallow, to have a conversation, to get dressed, to move one side of their body and many experience depression and anxiety. The extent of someone's disability is not just down to the severity of their stroke - their health and socio-economic status before the stroke can have an impact, as can the stroke's location and size. And a crucial factor is the quality and quantity of rehabilitation they receive after the stroke.

Stroke rehabilitation relies on neuroplasticity – the ability of the brain to forge new pathways through repeated activities and exercises focussing on specific functions or tasks. It can also help stroke survivors to find ways to adapt to their new situation, sometimes using assistive devices. Interventions aim to promote continued participation in domestic and social life and achieving as high a quality of life as possible. Currently best practise in rehabilitation is carried out by stroke specialist physiotherapists, speech and language therapists and occupational therapists. There is also research using stem cells, growth factors and other therapies to augment neural repair, regeneration and connectivity.

The provision of rehabilitation support after stroke is patchy, both within and between countries. While great strides have been taken in the last two or three decades to produce protocols and guidelines for stroke prevention and acute treatment, there is a scarcity of these things when it comes to rehabilitation. There is less evidence about what works in stroke rehabilitation and there are too few trained personnel.

EFFECTIVE REHABILITATION SERVICES SHOULD INCLUDE:

An experienced multidisciplinary team

Individualised goal-oriented approach

Equipment and facilities

Compared to richer countries, low- and middle-income countries struggle to provide the key elements of good rehabilitation: there is a lack of rehabilitation support in hospitals and in the community, lack of home assessments, education for stroke survivors and their carers, few protocols and very little availability of early supported discharge programs. This affects economic productivity in low- and middle-income countries, especially in places where stroke occurs at a younger age. And it is more vulnerable, older, poorer people living in remote or rural areas who are less likely to undergo rehabilitation. Without rehabilitation people make much less recovery from their stroke, are likely to suffer greater mental ill-health and to suffer economically.

Effective rehabilitation services should include:

- an experienced multidisciplinary team including physicians, speech therapists, physiotherapists, occupational therapists, nurses, prosthetists, orthotists, and other health-care professionals trained in stroke rehabilitation
- an individualised goal-oriented approach.
- equipment and facilities to provide rehabilitation interventions.

It is important that rehabilitation is intense enough and is delivered for long enough to be of most benefit. This requires major resources to be allocated to rehabilitation service provision. But even the delivery of the simplest interventions is patchy – in the WSO survey, only 35% of countries include education on self-management for stroke survivors.

Poor service organisation and a lack of protocols in low- and middle-income countries and in some high-income countries too, has led to long waiting times for assessments of people's needs and the best interventions. Too many people leave hospital without a discharge plan and many face inadequate long-term support with little psychological and social support.

It is important that rehabilitation is intense enough and is delivered for long enough to be of most benefit

Facilitators and barriers to good rehabilitation

Good rehabilitation services are complex. They require a wide range of specialists in stroke rehabilitation, physiotherapy, speech and language therapy, psychology, and specialists in prosthetics and orthotics. And rehabilitation needs to be provided in a wide range of settings: in acute care, for inpatients and outpatients and then in the home and in the community. The recruitment and governance of a specialised, yet disparate, workforce is a major challenge. These factors make it harder to prioritise, and secure funding for rehabilitation services. As a result, there is little data capture and reporting, which, in turn, has a negative impact on quality improvement and care co-ordination. According to the experts interviewed:

- Most stroke rehabilitation efforts are focused on a small range of services, for a limited time, and in only some settings. Respondents stated that often only physiotherapy was available, with very little access to other specialities.
- Publicly funded rehabilitation services are mostly provided in acute care, and not in the community or patients' homes, or via telemedicine.
- The broadest scope of services is available only in large cities and often only to patients who can afford to pay privately.
- There is low awareness of the role of rehabilitation after stroke across a broad range of stakeholders (eg, in the community and among health-care professionals and policy makers). This results in low political will to fund services and little advocacy to increase access to, or the scope of, services.

Often there is only physio-therapy available, with very little access to other specialities.

Online, internationally led mentoring programmes for people in low- and middle-income countries are important to prevent the so-called brain drain

Implementing evidence-based care, the provision of universal health care, and capacity building are the major facilitators of improve rehabilitation. Evidence-based guidelines, frameworks, and protocols for stroke rehabilitation help with service planning and ensure quality of care.

In countries with universal health coverage, most people get access to some rehabilitation after stroke. But public services are often underfunded. The importance of the private sector for access to a wide range of stroke rehabilitation services in diverse settings, including long-term services for discharged patients in the community, cannot be understated.

Building the capacity for improving national and local rehabilitation will require undergraduate and postgraduate training, and the certification of allied health professionals. This should include training beyond the more common nursing and physiotherapy often found in low- and middle-income countries. The building of communities of practitioners and mentoring programmes can contribute to capacity building.

Online, internationally led mentoring programmes for people in low- and middle-income countries are important to prevent the so-called brain drain of health professionals who emigrate to get training, but do not subsequently return to apply the skills.

Research priorities

- The determinants of functional dependence in different populations.
- The effectiveness of supervised task sharing of rehabilitation with available personnel and caregivers to overcome the shortage of health-care professionals.
- The effectiveness of community-delivered and home-delivered (including self-management) rehabilitation versus facility-based rehabilitation, regenerative interventions, and low-cost and accessible robotics, neuromodulation devices, and brain–computer interfaces.
- The effectiveness of rehabilitation-based educational tools, including telerehabilitation, training videos, and mobile health.
- The effectiveness and cost-effectiveness of locally manufactured rehabilitation and assistive devices.
- Assessment of health-care services and workforces for stroke rehabilitation in terms of training and availability of tools, and research into tailored rehabilitation protocols for low- and middle-income countries.
- Multidimensional characterisation of the life course after a stroke.
- Investigation of the prevalence and management of risk factors for functional dependence and mortality after stroke at the population level.
- Establishment of the capacity and needs of the health services and workforce for stroke rehabilitation in terms of education, skill and competencies, and availability of required tools and equipment—e.g., by using the WHO rehabilitation competency framework.
- Development of performance indicators to monitor rehabilitation quality.
- Development of tailored rehabilitation protocols for low-income and middle-income countries
- Assessment and monitoring of country coverage and outcomes of stroke rehabilitation with routine data collection from facilities—e.g., by using WHO's Routine health information systems—rehabilitation toolkit.
- Validation of the effectiveness of educational tools for stroke rehabilitation, including telerehabilitation, training videos, and mobile health.
- Investigation of the feasibility, safety, effectiveness, and coverage of home-based rehabilitation (including self- management), and community-based rehabilitation.
- Investments in regenerative medicine, novel medications to modify neuroplasticity, low-cost and accessible robotics, neuromodulation tools, and brain–computer interface approaches.
- Discovery of novel biomarkers for prognostication and quantification of neural repair and recovery

There is a need for research into the effectiveness of community-delivered and home-delivered (including self-management) rehabilitation versus facility-based rehabilitation.

Key messages: stroke rehabilitation

	Goals	Targets	Recommendations	Measures of progress
Some countries do not have stroke rehabilitation services	To establish and strengthen neurorehabilitation services in various settings in all countries	To ensure the availbility of multidisciplinary neurorehabilitation facilities and personnel in all countries by 2030, so that rehabilitation is accessible to all patients worldwide	All countries without multidisciplinary neurorehabilitation services should initiate a programme to establish these services and train personnel to deliver multidisciplinary care to patients after a stroke in hospital and community settings. Funding solutions are needed to facilitate access to neurorehabilitation services for patients with stroke in low-income and middle-income countries	Number of countries without multidisciplinary neurorehabilitation services in 2019 for stroke patients who have established such services by 2030
Many countries do not have sufficient stroke rehabilitation services (in terms of both number and quality)	To increase the number of facilities offering high-quality multidisciplinary care for patients with stroke and to increase adherence to best practice guidelines along the contiuum-of-care, including inpatient, outpatient, community, and home-based rehabilitation	To increase the number of facilities offering high-quality multidisciplinary care for patients with a continuum-of-care approach and inter-setting organisation, such that every patient with stroke has access to these services by 2030. The number and type of services required will depend on the burden of stroke in each region and country	Multidisciplinary care and inter-setting organisation along the continuum-of-care should be available for patients with stroke. Countries with stroke rehabilitation services should improve the quality of these services according to evidence-based guidelines. Training programs should be enhanced to increase the number of personnel available to offer services. Performance indicators for rehabilitation that address major impairments and patient and carer needs should be developed A repository for best practice rehabilitation protocols for sharing and adaptation to different countries and settings should be created	Number of new rehabilitation services established between 2019 and 2030 in each country. Improved adherence to clinical practice guidelines

Pragmatic recommendations to improve stroke rehabilitation by 2030. Pragmatic solutions to reduce the global burden of stroke: a World Stroke Organization–Lancet Neurology Commission

The concept of so-called living guidelines, whereby experts from across the world participate in the continuous development and updating of evidence-based guidelines that can be adapted in the local context.

The development of international, evidence-based stroke rehabilitation guidelines that focus on therapeutic approaches rather than on organisational issues to assist in the setting up of regional or local stroke rehabilitation pathways.

Assessment tools such as the modified Rankin Scale, the US National Institutes of Health Stroke Scale, and quality-of-life scales should be used to document the type and severity of disability and impairments.

There is an urgent need to invest in the creation of multidisciplinary rehabilitation services, and in research to generate innovative low-cost interventions (especially in low-income and middle-income countries), and in training of stroke rehabilitation professionals.

Dissemination of multidimensional assessment tools, solutions, training videos (including self-management), and advocacy targeting all stakeholders should be implemented for stroke rehabilitation in all regions. Telemedicine and digital channels could be harnessed.

In view of the increasing number of stroke survivors and the limited resources for community rehabilitation, effective and accessible self-management programmes or tools for stroke survivors and caregivers are crucial. Evidence suggests that self-management programmes are feasible and can improve survivors' outcome expectations.

Conclusion

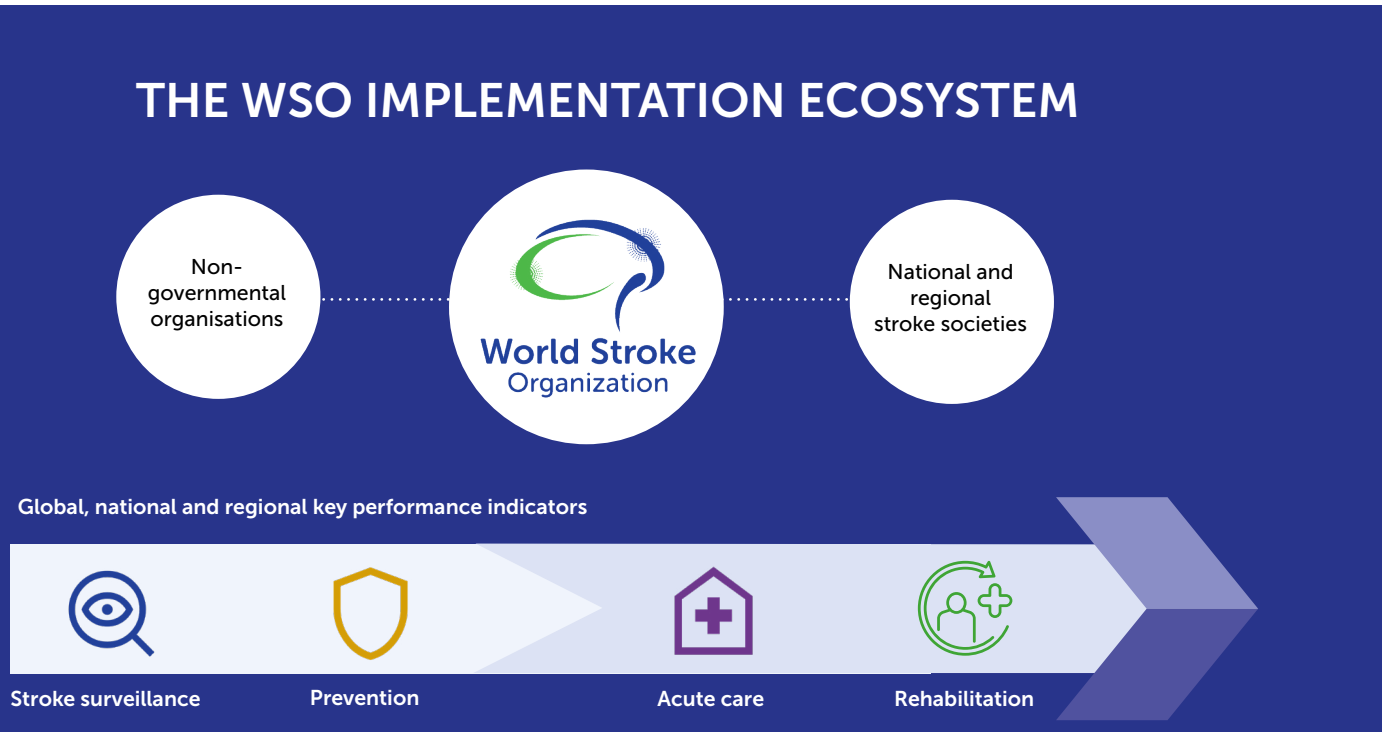
Effective planning of stroke surveillance, prevention, acute care, and rehabilitation is needed to tackle the global burden of stroke. However, there are huge intra-country and inter-country variations in stroke surveillance, prevention, acute care, and rehabilitation worldwide, with fewer services in low and middle income countries. To maximise the effect of the limited resources available, cost-effective and evidence-based pragmatic solutions need to be deployed, with active engagement of all stakeholders, including policy makers and local communities.

Region-specific adaptations of stroke prevention and care guidelines and incorporation of these guidelines into clinical practice are essential to bridge the gaps in stroke care between HICs and LMICs.

Population-wide detection and control of modifiable risk factors through task sharing and digital tools are needed to reduce the incidence of stroke across the life course. Establishment of stroke units, stroke centres, and rehabilitation services should be prioritised worldwide, particularly in resource-limited settings. Promotion of universal health coverage will enable wider usage of thrombolysis and mechanical thrombectomy. Simple interventions focusing on managing fever, swallowing assessments, and control of blood glucose are low-cost strategies that improve stroke outcomes.

Overall, partnering with global and regional professional organisations, WHO, and policy makers is essential in the dissemination and implementation of evidence- based interventions for stroke.

The WSO implementation ecosystem will work with partners, including non- governmental organisations and national and regional stroke societies to create, implement, and monitor pragmatic solutions to reduce the global burden of stroke. Global, regional, and national key performance indicators and targets will be devised to improve stroke surveillance, prevention, acute care, and rehabilitation.



Glossary

Angiographic imaging
An imaging technique used to visualise the lumen (ie, interior) of blood vessels and organs

Aspiration pneumonia
Infection of the lungs caused by inhaling saliva, food, liquid, vomit, or small foreign objects

Atrial fibrillation
An arrythmia (ie, irregular heart rhythm) originating from the atrium of the heart with a characteristic absent P wave on electrocardiograms

Carotid interventions
Surgical interventions to restore or improve blood flow to the carotid vessels—eg, carotid endarectomy, stenting

Disability Adjusted Life Year (DALY)
DALYs are defined as: the sum of years of life lost as a result of premature mortality from a disease and the years lived with a disability associated with prevalent cases of the disease in a population. One DALY represents the loss of the equivalent of one year of full health

Endovascular thrombectomy
Surgical technique for removing a blood clot from the artery. A small incision is made in the groin, and thin tubes (catheters) are threaded through the blood vessels to remove the clot

Epidemiological surveillance
The systematic collection, analysis, and dissemination of health data for the planning, implementation, and assessment of public health initiatives

Intravenous thrombolysis
A reperfusion treatment in which drugs are used to dissolve blood clots blocking an artery

Large vessel occlusion
A blockage of the internal carotid artery, or proximal segments of the middle cerebral, basilar, or vertebral arteries

Mechanical thrombectomy
An endovascular technique for physically removing blood clots from the brain after an ischaemic stroke

Modified Rankin scale
A standard scale used to measure disability, scores range from 0 (no symptoms) to 6 (death)

Motivational mass individual strategies
Motivational techniques delivered via smartphones that could be used in most of the adult population

Neuroplasticity
The ability of the nervous system to change its activity in response to intrinsic or extrinsic stimuli by reorganising its structure, functions, or connections after injuries, such as a stroke

Polypills
Pills containing fixed doses of at least two drugs. Polypills containing blood-pressure- lowering and blood-lipid- lowering drugs can be prescribed for prevention of stroke and transient ischaemic attack

Primordial prevention
- Improving socioeconomic conditions and reducing poverty
- Building healthy cities and homes
- Universal health coverage
- Provision of affordable healthy food and facilities for physical activity
- Reducing air pollution, tobacco use, and consumption of salt, sugar, trans fats, and alcohol
- Public health campaigns to raise awareness about stroke and stroke risk factors

Primary prevention
- Screening for cardiovascular risk factors
- Risk factor control in all people at any increased risk of stroke
- Interlinked eHealth tools for lay people and clinicians
- Polypill and anticoagulation (when indicated)

Reperfusion treatments
An umbrella term for treatment that seeks to restore blood flow to the brain—eg, intravenous thrombolysis, mechanical thrombectomy

Secondary prevention
Adequate treatment of stroke and transient ischaemic attack, including antithrombotic therapy, use of polypills, and carotid revascularisation

Socioecological model
A model that conceptualises health in the context of the complex interplay between individual, family, community, and societal factors

Stroke registry
A systematic approach to identification, diagnostic assessment, and registration of stroke cases in a community

World Stroke Organization's Global Stroke Care Guidelines
A roadmap that is intended to guide local health-care officials and stroke care clinical groups in establishing stroke systems of care and implementing as many of the defined components as possible throughout the continuum of care

World Stroke Organization's post-stroke checklist
A checklist to help health-care professionals identify post- stroke problems amenable to treatment or referral

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