World Health Organization

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ISBN 978-92-4-010366-5 (electronic version)
ISBN 978-92-4-010367-2 (print version)

Suggested citation. Framework for the care of acute coronary syndrome and stroke. Geneva: World Health Organization; 2024. Licence: CC BY-NC-SA 3.0 IGO.

Cataloguing-in-Publication (CIP) data. CIP data are available at https://iris.who.int/.

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Acknowledgements

This report was developed and produced by Dr Taskeen Khan of the Department of Noncommunicable Diseases, Rehabilitation and Disability, World Health Organization (WHO) and coordinated by Dr Slim Slama and Dr Shelly Chadha (Department of Noncommunicable Diseases, Rehabilitation and Disability, WHO). Dr Bente Mikkelsen (Department of Noncommunicable Diseases, Rehabilitation and Disability, WHO) and Dr Jérôme Salomon (Assistant Director-General, Universal Health Coverage/Communicable and Noncommunicable Diseases, WHO) provided strategic direction.

The valuable technical contributions from colleagues across WHO are recognized:

Dr Gampo Dorji, Dr Tarun Dua, Dr Jill Farrington, Dr Pradeep Joshi, Dr Rachel Tullet, Dr Emilie Calvello Hynes, Dr Pedro Ordunez, Dr Alexandra Rauch, Dr Andres Rosende, Dr Nicoline Schiess and Dr Lee Wallis.

WHO also recognizes the valuable contributions made by Dr Ganesan Karthikeyan, Ms Miriam Mikhail and Ms Diana Paez (International Atomic Energy Agency (IAEA)), Dr Aaysha Cader, Dr José González-Juanatey, Dr Fernando Lanas, Dr Jagat Narula, Dr Roland N'Guetta, Dr Pablo Perel, Dr Susanna Price, Mr Sean Taylor, Dr Sarah Zaman (World Heart Federation (WHF)), Dr Epiphania Collantes, Ms Maria Frieden Grupper, Dr Meron Gebrewold, Dr Maria Khan, Dr Carlos Molina, Dr Bo Norrving, Dr Jeyaraj Pandian and Dr Sheila Martins (World Stroke Organization (WSO)).

WHO also recognizes the participation of external peer reviewers Dr Atul Kotwal (Ministry of Health and Family Welfare, India), Dr Sarah Matuja (Senior Lecturer and Neurologist, Catholic University of Health and Allied Sciences – Weill Bugando, United Republic of Tanzania), Dr Ahmed Nasreldein (Lecturer and Consultant in Neurology Department, Assiut University Hospitals–Assiut University, Egypt), Dr Mayowa Owolabi (Director, Center for Genomic and Precision Medicine, College of Medicine, University of Ibadan, Nigeria), Dr Francesca Romana Pezzella (Neurologist, Medical Director, Stroke Unit, Department of Neuroscience, San Camillo Forlanini, Rome, Italy), Dr Antonio Luiz Pinho Ribeiro (Head of Research and Innovation and the Cardiology Service of the University Hospital at the Federal University of Minas Gerais, Brazil), Dr Nguyen Thi Thi Tho (Ministry of Health, Viet Nam), Dr Champika Wickremasinghe (Ministry of Health, Sri Lanka) and Dr Alexei Yakovlev (Associate Professor, Department of Anaesthesiology and Intensive Care, Almazov National Medical Research Centre, Russian Federation).

All Member States are acknowledged for the actions taken to diagnose, treat and control acute coronary syndrome and stroke.

Financial support

WHO is grateful for the financial support to develop this report from the Norwegian Agency for Development Cooperation (NORAD) and the European Union.

Abbreviations and acronyms

ACS	acute coronary syndrome
AF	atrial fibrillation
CK	creatine kinase
CT	computed tomography
CVD	cardiovascular disease
DALY	disability adjusted life year
ECG	electrocardiogram
ESC	European Society of Cardiology
IAEA	International Atomic Energy Agency
IPC	infection prevention and control
IV	intravenous
LMIC	low- and middle-income country
MRI	magnetic resonance imaging
NCD	noncommunicable disease
NSTEMI	non-ST elevation myocardial infarction
PCI	percutaneous coronary intervention
RCT	randomized controlled trial
SDG	Sustainable Development Goal
STEMI	ST elevation myocardial infarction
WHF	World Heart Federation
WSO	World Stroke Organization

Executive summary

Introduction

Cardiovascular diseases (CVDs) are the leading cause of death globally, accounting for approximately 17.9 million deaths annually. This group of disorders, which includes coronary heart disease and cerebrovascular disease, leads to significant morbidity and economic burden, particularly in low- and middle-income countries (LMICs). Despite a decline in CVD mortality in high-income countries since the 1980s, recent trends show a slowdown in progress, exacerbated by the COVID-19 pandemic. The public health approach to managing CVDs involves a balance of population-based prevention policies, treatment of intermediate risk factors, acute care for conditions such as acute coronary syndrome (ACS) and stroke, long-term management and rehabilitation.

Purpose and objective

This framework aims to guide countries in strengthening the care of ACS and stroke, ultimately contributing to a reduction of CVD morbidity and premature mortality, aligned with Sustainable Development Goal (SDG) target 3.4. The framework emphasizes a systems-focused, evidence-based, time-sensitive, people-centred, country-owned and partnership-driven approach.

Methodology

The framework was developed through a collaborative effort involving WHO, the World Heart Federation (WHF), and the World Stroke Organization (WSO). It incorporated existing WHO guidelines and included input from various expert groups and stakeholders. The development process involved extensive consultation, feedback and revision to ensure the framework's scientific rigour and practical applicability.

Health systems approach

The framework outlines a comprehensive health systems approach, covering models of care, service packages, planning and the role of public health authorities. It emphasizes the importance of a continuum of care, from community awareness and prehospital care to acute hospital care, rehabilitation and ongoing management.

Components of care

Key components of care for ACS and stroke include:

- community awareness and symptom recognition – enhancing community knowledge about the signs and symptoms of ACS and stroke to ensure timely access to care;
- access to care – addressing barriers to timely care and implementing potential solutions;
- prehospital care – establishing protocols for the initial management of ACS and stroke;

- initial facility-based care – providing immediate and appropriate care in emergency units and outpatient settings;
- diagnosis and directed therapeutics – utilizing accurate diagnostic tools and effective therapeutic interventions;
- acute care in hospital – ensuring comprehensive care during hospital stays, including the availability of specialized stroke units;
- rehabilitation – offering multidisciplinary rehabilitation services to enhance recovery and quality of life post-ACS or stroke; and
- ongoing care – supporting long-term management and secondary prevention to reduce recurrence and improve patient outcomes.

Quality improvement

Implementing a quality-improvement approach is crucial for highlighting gaps in care and identifying strategies to address them. The framework advocates for the use of national and international registries to collect data on patient outcomes, facilitating continuous evaluation and improvement of care standards. Initiatives such as the WHO Global Hearts technical package provide standardized protocols to enhance cardiovascular health management.

Applying the framework

The framework serves as a high-level guide for regional and national strategic and operational plans, allowing for adaptation to local contexts and evolving circumstances. It calls for the integration of core principles and care components into health policies to achieve comprehensive and effective management of ACS and stroke.

This framework aims to empower health systems worldwide to effectively tackle the burden of ACS and stroke, ultimately improving health outcomes and quality of life for affected individuals.

1 Introduction

Cardiovascular diseases (CVDs) are the leading cause of death globally and account for an estimated 17.9 million deaths annually *(1)*. They constitute a group of disorders of the heart and blood vessels that includes ischaemic heart disease, cerebrovascular disease, rheumatic heart disease, heart failure and other cardiovascular conditions. More than four out of five CVD deaths are due to ischaemic heart disease and stroke, and one third of these deaths occur prematurely in people under 70 years of age *(1)*. Stroke is the second leading cause of death globally *(2)*.

Ischaemic heart disease and stroke are also among the leading causes of disability globally. In 2019, they were the top-ranked causes of disability adjusted life years (DALYs) in the age groups 50 to 74 years and 75 years and older *(3)*.

The mortality and disability burden translates into a huge economic cost and societal burden, especially in low- and middle-income countries (LMICs), where over three quarters of ischaemic heart disease and stroke occur.

Although the burden of ischaemic heart disease and stroke has declined in high-income countries since the 1980s, the rate of decline has slowed in recent years; in addition, the COVID-19 pandemic halted or reversed any decrease in burden of these conditions. In LMICs, the total mortality and morbidity burden of ischaemic heart disease and stroke has not declined at the same pace. Furthermore, the needs of services that address the loss of function related to ischaemic heart disease and stroke are often unmet *(4)*.

The public health approach to managing CVDs balances population-based prevention policies, treatment of intermediate risk factors such as hypertension, diabetes, dyslipidaemia and atrial fibrillation, care of acute conditions, long-term management of chronic conditions, and rehabilitation. This is supported by WHO's *Tackling NCDs: best buys and other recommended interventions for the prevention and control of noncommunicable diseases (5)*, which list interventions for prevention, treatment and rehabilitation that are both cost-effective and feasible to implement *(6)*.

This is further supported by various modelling activities which show that to achieve Sustainable Development Goals (SDG) target 3.4 by 2030 and reduce premature mortality from noncommunicable diseases by one third through prevention and treatment we need to focus on:

- heart attacks and strokes – early detection and integrated management of cardiovascular risk factors *(7, 8)*;
- deaths and disability from heart attacks and strokes – improving the quality of acute care, early rehabilitation and secondary prevention at discharge; and
- recurrent heart attacks and strokes and their complications – focusing on education, self-management, and secondary prevention, including long-term and community rehabilitation.

For the purposes of this document, we will define acute coronary syndrome (ACS) and stroke with reference to the ICD-11 Mortality and Morbidity Statistics database *(9)*.

The term ACS covers a spectrum of pathologies, and includes the conditions of unstable angina, ST elevation myocardial infarction (STEMI), non-ST elevation myocardial infarction (NSTEMI) and sudden cardiac death *(10)*. These are usually a result of atherosclerosis-related coronary heart disease causing a complete or partial blockage of coronary artery flow, the vessels responsible for supplying blood to the heart.

Stroke can be classified as ischaemic (caused by an interruption in blood supply to the brain) or haemorrhagic (caused by bleeding in the brain or in the space below the layers covering it) *(2)*. Ischaemic stroke is defined as acute focal neurological dysfunction caused by focal brain infarction, evidenced either by symptom duration lasting more than 24 hours or by neuroimaging or autopsy *(11)*. Haemorrhagic stroke is defined as acute focal or global neurological dysfunction caused by intracerebral haemorrhage or subarachnoid haemorrhage, evidenced either by symptom duration lasting more than 24 hours or by neuroimaging or autopsy *(2)*. Intracerebral haemorrhagic stroke is defined as acute neurological dysfunction caused by haemorrhage within the brain parenchyma or in the ventricular system. Subarachnoid haemorrhage is defined as acute neurological dysfunction caused by subarachnoid haemorrhage *(11)*. In some cases, where the pathology is unclear, the classification would be "stroke not known if ischaemic or haemorrhagic".

The core elements of the care of ACS and stroke are included in *Tackling NCDs (5)* and in the World Stroke Organization–Lancet Commission on Stroke "Pragmatic solutions to reduce the global burden of stroke" *(2)*, which also highlights cost-effective interventions. For ACS, although there are widely accepted treatment options, there is increasing evidence of sex, race and ethnic disparities in the presentation, risk factors and access to care. This highlights a need to address factors responsible for these disparities, including cultural, socioeconomic, educational, psychosocial factors and health system organization. The *Intersectoral global action plan on epilepsy and other neurological disorders 2022–2031 (12)* aims to improve access to care and includes actions to attain global targets through effective, timely and responsive prevention, diagnosis, treatment and care *(13)*. However, despite a growing awareness of brain health *(14)*, a recent survey indicated an urgent need to improve access to acute treatments, stroke unit care and rehabilitation services globally, especially in LMICs *(15)*.

Systems for monitoring and evaluation and for surveillance are essential to assess the quality and effectiveness of implemented programmes, identify the need for modifications and improvements, and make decisions regarding resource allocation. WHO defines quality of care as "the degree to which health services for individuals and populations increase the likelihood of desired health outcomes". Harmonization of measures is essential to permit comparisons of quality of care between individual units, regions and countries.

With this background, the focus of this framework will be on strengthening the care of patients with ACS and stroke.

2 Purpose, use and objective of the framework

The purpose of this document is to provide a framework that outlines what is most needed, from a health system perspective, for the strengthening of care of ACS and stroke, including describing a care continuum and highlighting underlying core principles. This will also serve to complement and support the implementation of interventions outlined in *Tackling NCDs (5)* and other associated WHO initiatives such as the *Intersectoral global action plan on epilepsy and other neurological disorders (12)* and the *Package of interventions for rehabilitation modules for cardiopulmonary conditions and neurological conditions (16, 17).*

This framework also provides direction for increased investment in the care of ACS and stroke, an important consideration as recent data suggests that the world is not on track to meet SDG target 3.4 *(18)*.

The main objectives of this framework are:

- to present a population-based, public health approach to the care of ACS and stroke;
- to provide guidance for strengthening national health systems to ensure efficient, effective and rapid response to ACS and stroke events;
- to outline clinical health care services to be provided to patients suffering ACS and stroke;
- to advocate for increased community awareness of symptoms and promotion of care-seeking behaviour for ACS and stroke;
- to complement interventions listed in *Tackling NCDs (5)*; and
- to advocate for prioritizing financial and other resources to strengthen health systems to manage emergency conditions such as ACS and stroke; and
- to mobilize increased domestic and international investment in this area.

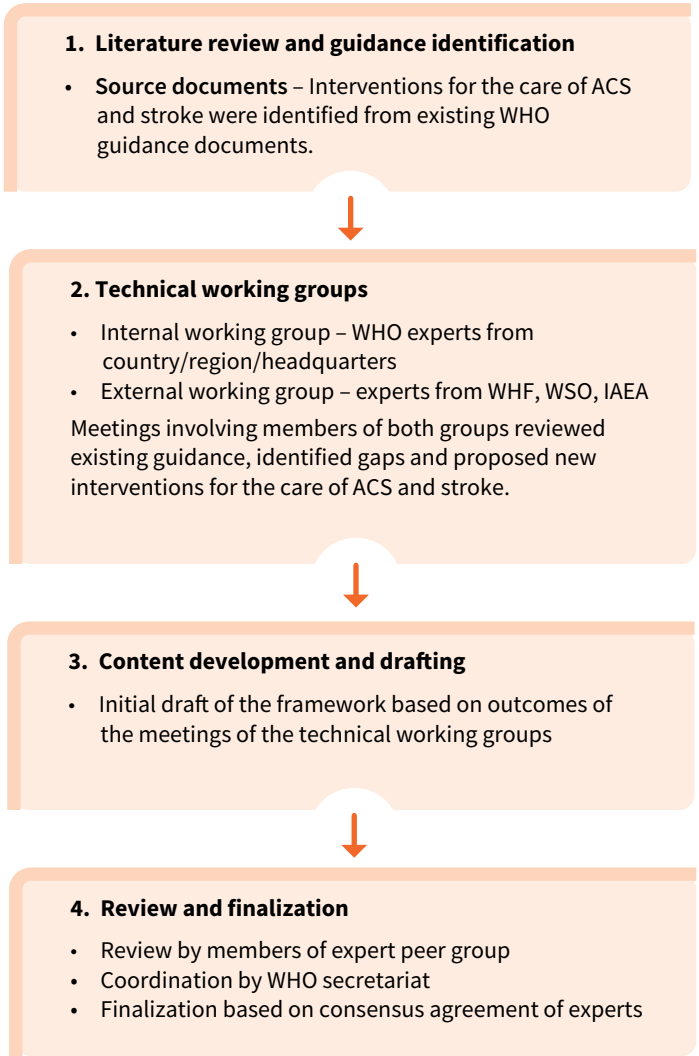
Ministries of health can use this framework to prioritize and implement critical interventions for ACS and stroke, while strengthening collaboration with communities and the private sector. This framework identifies the principles and models of the care continuum and core interventions, including medicines and diagnostics, for acute care and rehabilitation. It lays out the process by which countries can integrate these priorities and develop or strengthen their health systems, benefit packages and operational capacities. It also provides different options to assist in contextualization, and informs resource allocation by guiding decisions to ensure that financial investments support implementation. Each country's priorities will be different, depending on its own context and capacities. This framework is not a clinical guideline and is meant to be used in coordination with the clinical guidelines and recommendations in each country.

3 Methodology for developing the framework

This framework was developed by WHO in collaboration with two non-state actors, namely the World Heart Federation (WHF) and the World Stroke Organization (WSO).

To develop a comprehensive framework for the care of ACS and stroke, a scientific methodology was employed. For a summary of the steps involved see Fig. 3.1.

Fig. 3.1. Key steps in the methodology



The first step involved leveraging existing WHO guidelines, including *Tackling NCDs (5)*, the *Intersectoral global action plan on epilepsy and other neurological disorders (12)*, the *WHO list of priority medical devices for management of cardiovascular diseases and diabetes (19)* and

the modules relating to ischaemic heart disease and stroke in the *Package of interventions for rehabilitation (17, 16)*.

Three expert groups were convened (see Acknowledgements for details):

- an internal WHO group consisting of experts from all three levels of the organization (country, region and headquarters);
- an external working group consisting of content experts from the WHF and WSO, along with those from the International Atomic Energy Agency (IAEA) to advise on the use of technologies such as magnetic resonance imaging; and
- an external peer review group with content experts from academia and ministries of health.

Meetings were convened of two technical working groups in February and March 2023, facilitated by WHO and supported by WHF and WSO respectively. They were followed by further web consultations in July 2023 and February and April 2024. This informed the content and development of the framework. WHO provided organizational and logistical support to ensure productive discussions and comprehensive coverage of the topics.

The framework document was drafted with contributions from the internal and external working groups, ensuring a diverse and inclusive development process. It underwent a rigorous review process, encompassing feedback from a broad range of stakeholders, including experts in cardiology, neurology, rehabilitation and health care policy. WHO secretariat coordination included synthesizing feedback, making necessary revisions and ensuring that the document met the highest standards of scientific rigour and practical applicability. The final document was completed in agreement with a panel of experts, ensuring consensus on the proposed interventions and recommendations.

This systematic approach ensured that the resulting framework was comprehensive, evidence-based and aligned with global best practices for the care of ACS and stroke.

4 Goals, core principles and definitions

4.1. Goals

1. Provide a framework that countries can use to strengthen care of ACS and stroke.
2. Assist countries in reducing morbidity and premature mortality from CVDs (including stroke) as a contribution to achieving SDG target 3.4.

4.2. Core principles

A framework for the care of ACS and stroke should be:

Systems-focused – Strengthen health systems, utilizing a primary health care approach to achieve universal health coverage.

Evidence-based – Identify and prioritize best practices that are evidence-based, cost-effective and feasible to implement.

Time-sensitive – Facilitate rapid identification of, and care for, ACS and stroke to ensure favourable outcomes.

People-centred – Explore and define cultural understandings related to risk factors, acute signs and functioning limitations of ACS and stroke, and enable tailored, gender-responsive interventions to ensure high availability of, and equitable access to, information for individuals and communities. Advance advocacy and health literacy on ACS and stroke in the community. WHO has developed publications that draw on the lived experience of people with a range of conditions *(20)* and provide a model for therapeutic patient education *(21)*. The WHO Framework on integrated people-centred health services (IPCHS) advocates a shift to health systems designed for people *(22)*.

Country-owned – Improve ownership of efforts at the national and subnational levels to ensure that interventions, service delivery, indicators and milestones are prioritized and monitored for the delivery of care for ACS and stroke. Ensure that all stakeholders commit to and are held accountable for achieving agreed-upon goals, targets and milestones for ACS and stroke within national health plans.

Partnership-driven – Establish partnerships to maximize impact, accelerate progress towards shared goals, and promote sustainable delivery of interventions. Strengthen and expand existing partnerships, particularly at the local level, across organizations (particularly civil society organizations), the private sector (corporate and private service providers), academics and people with lived experience *(20, 21, 22)*.

4.3. Definitions

We have based this framework on the following definitions, taken from the International Classification of Diseases 11th Revision *(9)*.

Acute coronary syndrome (ACS) includes the following entities:

- **BA4Z Acute ischaemic heart disease, unspecified**
- **BA6Z Ischaemic heart diseases, unspecified**
- **BA40.0 Unstable angin**a: A type of angina pectoris that is irregular. It is also classified as a type of acute coronary syndrome.
- **BA41.0 Acute ST elevation myocardial infarction (STEMI)**: an acute myocardial infarction with developing ST elevation in two contiguous leads of the electrocardiogram. The criteria of ST elevation are as follows: new ST elevation at the J point in two contiguous leads where these cut points apply: 0.2mV in men > 40 years, > 0.25mV in men < 40 years, and > 0.15 mV in women *(23)*.
- **BA41.1 Acute non-ST elevation myocardial infarction**
- **BA41.Z Acute myocardial infarction, unspecified**

Stroke, as defined in this publication, includes the following acute conditions:

- **8B00 Intracerebral haemorrhage**: Acute neurological dysfunction caused by haemorrhage within the brain parenchyma or in the ventricular system
- **8B01 Subarachnoid haemorrhage**: Acute neurological dysfunction caused by subarachnoid haemorrhage
- **8B11 Cerebral ischaemic stroke**: Acute focal neurological dysfunction caused by focal infarction at single or multiple sites of the brain. Evidence of acute infarction may come either from a) symptom duration lasting more than 24 hours, or b) neuroimaging or other technique in the clinically relevant area of the brain. The term does not include infarction of the retina.
- **8B20 Stroke not known if ischaemic or haemorrhagic**: Fulfils criteria for stroke in acute symptoms of focal brain injury that have lasted 24 hours or more (or led to death before 24 hours), but subtype of stroke (ischaemic or haemorrhagic) has not been determined by neuroimaging or other techniques.

5 The health system approach

5.1. Models of care

WHO defines models of care as "a conceptualization and operationalization of how services are delivered, including the processes of care, organization of providers and management of services, supported by the identification of roles and responsibilities of different platforms and providers along the pathways of care" *(24)*. As ACS and stroke cause a high burden of death and disability, and are extremely time-sensitive conditions, planners should ensure that they explicitly address ACS and stroke in their health system's model of care.

Examples of models of care that are oriented to cardiovascular patients include systems that group specialized services in designated hospitals, such as stroke and coronary units. Within these systems, there should be established treatment protocols and clinical pathways for patient transfer, referral and counter-referral. Establishing networks involving prehospital care, emergency units, non-specialized and specialized centres is essential for efficient and coordinated care for ACS and stroke patients. These networks should aim to minimize treatment delays and facilitate appropriate patient transfer to specialized centres when indicated.

5.2. Service packages and planning

Well-planned and designed national health service packages that promote progress towards universal health coverage and quality are a critical component of a model of care. Service-delivery packages make explicit the choices governments have made regarding which services are available at which level of the health system. Furthermore, choices regarding which package to offer directly inform human resource requirements, medication and equipment needs, and referral pathways.

WHO encourages countries to explicitly define their national health service delivery packages at all levels of the health care system. Care for patients with ACS and stroke can benefit from explicit, well-designed national health service packages, and these service packages can then inform specifically designed pathways of care (see Box 1).

Box 1. Framework and roadmap for care systems for ACS and stroke in Kyrgyzstan

The Service Framework and Roadmap for the Development of Care Systems for Heart Attack and Stroke in Kyrgyzstan (CVD-RM) *(25)* was developed in 2018–2019, based on a situation analysis. Its design was coordinated by the WHO Regional Office for Europe and the WHO country office to create and transform existing networks and CVD systems of care in Kyrgyzstan by updating and implementing clinical guidelines, using resources more effectively, and improving infrastructure and performance management.

The roadmap proposes ways of strengthening care for coronary heart disease and cerebrovascular disease through health system interventions. Results were monitored through snapshot audits (2019–2023) conducted in regional public hospitals and private services (seven regions and the capital Bishkek) that measured infrastructure and process indicators.

Significant results were obtained. For example, the number of ACS patients who received treatment that followed the relevant guideline increased from 43.5% (2018) to 72.9% (2023) *(26)*. Concerning stroke, Fast test campaigns resulted in an increase in the availability of neuroimaging in public hospitals from 0% to 66.2%. Use of the nursing protocol that focuses on fever, blood-sugar levels and swallowing (FeSS) increased from 11% to 100% *(27)*.

Periodic situation analysis allowed stroke care in Kyrgyzstan to be monitored and transformed. The roadmap drove improvement in CVD care and could be considered as an effective model for other lower middle-income countries.

5.3. The role of public health authorities

Public health authorities play a crucial role in coordinating emergency care at the regional level, forming policies and providing a platform for the interaction of various participants within regional care systems, including ambulance services, inpatient and outpatient facilities.

Their responsibilities encompass developing and implementing standardized protocols for the rapid identification, triage and treatment of ACS and stroke patients. By facilitating communication and collaboration among emergency medical services, hospitals and rehabilitation centres, public health authorities ensure a seamless continuum of care.

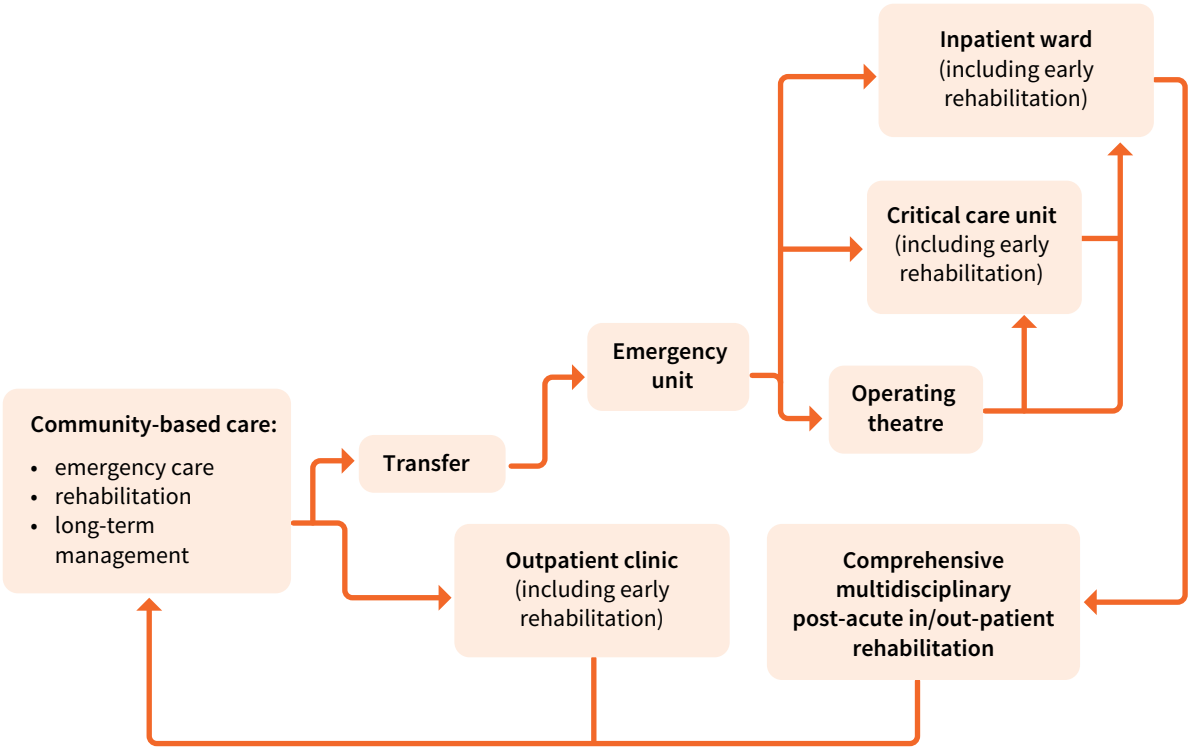
Public health authorities also establish quality control mechanisms and performance metrics to monitor and evaluate the effectiveness of the care provided. This coordinated approach enables the timely and efficient delivery of life-saving interventions, reduces variability in patient outcomes, and promotes adherence to evidence-based practices. Moreover, public health authorities are instrumental in policy formation, guiding the allocation of resources and supporting continuous professional development for health care providers.

By fostering an integrated and responsive regional care network, public health authorities enhance the overall efficiency and quality of ACS and stroke care, ultimately improving patient survival and recovery rates.

5.4. The care continuum

A well-designed model of care is supported by care pathways for certain tracer conditions. Due to their high burden of death and disability, ACS and stroke are important tracer conditions for health systems to address. Fig. 5.1 provides a care continuum model for ACS and stroke from symptom recognition and community awareness through outpatient follow-up care and rehabilitation services.

Fig. 5.1 Continuum of care for ACS and stroke



Acute care pathways can be applied to both ACS and stroke, as shown in Tables 5.1 to 5.8.

Table 5.1 Community-based care

Primary function	Component
Home assessment and treatment in acute phase	Patient self-assessment, including early recognition of danger signs by care providers (family members or caregivers) Self-administered intervention for acute process on practitioner guidance Home visit from community health worker or community first aid responder Home-based telemedicine encounter, including telephone triage

Community-based emergency care	System activation Community-based first aid Dispatch of personnel and instructions to bystanders Prehospital practitioner assessment and resuscitation Field-to-facility communication and destination triage
Community-based long-term care	Self-care interventions (including symptom management) and palliation Health-provider home visit, including rehabilitation

Table 5.2 Transfer from community to facility or between facilities

Primary function	Component
Patient transport	Transport of patient to facility or between facilities
Transport care	Isolation and IPC measures for high-risk syndromes [a] Positioning, monitoring, interventions

[a] IPC and isolation for high-risk syndromes included for first contact locations. Routine IPC is included in cross-cutting capacities as functionally necessary for basic service delivery.

Table 5.3 Outpatient clinic

Primary function	Component
Reception	Screening based on standard case definition Recognition of danger signs and transfer planning Isolation and IPC measures for high-risk syndromes [a] Registration
Assessment and treatment	Initial clinical assessment and early recognition Identification and urgent addressing of clinical needs Detailed clinical assessment, including severity classification and identification of risk factors Determination and execution of appropriate diagnostics Execution of additional diagnostics for risk stratification, identification of complications and differential diagnosis of other conditions Administration of empiric therapeutics Symptom management and palliation
Disposition	Early rehabilitation for critical illness Exit management, including follow up/referral and indications for care seeking Communication of care plan to patient and caregivers

[a] IPC and isolation for high-risk syndromes included for first contact locations. Routine IPC is included in cross-cutting capacities as functionally necessary for basic service delivery.

Table 5.4 Emergency unit

Primary function	Component
Reception	Handover Screening based on standard case definition Triage using validated tool Isolation and IPC measures for high-risk syndromes [a] Registration
Assessment and treatment	Initial assessment and resuscitation Monitoring and re-evaluation Detailed clinical assessment, including severity classification and identification of risk factors Execution of appropriate diagnostics Execution of additional diagnostics for risk stratification, identification of complications and differential diagnosis of other conditions Administration of empiric therapeutics Symptom management and palliation Additional therapeutics Establishment of (provisional or definitive) diagnoses
Disposition	Exit management, including follow up/referral and indications for care seeking Communication of care plan to patient and caregivers

[a] IPC and isolation for high-risk syndromes included for first contact locations. Routine IPC is included in cross-cutting capacities as functionally necessary for basic service delivery.

Table 5.5 Operating theatre

Primary function	Component
Assessment and treatment	Preoperative evaluation Maintenance of sterile field Frequent-to-continuous monitoring and re-evaluation Ongoing support for basic physiologic functions Pain control and maintenance of anaesthesia Administration of empiric antibiotics to prevent surgical infection Execution of intraoperative diagnostics Exploratory procedures for establishing diagnosis Targeted procedures for definitive care Postoperative monitoring and re-evaluation
Disposition	Communication of care plan to patient and caregivers Postoperative transfer and follow-up planning

Table 5.6 Critical care unit

Primary function	Component
Assessment and treatment	Detailed clinical assessment Frequent-to-continuous monitoring and re-evaluation Ongoing support for basic physiologic functions Execution of additional diagnostics for risk stratification, identification of complications and differential diagnosis of other conditions Administration of targeted therapeutics Reassessment of severity to determine eligibility for advanced therapeutics Symptom management and palliation Additional therapeutics Development of detailed prognosis-based care plan (goals of care and transition to post critical care) Coordination of specialist services for multisystem illness Provision of early rehabilitation
Disposition	Step-down transfer and follow-up planning Communication of care plan to patient and caregivers

Table 5.7 Inpatient ward

Primary function	**Component**
Assessment and treatment	Intermittent monitoring and re-evaluation Detailed clinical assessment, including severity classification and identification of risk factors Execution of additional diagnostics for risk stratification, identification of complications and differential diagnosis of other conditions Administration of targeted therapeutics Symptom management and palliation Additional therapeutics Establishment of ongoing treatment plan Establishment of definitive diagnoses Provision of early rehabilitation
Disposition	Exit management, including follow up/referral (including downward referral to primary health care) and indications for care seeking Communication of care plan to patient and caregivers

Table 5.8 Comprehensive multidisciplinary rehabilitation

Primary function	Component
Assessment and treatment	Comprehensive, multidisciplinary assessment of functioning Development of the individual rehabilitation plan (with involvement of the patient and caregivers) Provision of multidisciplinary rehabilitation Monitoring of rehabilitation outcomes
Disposition	Discharge management and referral to out-patient rehabilitation at primary care level (if needed) Communication of care plan to patient and caregivers

6 The components of care of ACS and stroke

The previous section details the continuum of care. In this section we provide more details of the specific care required for ACS and for stroke, including chronic care and rehabilitation (Fig. 6.1).

Fig. 6.1 Components of care for ACS and stroke

ACS	Stroke
Community awareness	
Recognition of symptoms by individuals, caregivers, or families Emergency call	
Initial care Pre-hospital or on presentation at primary health care centre	
■ Triage ■ Stabilization of airway, breathing and circulatory problems ■ Administration, as appropriate, of: ○ oxygen ○ IV fluids ○ oral aspirin ○ glyceryl trinitrate ■ Obtain electrocardiogram (ECG), but only if it doesn't delay referral	■ Triage ■ Stabilization of airway, breathing and circulatory problems ■ Blood-glucose check (to rule out hypoglycaemia) ■ Administration of glucose to correct hypoglycaemia (after checking blood-glucose levels) ■ Use of stroke-identification instrument
A well-designed network of care can help outpatient providers to refer patients with suspected ACS or stroke to an appropriate facility/hospital Triage and pre-notification of patient's arrival at hospital is important	
Diagnosis in hospital	
■ Triage ■ Emergency evaluation and stabilization, as above ■ 12-lead ECG immediately on arrival ■ Additional history and diagnostics to confirm diagnosis of ACS	■ Triage ■ Emergency evaluation and stabilization, as above ■ CT or MRI scan of the brain ■ CT angiogram
Acute care	
■ For STEMI, reperfusion therapy: ○ fibrinolytic drugs ○ percutaneous coronary intervention (PCI) ■ Immediate neurological assessment by stroke team or specialist	■ For cerebral ischaemic stroke, reperfusion therapy: ○ intravenous thrombolytic therapy ○ mechanical thrombectomy, if appropriate ○ immediate neurological assessment by stroke team or specialist

Inpatient care	
■ Components of care: ○ cohorting ○ monitoring ○ secondary prevention, including medication ○ early mobilization ○ discharge planning	■ Components of care (ideally in a stroke unit): ○ cohorting ○ monitoring ○ investigations for risk factors ○ prevention and early identification of complications (e.g. aspiration pneumonia, deep venous thrombosis) ○ early rehabilitation ○ secondary prevention, including medication ○ discharge planning
Post-acute and long-term care	
Continue with specialized, comprehensive in- or outpatient rehabilitation (physical, speech, cognitive) Monitor medications (antihypertensives, statins, antithrombotics) Long-term rehabilitation (outpatient) Continue addressing modifiable risk factors such as smoking, alcohol consumption, unhealthy diet Monitor mental state of patient and provide therapy or medication if necessary	
Quality control	
Data collection Benchmarking Continuous improvement	

6.1. Community awareness and recognition of symptoms and signs

In order to appropriately seek care promptly, patients must recognize the symptoms and signs of ACS and stroke, and know how to access the health care system. Community awareness campaigns can assist with both of these factors. Those in contact with people at high risk of CVD and with a previous history of ischaemic heart disease and stroke need special attention and training in the early recognition of symptoms and signs and in how to activate the response cascade.

6.1.1 Symptom recognition for ACS

Classically, ACS is described as presenting with acute, persistent chest discomfort, which may be described as pain, pressure, squeezing, heaviness, burning or tightness in the chest, shoulders, arms, neck, back, upper abdomen or jaw. The pain is usually deep, difficult to localize, and diffuse. Patients may describe additional symptoms such as nausea, shortness of breath, sweating, fatigue, palpitations and syncope, all of which should be considered chest-pain equivalents *(28)*. However, symptoms may vary at time of presentation due to delays in seeking care; patients may present with cardiogenic shock, cardiac arrest, or may be pain free. Additionally, many patients, such as women, those of certain ethnicities, and patients with chronic disease, will not experience these "classic" ACS symptoms. For example, the clinical presentation of ACS in women may include pain

in the upper limb(s), palpitations, dyspnoea, nausea and vomiting or simply fatigue *(29)*. In order to ensure that people seek appropriate care in a timely manner, the public must be aware of the full range of possible presentations of ACS.

6.1.2 Symptom recognition for stroke

Early stroke symptom recognition is vital for prompt medical attention, yet public awareness of the symptoms of stroke is low. This lack of awareness leads to delays in seeking care and contributes to disparities in stroke outcomes. Poor public awareness of stroke is exacerbated by various misconceptions, including the confusion with heart attacks, the misconception that it exclusively impacts older individuals, the belief that it cannot be prevented, and the notion that there is no therapy available during the acute phase.

Dispelling these myths is crucial for symptom recognition and timely presentation in order to improve outcomes. Targeted stroke education campaigns, taking into consideration variations in age, sex and racial/ethnic background, are necessary for maximum effectiveness *(30)*. Community awareness campaigns effectively increase stroke recognition and the use of emergency services, thereby reducing response time *(31)*. These campaigns (Box 2, Box 3) involve diverse strategies, such as education, collaboration with health care professionals, cultural sensitivity, and partnerships with schools and workplaces, all of which can have a significant public health impact *(32)*. The "Balance, Eyes, Face, Arm, Speech, Time (BE-FAST)" acronym can help to improve early recognition and presentation of stroke *(33)*.

Box 2. FAST Heroes initiative

The FAST Heroes initiative is a global stroke awareness campaign aimed at educating children about the signs of stroke and empowering them to act and call the ambulance if they or someone they know experiences a stroke *(34)*. It was launched in 2019 by the Angels Initiative together with World Stroke Organization (WSO).

The campaign harnesses children's enthusiasm for learning, encouraging them to share the knowledge they gain with their loved ones, particularly their grandparents.

The initiative includes educational materials such as videos, comic books, and interactive games that are available in multiple languages and can be accessed online. The campaign also provides resources for teachers and parents to help them incorporate stroke awareness into their lessons and conversations with children.

Studies showed knowledge about stroke transferred well from children to their families through the FAST Heroes approach, and that the knowledge was retained by the parents six months after completion of the programme by their children *(35)*.

Box 3. Educational intervention on stroke, Ghana and Nigeria

A recently published pilot randomized controlled trial (RCT) on educational intervention (consisting of a stroke educational video and a stroke riskometer) for Primary Stroke Risk Reduction in Ghana and Nigeria showed a reduction in stroke risk score and improvement in stroke risk awareness at two months *(36)*.

In another RCT in Nigeria, an intervention consisted of 30-minute health talks on stroke and distribution of fliers. A pre- and post-assessment was done, revealing higher mean scores on knowledge of stroke and its risk factors among the intervention group than seen in the control group *(37)*.

However, the impact on actual improvement in identification and control of risk factors and early stroke recognition needs to be systematically studied.

6.2. Access to care

Even if the community accurately interprets symptoms of ACS and stroke, in order to receive timely care patients must be able to access health care. There are several key components of appropriate access *(38)*. To facilitate access, a health care system should have a toll-free universal access number that patients can call to activate response; they should also receive live instructions from a trained call taker. Ideally, there should be staffed and equipped ambulances available to transport patients to a hospital, and a well-organized health care network to direct ambulances to the most appropriate facility (see 5.1 Models of care). In many settings, some or all of these components are missing, and patients may face barriers to accessing care.

6.2.1 Barriers to timely care and potential solutions

Reperfusion of acute coronary or cerebral artery occlusion is time-sensitive, and several barriers can hinder optimal care provision. Barriers can be categorized as delays in recognition of symptoms and signs, followed by delay in deciding to seek care, delays in identifying and reaching a health care facility, and delays in receiving appropriate treatment. These barriers may be related to the patient, the health care system or the health care provider, and will vary between health care settings and regions *(39).*

Patient-related barriers predominantly relate to delayed presentation owing to inadequate awareness of symptoms and lack of urgency in presentation *(40*, *41)*. Factors contributing to delays in presentation for ACS include poor education and lack of training, and the patient being female, having diabetes or being from a lower socioeconomic group. Poor health literacy and, occasionally, mistrust of health care systems may additionally lead to delays in consent for timely reperfusion, refusal of invasive therapies and non-adherence to prescribed medical therapies, leading to poor outcomes *(42, 43)*. Individual educational, financial or socioeconomic barriers hinder access to care in certain health care systems. Effective strategies to minimize patient delays include training and education of high-risk people, efficient science communication via mass and social media, and personalized interventions, especially those that address behavioural consequences and psychological barriers and provide practical action plan considerations *(44)*.

Health care system-related barriers vary according to country or regional health care infrastructure and organization of health care networks, and to economic, sociodemographic, geographic and cultural aspects, which might lead to lack of availability and timely implementation of reperfusion therapy. With regard to prehospital emergency care, lack of a toll-free universal access number, an inadequate number of ambulances to meet population needs, lack of appropriately trained prehospital personnel and absence of clinical management guidelines might all affect access. Failures in early recognition, initial management, lack of medicines and diagnostics, and inappropriate referral are common barriers to access to quality care, whether at primary care or in first-level hospital settings. Absence of organized referral systems or protocols for acute care, in addition to the cost of care associated with non-universal health system coverage, are significant barriers to care *(45)*. Lack of access and availability of directed therapeutics such as fibrinolytics and specialized invasive procedures further limit access to timely care. The lack of local data regarding disease burden and demographics, and absence of specifically tailored, locally relevant, guidelines or protocols remain long-term health-system barriers *(45)*.

Provider-related barriers to care of ACS and stroke include inadequate training in early recognition and timely management protocols across teams, particularly at peripheral primary care facilities *(45)*. Implicit biases are an additional barrier, potentially resulting in delays in care for those who fall into certain demographic categories, such as women and younger patients *(46)*.

Effective solutions need to be tailored to tackle specific barriers to care of ACS and stroke *(47, 48, 49)*. They include:

- effective science communication and public awareness campaigns (where funding allows) via mass and social media to combat lack of knowledge of ACS and stroke symptoms, fear and misconceptions about hospital treatment and misconceptions about risk (e.g. that women and younger patients are always at very low risk of ACS and stroke) *(50)*;
- ensuring equitable access to reperfusion therapies: national policies on health care systems to prioritize health care spending on acute cardiovascular and stroke care, legislature for universal pricing of specialty care devices such as coronary stents, decentralization of infrastructure and health care with provision for computed tomography (CT) and catheterization laboratories, collaboration between health care providers, policy-makers, community stakeholders;
- improvements in prehospital care, education of emergency medical services personnel and cost-effective approaches to timely care;
- utilization of digital health platforms, telemedicine and teleconsultation (e.g. virtual emergency units) to enable rapid diagnosis of STEMI, to review ECGs in ambulances and primary care facilities, provide fibrinolysis and transfer to centres equipped to provide PCI (Box 4) *(51, 52, 553)*; and
- establishment of regional networks that involve the coordination of emergency medical services, emergency units and specialized cardiac and stroke centres to facilitate timely transfer of people with ACS and stroke, such as a hub and spoke model *(50)*.

Any policy-level interventions to improve symptom-to-reperfusion times should be tailored to the specific needs of the region or sub-region in which they will be implemented. This is because of

differences in symptom-to-presentation times between countries and even within regions in large countries. Therefore, the first step in any programme should be to determine the current process measures for each region. The primary policy interventions can then be tailored to needs.

Box 4. Latin America Telemedicine Infarct Network (LATIN)

The Latin America Telemedicine Network (LATIN), provides an umbrella of acute myocardial infarction care to almost 100 million inhabitants in 355 centres in four countries (Argentina, Brazil, Colombia and Mexico) *(53)*. Most regions lack a central ambulance system, but LATIN provides a "hub and spoke" platform, which enables patients to be triaged at remote primary health care centres and small clinics (spokes) through three telemedicine command sites (hubs), which provide 24/7 teleconsultation and interpretation of ECGs.

A total of 780 234 patients in 313 spokes were screened, with expert telemedicine diagnosis of 8395 (1.1%) STEMI cases, of which 46.1% were urgently treated at 47 hubs and 78% reperfused with PCI. Delays in diagnosis were reduced, with time-to-telemedicine diagnosis averaging 3.5 minutes, and improvement of average door-to-balloon time from 120 to 48 minutes during the study period. STEMI mortality was 5.2%.

6.3. Prehospital care

After accessing the health care system through a toll-free universal access number, the next component of the care continuum should be prehospital care. Ideally, this would be delivered by providers who have been trained in prehospital clinical care. Trained prehospital providers can perform basic lifesaving stabilization, make presumptive diagnoses and, if operating in a system with established referral pathways, can transport patients to the most appropriate hospital for their condition. Destination triage is particularly important for ACS and stroke, as certain health care systems may have only a limited number of hospitals with a full range of directed therapeutics. Formal prehospital systems also allow for notification of the impending arrival at hospital of these time-sensitive patients. This allows receiving hospitals to prepare for the arrival of the patient by arranging for the appropriate clinical staff, diagnostic imaging and therapeutics to be available.

In many areas of the world, there are limited formal prehospital services. In such places, there may be community-based prehospital care. Although community first-responders can provide a much more limited range of clinical services and do not necessarily have transport capabilities, with training they can recognize symptoms concerning for ACS and stroke, and assist patients to access the health care system.

6.3.1 Prehospital care for ACS

All prehospital clinical care should begin with stabilization of airway, breathing, and circulatory problems. For ACS, this may include the administration of oxygen for hypoxemia or intravenous (IV) fluids for hypotension. Once a prehospital provider identifies that a patient's symptoms are concerning for ACS, they may administer low-dose oral aspirin and glyceryl trinitrate if local protocols allow. If the provider is trained in ECG provision and interpretation, a prehospital ECG may

assist in appropriate destination triage, as patients with ECG findings suggestive of ischaemia may be prioritized for certain hospitals. Local referral pathways can assist with appropriate destination triage for patients with suspected ACS.

6.3.2 Prehospital care for stroke

In a similar manner to that for ACS, prehospital clinical care for stroke should begin with stabilization of airway, breathing and circulatory problems. When assessing for disability, it is crucial to check blood glucose as hypoglycaemia may mimic stroke. If the patient is found to be hypoglycaemic, glucose should be provided. Prehospital providers should also be aware of other stroke mimics, such as seizure, drug overdose and trauma. Several stroke-identification instruments have been developed and validated that enable dispatch centres to prioritize prehospital services and help prehospital providers notify receiving hospitals about patients with suspected stroke.

As with ACS, it is also beneficial to develop referral pathways for patients with suspected stroke. For instance, certain systems may recommend that patients with suspected stroke be transported to the nearest hospital with CT and thrombolytic capabilities. In more resourced settings, referral pathways may also take endovascular therapy capabilities into consideration, although this is not applicable in many parts of the world.

6.4. Initial facility-based care

Whether a patient is transported by a trained prehospital provider or self-presents, the initial evaluation of all patients must include assessment and stabilization of immediate threats to life. All patients must have their airway, breathing and circulation assessed, as well as undergoing a disability assessment. There may be limitations in the initial management of the patient, depending on the health care facility; there will be more equipment available to resuscitate a patient in an emergency unit than in a primary care facility. Regardless, a systematic approach ensures that all threats to life are rapidly identified and addressed, and allows for timely diagnosis and definitive management.

6.4.1 Emergency unit care

On arrival at the emergency unit, all patients should have their airway, breathing and circulation assessed. Any immediate life threats must be identified and addressed. This might include basic or advanced airway management for patients with airway compromise, oxygen administration for hypoxemia, and IV fluids for hypotension. A disability assessment must include obtaining a blood glucose level for any patient with altered mental status or signs of stroke. If hypoglycaemic, glucose must immediately be given.

Emergency unit care for ACS

After addressing immediate life threats, initial emergency unit care for suspected ACS must include an ECG. ECG is pivotal in the evaluation because of its capacity to rapidly identify STEMI for urgent coronary reperfusion. A 12-lead ECG should be acquired within 10 minutes of first medical contact *(54)* and interpreted by a trained provider. Even if an ECG was performed in the prehospital setting, it should be repeated on arrival at the emergency unit.

If patients have not received low-dose oral aspirin in the prehospital setting, it should be given at this time. For patients with severe hypertension, medication may be required to maintain blood pressure in the recommended window.

Other important care considerations in the unit include pain management with glyceryl trinitrate and other medications as needed, and additional history and diagnostics to establish the diagnosis of ACS and rule out other causes of symptoms.

Emergency unit care for stroke

After addressing immediate life threats and assessing for hypoglycaemia, patients must have a detailed neurological assessment and brain CT or MRI scan to establish the diagnosis of stroke. It is critical that health care providers be aware of stroke mimics such as hypoglycaemia, hyperglycaemia, seizure, migraine headaches, overdose and trauma, as well as stroke chameleon (stroke presenting with vague non-focal, non-specific symptoms such as headache).

For patients with severe hypertension, medication may be required to maintain blood pressure in the recommended window.

6.4.2 Outpatient care

Although best served in a hospital, many patients with ACS and stroke may present at outpatient or primary care facilities due to limited understanding of their symptoms or challenges in accessing the health care system. As best they can, outpatient providers should rapidly assess and address life threats. As in the emergency unit, they should obtain an ECG for patients with suspected ACS and a blood glucose level, brain CT or MRI scan for patients with suspected stroke, if these diagnostics are available. They should also be investigated for stroke risk factors including hypertension, obesity and dyslipidaemia. A well-designed model of care delivery and complementary referral pathways can assist outpatient providers in referring patients with suspected ACS or stroke to an appropriate hospital. In all instances of referral, the outpatient provider should give pre-arrival notification and send a report on the patient to the receiving hospital.

6.5. Diagnosis

6.5.1 Diagnosis of ACS

ACS includes the conditions of unstable angina, NSTEMI, STEMI, and sudden cardiac death *(10).* The most important tool in the diagnosis of ACS is the ECG, which can be used to rapidly identify STEMI for urgent coronary reperfusion. STEMIs require immediate treatment as they are usually caused by complete obstruction of a coronary artery, leading to myocardial ischaemia and death. A 12-lead ECG should be acquired within 10 minutes of first medical contact *(54)* and interpreted by a trained clinician. Patients with a history concerning for ACS, and an ECG showing ST elevation in at least two contiguous leads, are categorized as having a STEMI and are prioritized for emergency reperfusion *(10).*

If the initial ECG does not show signs of STEMI, it is recommended that additional ECGs are obtained (55). The diagnosis of STEMI can be supported through a telematics system if there is no-one with the capability to interpret the ECG interpretation locally *(56)*.

NSTEMI is used to define myocardial injury resulting from ischaemia that is not due to a complete blockage of a coronary artery. The diagnosis requires a focused history that includes characteristics and duration of symptoms, associated features and cardiovascular risk factors, physical examination, ECG and biomarkers *(57).* In many settings, NSTEMI is diagnosed by a combination of symptoms concerning for ACS, an ECG that does not show ST elevation (but may show other signs of ischaemia) and cardiac biomarkers that are rising and/or falling. High-resourced settings use troponin as the diagnostic cardiac biomarker, but other settings may use creatine kinase (CK), a subtype of creatine kinase (CK-MB) or others. Some sites may not be able to detect biomarkers and may rely on symptoms of ischaemia combined with ECG changes alone, such as persistent or transient ST depression or T-wave inversion *(10).*

Patients presenting with acute, worsening symptoms suggestive of myocardial ischaemia but who have normal biomarkers may be diagnosed as having unstable angina *(58)* .

6.5.2 Diagnosis of stroke

The diagnosis of stroke is centred on the medical history of acute onset and the physical neurological examination. An acute CT scan without contrast can be used to identify intracerebral and subarachnoid haemorrhage, whereas in a proportion of acute ischaemic strokes the ischaemic area will not be visualized. A CT scan can also rule out structural differential diagnoses such as subdural haematoma and brain tumour. Thrombolytics should never be administered to patients with suspected ischaemic stroke prior to obtaining a CT scan without contrast. If available, a CT angiogram may be useful for identifying large vessel occlusion. If a CT scan is not available at the current health facility, the patient should be referred to a higher-level care facility for further evaluation and treatment.

6.6. Directed therapeutics

Both STEMI and stroke represent acute artery occlusion with resultant ischaemia and tissue death, therefore reperfusion is incredibly time sensitive. The mainstay of reperfusion for both conditions worldwide is thrombolysis, although there are specific considerations for each condition. Thrombolysis involves the administration of IV thrombolytic medications, which help dissolve the blood clot, restoring flow in the ischaemic area. Thrombolysis can happen in different locations, depending on a health care system's model of care. In many health care systems, thrombolysis occurs in the emergency unit after assessment by a trained physician. In some systems, thrombolysis may occur in the prehospital setting in an attempt to decrease time-to-directed therapy but doing so without a prior CT scan when a patient presents with a suspected stroke is not recommended. In addition to thrombolysis, there are other modalities of directed therapeutics which may be used in certain health care systems.

6.6.1 Directed therapeutics for ACS

The early hours following the onset of symptoms in STEMI represent a crucial period during which prompt and well-coordinated care can significantly influence patient outcomes, mitigating disability and reducing mortality.

The key component of the service described in *Tackling NCDs (5)* is:

- treatment of new cases of acute myocardial infarction with: acetylsalicylic acid, or acetylsalicylic acid and thrombolysis, or acetylsalicylic acid, thrombolysis and clopidogrel, or primary percutaneous coronary interventions (PCI) initially treated in a hospital setting with follow up carried out through primary health care facilities at a 95% coverage rate.

Reperfusion therapy, which aims to restore blood flow to the ischaemic myocardium, is a cornerstone of STEMI management. Treatment is more effective when administered in the early hours following symptoms, ideally within the first two hours. Reducing delays from symptom onset to reperfusion with fibrinolysis or primary PCI is important to improve prognosis. In most countries, reperfusion for STEMI is best achieved by thrombolysis due to insufficient access to PCI-capable facilities. Thrombolysis should be administered once a STEMI is diagnosed, as long as the patient is presenting within 12 hours of symptom onset and does not have contraindications to thrombolysis.

For health care systems with PCI-capable facilities, patients should be transferred to a PCI-capable facility if PCI can be performed within 120 minutes of diagnosis. Reperfusion for STEMI using a primary PCI approach requires significant health care infrastructure (e.g. emergency medical services, cardiac catheterization laboratories) as well as a specialized and trained health professional team (e.g. paramedics, nurses, doctors, cardiologists, radiographers and cardiac technicians). As many countries may have PCI-capable facilities in only a few major cities, this emphasizes the need to have well established referral pathways for prehospital services to reference.

For people with NSTEMI and unstable angina, timely risk stratification using clinical evaluation and cardiac biomarkers (e.g. CK, CK-MB or troponin) is important to identify patients who are high-risk. An early invasive approach with coronary angiography in high-risk people with NSTEMI and unstable angina can improve prognosis, but this is not available in many parts of the world. Alongside reperfusion, people with ACS benefit from receiving antiplatelet agents, anticoagulants and adjunctive pharmacotherapies (see Section 6.7 Acute care in hospital) *(10).*

6.6.2 Directed therapeutics for stroke

There is a critical phase in which timely and well-organized stroke care can have a profound impact on patient outcomes, reducing disability and mortality *(59)*. The first few hours are a critical window that presents a unique opportunity to salvage viable cerebral tissue and avoid potential brain damage; immediate interventions can make a significant difference in the course of recovery.

Ischaemic stroke represents 62.4% of strokes, and reperfusion treatments such as thrombolysis and thrombectomy play a pivotal role in improving outcomes. Thrombolysis decreases disability in one-third of patients and increases the absolute percentage of individuals with minimal or no disability by 10% when administered within 4.5 hours of symptom onset *(60)*

As with thrombolysis for STEMI, it is critical to ensure that patients do not have contraindications to receiving thrombolysis when presenting with symptoms of an ischaemic stroke. One such contraindication is intracranial haemorrhage, which can present with similar symptoms to those of ischaemic stroke. In order to administer IV thrombolysis to patients presenting with symptoms of

ischaemic stroke, a facility must have access to a functioning CT scan at all hours of the day.

The efficacy of IV thrombolysis is a function of time: the earlier a stroke patient is treated, the greater the likelihood of a good recovery. Modelling of the potential health gains from extension of the treatment time window for tissue plasminogen activator (tPA) has demonstrated that a majority of the population gain substantially more from earlier awareness of symptoms and access to treatment – for example, through improved prehospital notification and better in-hospital efficiency – than by extending the treatment window from 3 to 4.5 hours.

Initiatives to optimize in-hospital procedures to achieve door-to-decision or door-to-needle times as low as 40 or even 20 minutes by introducing point-of-care laboratory test and streamlining procedures have been reported. However, even in those hospital systems with the shortest door-to-needle times, onset-to-needle times remained relatively long, and the majority of patients arrive outside the therapeutic window of 4.5 hours from onset to treatment due to long prehospital delays.

In order to achieve optimal reduction in onset-to-needle times, all steps of the stroke rescue chain need to be streamlined.

Mechanical thrombectomy is employed for more severe ischaemic strokes characterized by large vessel occlusion, which accounts for 30% to 40% of all strokes. It represents a more invasive procedure in which a catheter is used to physically remove the blood clot from a large occluded vessel, allowing the restoration of blood flow up to 24 hours from symptoms. Thrombectomy can increase the absolute percentage of individuals with functional independence by 19.5% in more severe strokes *(61)*. In both reperfusion therapies, the faster the vessel is opened, the better the functional outcome.

The key components of the services for acute ischaemic stroke described in Tackling NCDs *(5)* are:

- treatment of acute ischaemic stroke with intravenous thrombolytic therapy;
- treatment of acute ischaemic stroke with mechanical thrombectomy within an experienced facility;
- low-dose acetylsalicylic acid within 24 to 48 hours for secondary prevention of ischaemic stroke; and
- comprehensive care with a multidisciplinary team and access to equipment for monitoring and early rehabilitation in hospital of stroke patients in stroke units.

This applies even for patients who may be eligible for thrombectomy, since delays in initiation of IV thrombolytics may result in patients not receiving any reperfusion treatment associated with the benefit. Unlike the use of acute cardiac catheterization in STEMI cases, where the intention is to avoid fibrinolysis in patients eligible for primary PCI, stroke patients do not seem to be harmed by IV thrombolysis before thrombectomy.

6.7. Acute care in hospital

Patients presenting with ACS and stroke need further care in hospital wards after receiving resuscitation in the emergency unit and directed therapeutics. While smaller hospitals may care

for these patients in general medical wards, ideally ACS and stroke patients should be cared for in specialized units.

Specialized units for the management of acutely ill cardiovascular patients are closely related to in-hospital and long-term patient outcomes. In ACS patients, most adverse in-hospital events occur early after admission or initiation of treatment. Similarly, admitting stroke patients to specialized units reduces the risk of poor functional outcome by 23% and the risk of death or dependence by 25% *(62).*

6.7.1 Acute hospital care for ACS

Following reperfusion, all high-risk ACS patients (including all STEMI cases) should ideally be admitted to a specialized unit, where patients are cohorted, monitored and managed by a multidisciplinary team trained in the care of ACS. These specialized units serve as the primary site of care in that hospital for patients with ACS, and should have clinical staff providing continuous expertise in acute cardiovascular care *(10)*. Additionally, these units may have advanced monitoring capabilities, such as continuous ECG, if resources allow. What follows are the fundamental principles of care.

- **Cohorting**: Ideally, ACS patients should be placed in specialized cardiac units based on their required level of care. For patients requiring reperfusion therapy, these units should be critical care units, and may be designated as either coronary care, cardiac care or intensive cardiac care units, depending upon local/national designation/classification and capabilities. Some patients who do not require immediate reperfusion therapy and are haemodynamically stable may be admitted to general cardiac wards. Cohorting patients in specialized units allows provision of evidence-based strategies with appropriate staffing, expertise, diagnostic and intervention facilities to manage all aspects of ACS and its complications. Different levels of acuity and complexity have been defined and will vary according to local/national/regional requirements. Where patient acuity demands, this will require networking between centres/units to ensure patients receive the level of care their illness demands.
- **Monitoring**: Continuous ECG monitoring is recommended as soon as possible in all patients with ACS, to be continued for at least 24 hours *(63)*. This allows detection of life-threatening arrhythmias and prompt defibrillation, where indicated. Longer ECG monitoring may be required in patients with high-risk features such as STEMI, cardiac arrest, haemodynamic instability or cardiogenic shock, recurrent or refractory chest pain, arrhythmias and acute heart failure. In many hospitals, continuous monitoring may only be possible in a critical care unit. If a hospital does not have specialized cardiac units, ACS patients should be admitted to a critical care unit where they can have continuous monitoring. Duration of stay in the specialist units and the optimal length of hospital stay should be determined on an individual basis, according to the patient's known clinical and functional status.
- **Secondary prevention**: Secondary prevention medications, including antiplatelet therapy and statins, are recommended for all patients. Angiotensin-renin antagonist therapies and beta blockers are particularly recommended in people with impaired left ventricular function. Medication should start as early as possible after the index event, with the aim of enhancing prospective quality of life and decreasing morbidity and mortality *(64)*.

- **Early rehabilitation** (including early mobilization). This is recommended where there are no contraindications.

Barriers to provision of in-hospital care for ACS and potential solutions

There is wide variation in the provision of in-hospital care for ACS patients. Physiological monitoring is frequently impractical as it requires resources that are either unavailable or too expensive. Furthermore, maintaining operability of equipment presents challenges in terms of power supply, ambient temperature and humidity, availability of maintenance staff and replacement parts. A shortage of appropriately trained staff (including rehabilitation professionals), and limited infection prevention and control may result in increased complications. The cost of more intensive care may not be covered by health/insurance systems, limiting access to high-intensity care for the socioeconomically disadvantaged and uninsured.

Potential solutions to these barriers may involve the adoption of emerging technologies, including the implementation of low-cost wearable devices combined with artificial intelligence, additive manufacturing of devices/monitors, telemedicine, point-of-care imaging with remote review and remote education/training programmes for relevant health care staff *(65, 66).*

6.7.2 Acute hospital care for stroke

As with ACS, cohorting, monitoring and secondary prevention are key to in-patient management of patients with acute stoke.

Admitting stroke patients to dedicated stroke units facilitates specialized care provided by a multidisciplinary team. Such units are equipped to address the specific needs of stroke patients and have been associated with improved outcomes, reduced complications and better patient satisfaction *(5).*

Organized inpatient stroke care refers to specialized care provided to stroke patients in a hospital setting by a multidisciplinary team with expertise in stroke management. This approach has consistently shown benefits in improving outcomes for stroke patients, regardless of age, stroke severity, subtype, or the level of stroke unit care. It consists of two main components: the structural aspect, which involves the physical location of admission, and the multidisciplinary team, which includes physicians, nurses, physiotherapists, speech and language pathologists and nutritionists, among others.

The Stroke Unit Trialists' collaboration has established a hierarchical model for stroke units based on service organization *(52)*. This model includes the following categories:

- **Stroke ward**: This involves a dedicated multidisciplinary team caring exclusively for stroke patients in a discrete ward. It encompasses three subcategories.
    - Acute stroke units admit patients in the acute phase but discharge them early, typically within seven days. These units can be further classified as intensive (with continuous monitoring and life support), semi-intensive (with continuous monitoring but no life support), or non-intensive (lacking the aforementioned features).

- Rehabilitation stroke units admit patients after the acute phase (after three days or more) and focus on rehabilitation.
- Comprehensive stroke units provide both acute care and rehabilitation for several weeks, if necessary, for patients admitted in the acute phase.

- **Mixed rehabilitation ward**: In this model, a multidisciplinary team in a general ward provides a generic rehabilitation service but not exclusively for stroke patients.
- **Mobile stroke team**: This model involves a peripatetic multidisciplinary team (excluding specialist nursing staff) that provides care in various settings.
- **General medical ward**: Care in an acute medical or neurology ward without routine multidisciplinary input, which is not considered a stroke unit.

Evidence-based strategies should be implemented in stroke services, defined as hospitals with organization, structure and pathways for stroke patients *(67).*

Langhorne et al. *(59)* identified three approaches to delivering care to stroke patients:

1. assessment procedures (medical, nursing and therapy assessments);

2. early management policies (e.g. early mobilization, avoidance of urinary catheterization, treatment of hypoxia, hyperglycaemia and suspected infection); and

3. ongoing rehabilitation policies (e.g. coordinated multidisciplinary team care, early assessment for discharge).

These approaches are achieved through various components, including:

- vital signs monitoring, which encompasses:
  - airway and oxygenation management
  - monitoring of hypocapnia (low carbon dioxide levels)
  - rhythm monitoring
  - temperature monitoring
  - blood pressure management
  - monitoring and management of hypo- and hyperglycaemia;
- prevention and early identification of stroke complications, such as:
  - deep vein thrombosis (DVT) prevention (early mobilization, low molecular weight heparin)
  - dysphagia screening
  - seizure management
  - haemorrhage prevention
  - identification of malignant transformation; and
- early evaluation for rehabilitation and discharge planning, including referral to specialized post-acute rehabilitation care.

Patients who receive organized inpatient care in a stroke unit have a better chance of survival and of achieving independence one year after the stroke. These benefits are most evident in stroke units

based in a discrete ward. Organized in-patient stroke care reduces mortality across all age groups compared to treatment in a general medical ward. It also improves outcomes for both ischaemic and haemorrhagic stroke, with a higher organized care index associated with lower 30-day mortality. The improvement in outcomes is attributed to a reduction in stroke progression/recurrence and a decrease in complications related to immobility, such as infections and pressure sores *(52).*

Comparing various models of stroke unit care, it is evident that discrete stroke units have the greatest impact on reducing stroke-related mortality, followed by mixed rehab wards, when compared to general medical wards. Mobile stroke teams may provide multidisciplinary care but do not demonstrate a mortality benefit compared to care in a general ward.

Organized in-patient stroke care in the form of a stroke unit and a multidisciplinary team is clearly highly beneficial in reducing mortality and complications. In settings where establishing a fully equipped stroke unit is not feasible, a less well equipped, and even a minimally equipped, stroke unit with vital signs monitoring in a discrete unit by a dedicated team can be a reasonable alternative.

A nurse-led intervention that focuses on fever, blood-sugar levels and swallowing (FeSS) following a stroke was proven in the Quality in Acute Stroke Care (QASC) trial *(68)* to significantly reduce death and dependency following stroke. It is set of protocols that can be carried out in low-income countries.

6.7.3 Availability of stroke unit care

Based on a 2017 survey conducted by WHO, only 18% of 105 countries surveyed reported stroke units *(69)*. This study sheds light on the disparities between countries, revealing that the implementation rates of recommended interventions, including stroke units, tend to increase with higher income levels. The establishment of stroke units with a high organized-care index in low-income countries may face challenges due to financial constraints. Additionally, in LMICs, the presence of multidisciplinary stroke teams, which include various health care professionals such as physicians, nurses, physiotherapists, occupational therapists, speech and language pathologists and nutritionists, is lacking despite there being multiple health care professionals in these settings. These teams play a crucial role in enhancing the effectiveness of stroke units *(70)*.

While comparing stroke unit care across different settings can be difficult due to variations in available facilities, several studies *(71)* conducted in LMICs from different continents have demonstrated reduced mortality rates in patients treated in dedicated stroke wards compared to those receiving care in general wards.

The Tezpur model (Box 5) exemplifies the effectiveness of organized stroke care led by physicians in a resource-limited environment as it successfully reduced complication rates, shortened hospital stays, and improved adherence to guidelines *(72)*. Another study, conducted by Cisse et al. (Box 6), showcased that even a minimally equipped stroke unit with dedicated vital sign monitoring and a specialized team in a discrete three-bed unit significantly reduced stroke mortality and complications in a public hospital in sub-Saharan Africa *(73)*.

Box 5. Physician-based stroke unit, India

Setting: Baptist Christian Mission Hospital, Tezpur, Assam, India

Intervention: Implementation of organized in-patient stroke service with the following components:

- online training of local physicians by stroke experts;
- training of Stroke Team by the trained stroke physicians; and
- implementation of stroke care pathways pertaining to assessment and monitoring, acute care, multi-disciplinary team approach and discharge planning.

Results: When compared to the pre-intervention cohort, the post-intervention group had:

- higher rates of assessment for swallowing and mobility and of receiving education;
- lower rates of complications and a shorter length of stay in hospital; and
- no significant difference in functional outcomes at one month (possible reason being the small sample size).

Source: John et al. (72).

Box 6. Minimally equipped stroke unit, sub-Saharan Africa

Setting: Ignace Deen Public Referral Hospital, Conakry, Guinea

Intervention: Minimally equipped stroke unit with the following:

- three stroke beds, separated from neurology ward, with equipment for monitoring heart rate, blood pressure and blood oxygen saturation monitoring, and a portable oxygen concentrator;
- dedicated stroke team comprised of: five senior neurologists, eight trainee neurologists, seven nurses, three physiotherapists;
- patient evaluated every four hours for clinical parameters, body temperature and National Institutes of Health Stroke Scale (NIHSS) by the dedicated stroke team;
- standard procedures implemented for fever, pneumonia and prevention of complications of immobility.

Results: When compared to the pre-intervention cohort, the post-intervention group had:

- lower mortality;
- fewer medical complications (pneumonia, urinary tract infection and bed sores); and
- a trend for a higher modified ranking score in stroke survivors.

Source: Cisse et al. (73).

6.8. Rehabilitation

For patients with ACS and stroke, access to rehabilitation, including early rehabilitation during the acute phase, is essential. Ideally, early rehabilitation is already initiated during acute care and is integrated into acute care units, specifically in coronary and stroke units. For those with limitations in functioning after acute care, rehabilitation needs to continue in the post-acute phase to support people to achieve optimal levels of functioning.

Referral to specialized rehabilitation services is therefore essential. If such a service is not available, rehabilitation should be provided at the primary care level to try and ensure that the patient becomes as independent as possible in everyday activities, is able to participate in work, recreation and meaningful life roles such as taking care of their family.

For people with long-term limitations in functioning and disability, interventions for rehabilitation should be integrated into the ongoing care to maintain optimal levels of functioning and well-being but also to prevent secondary conditions. At any stage, rehabilitation needs to be tailored to an individual's needs, goals and preferences to ensure outcomes that are meaningful to the person in need.

6.8.1 Rehabilitation following ACS

In people who have experienced an acute coronary syndrome as a consequence of ischaemic heart disease, symptoms such as chest pain (angina pectoris), shortness of breath, general pain, feeling faint or nauseous often persist, despite treatment. This often leads to severe limitations in their capacity to perform physical activities, including meaningful activities such as work or social engagement, as well as to high levels of anxiety and depression and overall reduced well-being. Coping with the symptoms and related limitations in physical activities is often challenging. Treatment of the cause of the disease and related symptoms alone is not sufficient to support people to regain physical functioning, adjust to new treatments and change their lifestyle to prevent recurrent events.

Cardiac rehabilitation provides interventions to support people with cardiac diseases, including ischaemic heart disease, to improve cardiovascular health, achieve and maintain optimal functioning and independence, and to adjust to the consequences of the disease. As such, it addresses the comprehensive needs of people with ischaemic heart disease that go beyond physical functions. It is proven effective at achieving better health-related quality of life related to, amongst others, physical and social functioning and mental health *(74, 75)*. Furthermore, cardiac rehabilitation is effective at reducing mortality, preventing additional cardiac events and related hospitalization and, thus, helps to reduce health care costs *(74, 76)*. It is most effective if delivered along the continuum of care, from the acute, sub-acute and post-acute phase to the long-term (maintenance) care.

Table 6.1 provides a list of essential interventions for rehabilitation found in the *Package of interventions for rehabilitation: module 4: cardiopulmonary conditions (16)*.

Table 6.1 Essential interventions for rehabilitation in relation to ACS

Target of the intervention	Interventions
Cardiac functions (blood pressure)	Antihypertensive agents
Mental health and emotional distress (including catastrophizing, fear, avoidance behaviours)	Antidepressants (in people with moderate to severe depression) Psychological therapies (including cognitive behavioural therapy (CBT), stress-management training)
Motor functions and mobility (including fall prevention)	Muscle-strengthening exercises and balance training
	Provision and training in the use of assistive products for mobility
Exercise and fitness	Fitness training (including aerobic exercises)
Work and employment	Vocational counselling, training and support
Self-management and lifestyle	Education, advice and support for self-directed exercises, healthy lifestyle, and self-management
Carer and family needs	Carer and family training and support

Source: Package of interventions for rehabilitation: module 4: cardiopulmonary conditions (16).

6.8.2 Rehabilitation following stroke

Strokes have a profound impact on individuals, their families and communities. Stroke is one of the main causes of long-term disability and accounted for the highest nervous system DALYs in 2021 *(77)*. It also doubles the risk of dementia *(78)*. Strokes can cause impairment in perception, memory, language and communication, muscle power, muscle tone and motor control, and thus movement and mobility. Depending on the severity of these impairments following a stroke, people can experience limitations in their interactions with others, in their participation in meaningful activities, such as work and social life, and in their ability to care for themselves. Furthermore, one in three people with stroke are at risk of experiencing depression and anxiety in the year following the stroke *(79)*. As a consequence, quality of life following a stroke is often made lower by depression, lower functional status and, in more serious cases, paralysis *(80, 81)*.

Due to the chronic course of stroke, stroke survivors often require ongoing care, provided largely by informal carers. These carers face challenges that include stress, strain, financial burden, social isolation and bereavement in the event of the loss of loved ones. Caring for a person with stroke may therefore affect the carer's own health, well-being and social relationships.

Rehabilitation in stroke is progressive, dynamic and goal-orientated. It not only aims to achieve and maintain optimal levels of functioning in stroke survivors but also to prevent recurrent strokes. More specifically, it aims to enable people to reach their optimal physical, cognitive, emotional, communicative and social activity levels through addressing impairments related to spasticity,

upper and lower extremity dysfunction, shoulder and central pain, mobility/gait, dysphagia, vision and communication *(82)*. As stroke can cause continuing problems in subsequent years and decades, people living with stroke often need long-term access to rehabilitation services. Furthermore, rehabilitation aims to train and support carers and families by providing appropriate strategies to care for the person in need and for themselves.

Table 6.2 provides a list of essential interventions for rehabilitation found in section 1 of the *Package of interventions for rehabilitation: module 3: neurological conditions (17)*.

Table 6.2 Essential interventions for rehabilitation in relation to stroke

Target of the intervention	Interventions	
Treatment of primary conditions		
Cognitive functions	Cognitive training Provision and training in the use of assistive products for cognition	
Vision	Vision skills training	
Speech, language and communication	Speech and language therapy, communication skills training Provision and training in the use of assistive products for communication	
Swallowing	Swallowing therapy	
Pain	Neuropathic pain:	Medication: oral muscle relaxants, amitriptyline, duloxetine Transcutaneous electrical nerve stimulation
	Shoulder pain:	Analgesics: oral non-steroidal anti-inflammatory drugs (ibuprofen) or non-opioids (paracetamol) Range of motion exercises, pain-relieving positioning
Bowel and bladder functions	Medication: laxatives (for defecation), anticholinergics (for urination) Nutritional management (for defecation) Pelvic floor muscle strengthening exercises (with biofeedback) Bowel and bladder management skills training Provision and training in the use of incontinence products	
Oedema	Decongestive therapy (including range of motion exercises, retrograde massage, positioning, and provision and training in the use of products for compression therapy)	

Motor functions and mobility	Medicines for spasticity:	oral muscle relaxants (baclofen, tizanidine) chemodenervation (botulinum toxin)
	Range of motion exercises (for joint mobility and spasticity) Muscle-strengthening exercises Positioning (for spasticity and prevention of contractures) Balance, gait and mobility training Provision and training in the use of assistive products for mobility Constraint induced movement therapy (CIMT) and functioning training for hand and arm use	
Exercise and fitness	Fitness training	
Activities of daily living (ADL)	ADL training Modification of the home environment Provision and training in the use of assistive products for self-care	
Work and employment	Vocational counselling, training and support Modification of the workplace environment	
Community and social life	Participation-focused interventions such as self-help groups and community volunteers	
Self-management and lifestyle	Education, advice and support for self-directed exercises, healthy lifestyle, and self-management	
Carer and family needs	Carer and family training and support	
Prevention of secondary conditions		
Mental health (depression, anxiety) and emotional distress	Antidepressants (in people with moderate to severe depression) Psychological therapies (including cognitive behavioural therapy, stress management training) Physical exercise training	
Malnutrition	Nutritional management	

Source: Package of interventions for rehabilitation: module 3: neurological conditions (17).

6.8.3 Barriers to access to rehabilitation and potential solutions

Globally, there are substantial disparities in the access to rehabilitation for ischaemic heart disease and stroke at the different service delivery levels and in the quality of the rehabilitation services provided. While cardiac and stroke rehabilitation are well established in many high-income countries, the availability and utilization in LMICs is only limited *(83, 84, 85, 86, 87)*. If rehabilitation is available, the type of rehabilitation also varies and does not always address the comprehensive needs of people with ischaemic heart disease and stroke in LMICs. This contributes to the huge unmet needs for rehabilitation for people following ACS and stroke globally, but in LMICs specifically.

The barriers are often caused by lack of knowledge and awareness of the benefits of rehabilitation, lack of guidance or protocols on evidence-based interventions for rehabilitation, lack of a skilled rehabilitation workforce and lack of sufficiently equipped rehabilitation facilities and resources to finance rehabilitation in health systems *(83, 2)*. These gaps result in the low availability of specialized, multidisciplinary rehabilitation services that is particularly evident in LMICs.

To increase access to and utilization of rehabilitation for ischaemic heart disease and stroke, particularly in LMICs, the following approaches can be helpful:

- raising awareness of the need for and benefits of rehabilitation (e.g. advocacy for rehabilitation for ischaemic heart disease and stroke, rehabilitation to be included in the curricula for the training of health workers and rehabilitation professionals);
- development of national guidelines or protocols on evidence-based rehabilitation for ischaemic heart disease and stroke;
- development of models of care that integrate rehabilitation in the continuum of care and facilitate access to rehabilitation for ischaemic heart disease and stroke (e.g. structured referral pathways, provision of specialized multidisciplinary post-acute rehabilitation, provision of home-based rehabilitation, availability of telerehabilitation) and that are appropriate for the context. Specific consideration should be given to the access to rehabilitation at the primary care level to allow people in need to access rehabilitation close to their homes;
- strengthening of the rehabilitation workforce (e.g. develop training and adjust curricula for the multidisciplinary rehabilitation workforce, including rehabilitation physicians, physiotherapists, occupational and speech therapists, psychologists, nutritionists and nurses), using task-sharing/task shifting approaches to overcome workforce gaps; and
- ensuring adequate financing for rehabilitation through its inclusion in health benefit packages, including where countries develop essential packages for health services.

6.9. Ongoing care

After an acute period of hospitalization, patients with ACS and stroke may need ongoing care in the hospital. The duration of hospitalization should be based on individual patient needs. Ongoing monitoring and step-down require clear communication between units (internal or external). In some settings, selected patients may be transferred from a referral hospital back to their local hospital if they are still able to receive adequate monitoring and supervision. Structured protocols should be followed in order to guide referral, transfer and counter-referral.

Barriers to ongoing care for survivors of ACS and stroke are multifaceted, and significantly impact the management of CVD risk and rehabilitation outcomes. Primary health care, family doctors and nurses are essential in managing hypertension and other CVD risks, providing continuous, patient-centred care crucial for preventing recurrence. However, several barriers impede this process. The cost of medications remains a significant obstacle, often limiting patients' ability to adhere to prescribed treatment regimens. Additionally, there is frequently a lack of seamless information transfer between hospitals and primary care providers, hindering effective post-discharge management and continuity of care. This gap can result in suboptimal monitoring and adjustment

of treatment plans. Furthermore, insufficient integration and communication within the health care system often leads to fragmented care, which may lead to critical information regarding patient history, medication, and rehabilitation needs being lost or delayed. Addressing these barriers requires coordinated efforts to enhance communication pathways, ensure affordability and accessibility of medications, and strengthen the role of primary health care teams in the long-term management of hypertension and CVD risks. By overcoming these challenges, health care systems can improve the quality and effectiveness of ongoing care for ACS and stroke survivors, ultimately reducing the incidence of recurrent cardiovascular events.

6.9.1 Ongoing care following ACS

Established decision-making tools can be used to determine the length of the post-intervention hospital stay for a wide range of ACS patients.

Risk stratification can be assessed soon after presentation to optimize decision-making and enable initiation of evidence-based therapies. Where available, transthoracic echocardiography can determine left ventricular ejection fraction and identify any mechanical complications.

Secondary prevention

Appropriate medication, cardiac rehabilitation, and lifestyle modification can significantly reduce the incidence of repeat cardiovascular events and death. First-line therapies for secondary prevention are antiplatelet treatments (aspirin with or without P2Y12 receptor blockers), lipid lowering (statins with or without ezetimibe and other types of lipid-lowering medication, e.g. PCSK9 monoclonal antibodies), angiotensin converting enzyme (ACE) inhibitors or angiotensin receptor blockers (ARB) and beta blockers. There is some evidence that anti-inflammatory medications, including low-cost colchicine, reduce cardiovascular events in people with coronary artery disease. Evidence also supports the impact of influenza vaccination in reducing mortality and other major cardiovascular events. Cardiac rehabilitation involves a multifaceted programme of support, exercise and education, generally led by health professionals. Lifestyle modification should include assistance with smoking cessation (including behavioural support, pharmacotherapies and referral to smoking cessation programmes where available), and physical activity, diet and weight management *(88)*.

Outpatient care

Steps to facilitate access to primary care and optimize the hospital discharge process can improve the impact of secondary prevention interventions for ACS. These can include regular planned recall of patients, structured monitoring of risk factors and prescribing, patient education in primary care, and use of post-discharge care coordinators, decision support in electronic health records and automatic referral to cardiac rehabilitation during the hospital discharge process.

6.9.2 Ongoing care following stroke

Stroke has a great impact on the quality of life of a patient, and of their family and carers. Aside from physical disabilities, there may be psychological and cognitive impairments as stroke is one of the main causes of disability and doubles the risk of dementia *(89)*. Depression, lower functional status

and more serious paresis worsen quality of life following a stroke *(80, 81)*. Social relationships are a major determinant of quality of life for stroke patients, and family and support groups can therefore support recovery *(90)*. Components of rehabilitation for stroke are further expanded on and can be found listed in *Package of interventions for rehabilitation: module 3: neurological conditions (17)*, as well as the rehabilitation pillar of the WSO Lancet Commission on Stroke publication. This includes multidisciplinary rehabilitation services and use of assessment tools, such as the modified Rankin Scale, and quality-of-life scales to document the type, and monitor the severity of, disability and impairment *(2)*.

Life-after-stroke services

Life-after-stroke services provide a patient with an individualized stroke recovery plan. The extent and manner in which these are provided, and the physical and emotional support the patient receives, will have an impact on the patient's recovery.

Access to physical and language therapy, including psychological evaluation and intervention, will hasten the recovery process. A healthy lifestyle and prevention of stroke recurrence will decrease disability and mortality.

It is vital to plan for the patient to be reintegrated into the community and for them to regain as much independence as possible, thereby increasing their quality of life. Medication and physical therapies should be provided at no cost to patients and incorporated into universal health coverage packages.

The goals of life-after stroke services are therefore as follows:

- reduce stroke recurrence and hospital admissions;
- prevent and treat post stroke complications;
- empower family and caregivers to give proper care;
- improve physical and emotional wellbeing of patients;
- reintegrate into the community; and
- achieve better functional outcome and decreased mortality.

Typical problems encountered by stroke patients, possible interventions, frequently encountered barriers and proposed solutions can be found in the *World Stroke Organization Global Stroke Services Guidelines and Action Plan (91).*

7 Quality improvement

A quality improvement approach is needed to highlight existing gaps in care and identify strategies to address these gaps.

7.1. ACS registries

Quality improvement in acute cardiovascular disease is pivotal in reducing morbidity and mortality. Central to this are the development of quality metrics and national/international registries that systematically collect data on patients, interventions and outcomes. These registries form a robust foundation for evaluating current practice, identifying gaps in care and supporting implementing evidence-based interventions.

Quality metrics in ACS have evolved significantly over the past few decades. Initially, the focus was on the development of clinical guidelines and standards, such as those from the American College of Cardiology (ACC), the American Heart Association (AHA) and European Society of Cardiology (ESC), which aimed to standardize care for STEMI and NSTEMI. National and international registries, such as a Swedish web-based registry (Box 7), a national data registry in the United States of America (USA) (Box 8), an ESC-supported registry (Box 9) and a project collecting data on the management of myocardial infarction in United Kingdom of Great Britain and Northern Ireland (UK) (Box 10), provide structured frameworks for data collection and analysis. These registries track various performance metrics, including door-to-reperfusion time and adherence to medication protocols, critical to assessing and improving the quality of care.

The provision of data-driven insights helps identify gaps in care and drive evidence-based interventions. Indeed, the WHO and partners, including the WHF, WSO and others, have collaborated on the Global Hearts Initiative, which aims to improve cardiovascular health, and includes the HEARTS technical package *(92)*, providing standardized protocols for managing cardiovascular risk factors and acute cardiac events. The package emphasizes the importance of data collection and analysis in the improvement of quality of care.

Box 7. SWEDEHEART, Sweden

Established in 2009, SWEDEHEART (Swedish Web-system for Enhancement and Development of Evidence-based care in Heart disease Evaluated According to Recommended Therapies) is a comprehensive national registry that collects data on patients with ACS and those undergoing PCIs. SWEDEHEART has been instrumental in improving STEMI care by facilitating rapid feedback and quality improvement initiatives, notably reducing door-to-balloon times and improving mortality rates.

Box 8. CathPCI, USA

CathPCI collects detailed data on cardiac catheterization and PCI procedures. It has significantly contributed to quality improvement by providing hospitals with quarterly reports on performance metrics, enhancing adherence to guideline-recommended therapies, and improving patient outcomes.

Box 9. EURObservational Research Programme (EORP)

EORP is an international registry supported by ESC, which includes multiple modules on various cardiovascular conditions, including ACS. This enables a comparison of care practices and outcomes across different countries, and fosters international collaboration and the adoption of best practices.

Box 10. Myocardial Ischaemia National Audit Project (MINAP), United Kingdom

Initiated in 1999, MINAP is a national clinical audit in the United Kingdom that collects data on the management of myocardial infarction. This registry ensures all patients receive appropriate and timely treatment in line with national guidelines, providing valuable insights for benchmarking performance and identifying areas for improvement.

Quality metrics, improvement initiatives and registries are indispensable tools in the drive to enhance care for acute cardiovascular diseases. By leveraging the data collected through these efforts, health care providers can implement targeted interventions, benchmark performance and ultimately improve patient outcomes. The success of registries such as those described in Boxes 7 to 10 underscores the potential of these tools to drive meaningful improvements in cardiovascular care.

7.2. Stroke registries

The concept of integrating a quality-of-care measurement into a stroke service framework has been emphasized since the 1990s. However, a recent survey by the Stroke Experts Collaboration Group found that 60 of the 78 countries surveyed (77%) reported the presence of stroke registries, but only 14 had a nationwide registry such as that described in Box 11, which potentially gives a skewed picture of the burden of stroke and its treatment worldwide *(4)*. In addition, stroke registries are still rare in LMICs.

Several sets of quality indicators have been proposed, for example by the WSO and in the *Action plan for stroke in Europe, 2018–2030 (91, 93)* (Box 12). However, the selection of indicators needs to be targeted and may need to be reduced in low-resource settings. Any set of indicators should include the core recommended services for stroke care, as detailed in *Tackling NCDs (5)*, and align with the *Intersectoral global action plan on epilepsy and other neurological disorders (12)*. The accuracy of

data in hospital care registers must be taken into account, with particular attention to potential biases arising from incomplete coverage during registration.

WHO has developed a free-to-use clinical registry, housed on the widely used DHIS2 platform *(94)*. The registry has customizable visuals and predefined audit filters, and allows collection of patient data for quality-improvement activities and system planning.

Box 11. The Catalan Stroke Register (CICat), Spain

The CICat registry, which has been running since 2016, includes data from the older Acute Stroke Online Information System, and is managed within the framework of the Catalunya Stroke Code system *(95)*.

An urgent-action protocol (the Stroke Code system (SCI-Cat)) is activated when the health system is alerted that someone has suffered a stroke. The SCI-Cat guarantees the urgent transfer of the patient to the nearest hospital with adequate diagnostic and therapeutic capacity. The 26 hospitals in the stroke code network have IV thrombolysis available.

The hospitals contribute data to the CICat registry, and the continuous monitoring of the information has proven to be an extremely useful tool for achieving improvements in the care of people with stroke.

Box 12. The European Stroke Organisation Stroke Action Plan

The Stroke Action Plan for Europe was prepared by the European Stroke Organisation in cooperation with the Stroke Alliance for Europe *(96)*. The action plan includes seven domains (primary prevention, organisation of stroke services, management of stroke, secondary prevention, rehabilitation, evaluation of stroke outcome and quality assessment and life after stroke), and it states targets for stroke prevention and care to be reached by 2030.

The organization Stroke Action Plan for Europe has committed to providing each participating country with their own aggregated data through a web-based Stroke Service Tracker *(97)*. This will permit a publicly available pan-European comparison of uniformly defined quality measures across countries, and will help to inform the policies, programmes and services for the management and secondary prevention of stroke in Europe.

7.3. Certification of stroke centres

The certification of stroke centres serves as a valuable framework for promoting and monitoring enhancements to elevate the quality of stroke care *(91)*. An external audit by a national or international agency should assess the physical infrastructure, equipment, medications and devices available, personnel qualifications, protocols, team training, pathways and quality indicators. The European Stroke Organisation *(67)*, the collaboration between the Joint Commission, the American Heart Association and the American Stroke Association described in Box 13, and the Stroke Unit Certification Program in Australia are examples of certification programmes for stroke centres.

Box 13. WSO certification of stroke centres

The WSO Stroke Centre Certification programme *(98)* provides free certification for stroke centres in LMICs. It is a rigorous programme based on the WSO's Roadmap, with certification criteria defined by international experts. To receive certification, a hospital must have implemented 100% of mandatory elements and at least 75% of the recommended elements outlined in the roadmap.

The programme was launched in Latin America in 2021, in collaboration with regional and national societies and ministries of health and, as of 2023, 13 countries are participating, with nine of them having certified a total of 57 hospitals. In addition to an onsite assessment to evaluate the recommendations for a qualified stroke centre, the WSO certification includes a validation of the hospital's registry, which involves randomly reviewing the medical records of three to five stroke patients and comparing the results with the quality indicator registry.

Hospitals qualify for certification by implementing protocols that did not previously exist, with a follow-up and recertification process to ensure continuity. Since the programme started, the self-assessment tool has been used 745 times by 514 hospitals to assess their situations and prepare for certification. The average time between the first self-assessment and the application for certification was around eight months.

On average, only 61% proportion of the elements recommended by the WSO Roadmap were already implemented at the time of the initial self-evaluation. By the time the application for certification was made, this had increased to 91%, indicating a significant improvement in hospital practices. In one Brazilian state, certification is mandatory to ensure funding of the 26 ministry of health hospitals. Since 2023, the programme has been expanded to other regions of the world.

Several challenges persist in developing systems to monitor quality of care for stroke and ACS (Table 7.1). There is limited data, especially in the developing world, and there may be a reluctance to share it publicly. It is particularly important for ACS and stroke management that new data portals should not be developed in silos, but should be integrated into existing platforms, especially those related to NCDs.

Table 7.1 Proposed solutions to barriers in creating systems to monitor quality of stroke care

Identified barriers	Proposed solutions
Lack of a system to monitor quality of ACS and stroke care	Establish national heart and stroke plans, in which monitoring of quality of care form an integral part Harmonize indicators with guidelines and regional/ global heart and stroke action plans
Insufficient or fragmented information technologies and medical records	Build up and integrate adequate information technologies across the whole health care system Integrate the collection of data on the quality of stroke services through information technologies
Lack of a tradition of openly and publicly sharing data on the quality of care in hospitals and health systems	Promote transparent and fully open benchmarking principles for data on quality of stroke care Display inequalities and knowledge-to-practice gaps

7.4. Important considerations on data quality

- Data collection should be standardized by the adoption of uniform data collection protocols to ensure comparability across institutions.
- Advanced analytics should be integrated by the utilization of big data analytics and machine learning to derive deeper insights from registry data.
- Transparency should be promoted by publicly reporting performance metrics to foster accountability and motivate improvement.
- Continuous feedback loops should be implemented, using data from registries to enable real-time improvement in care practices.
- Monitoring the quality of stroke services should be an integral part of services and not an optional add-on to services.
- Collection of data on quality of care is essential to monitor the implementation of recommended therapies and management options for stroke.
- Certification of stroke centres can help to improve the quality of care delivered.

7.5. Governance

The development of a comprehensive national plan for the entire continuum of care for ACS and stroke is essential to ensure broad access to evidence-based interventions for the population. The specialists and specialized centres for ACS and stroke can provide technical support for, and work together with, ministries of health to guide them in the national plan – as has occurred for stroke in Brazil, Chile, Colombia and Egypt *(99)*.

Initiatives such as the Latin American Stroke Ministerial *(99)* and World Stroke Organization's Global Stroke Alliance *(100)* can be organized in all regions to bring together health care managers, including ministers of health and other partners to facilitate discussions and formulate action plans. Identification of recognized regional and national stroke champions could help in discussions with local health care authorities and the implementation of evidence-based recommendations.

To expand the implementation of essential interventions and services for ACS and stroke on a people-centred basis, it is important to emphasize outcomes. Care needs to be coordinated, with a comprehensive health system response and a strong governance connecting national, regional and local levels. The following will need to be addressed *(101)*.

- A multidisciplinary health workforce should be trained to deliver evidence-based treatments for acute patients in hospitals, and preventive measures in primary care units.
- Health financing should ensure that public health services are well resourced (including the workforce):
    - primary care for primary and secondary prevention, with quality medicines available and promotion of generics to decrease costs; and
    - specialized services for acute care, with hospital infrastructure, equipment (including devices), thrombolytic medication, medicines for prevention, rehabilitation protocols, surgical room for more comprehensive hospitals.
- A clear policy on medicines, including the implementation of pricing policies and the promotion of generics, and on the availability of diagnostic tests is crucial to guaranteeing the quality of medications and ensuring access to treatment.
- Information solutions play a crucial role in population health management, the care of ACS and stroke within primary care and hospitals, seamless coordination across providers, and the enabling of self-management.

8 Applying the framework

This is a high-level framework for guiding actions; as such, it does not lay out operational details, which will need to be developed.

The core principles and framing of care components should be included in regional and national strategic and operational plans that take into account the local context, allowing for flexibility to adapt to evolving circumstances.

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Annex. Managing declarations of interest and conflicts of interest

The responsible officer followed the current Compliance, Risk Management and Ethics (CRE) policy.

All members of the leadership team were asked to fill in the standard WHO Declaration of Interest (DOI) forms, which were reviewed. The WHO Secretariat reviewed the curriculum vitae of each potential participant and conducted internet searches (PubMed, Open Payments Data, Google Scholar) for information on potential financial and academic conflicts of interest related to the subject of the meeting. All DOIs are on file at the WHO Department of Noncommunicable Diseases.

None of the declared interests was judged sufficient to affect any of the experts' objective judgement during the framework development process or on the content, or therefore to preclude their full participation in the development of the framework.

All members of the leadership team were required to sign a confidentiality agreement before participating in the meeting.

All members of the External Review Group (ERG) were asked to fill in the standard WHO DOI forms, which were reviewed. None of the declared interests was judged sufficient to affect the judgement of any of them during the review process, or therefore to preclude their participation as expert reviewers.

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