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ORIGINAL RESEARCH

Optimizing care and quality indicators in the management of patients with acute ischaemic heart disease and atherothrombotic stroke: measuring to improve

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Abstract

Background: Acute ischaemic heart disease (AIHD) and atherothrombotic stroke are amongst the leading causes of mortality and disability worldwide, sharing pathogenic mechanisms. Quality indicators (QIs) are essential tools for evaluating and optimizing clinical management. The aim of this article is to develop an integrated organizational model for the care of AIHD and atherothrombotic stroke, incorporating validated and measurable QIs to improve patient outcomes and care coordination.

Methods: A multidisciplinary panel of cardiologists, neurologists, internists, primary care physicians and nursing staff reached a consensus through structured meetings. After reviewing the literature and scientific recommendations, the most relevant QIs were selected. When clear standards were lacking, the panel established criteria by consensus. The selected QIs were integrated into a care pathway covering the pre-hospital phase through long-term follow-up.

Results: Sixteen key QIs were identified for each process, covering intervention times, secondary prevention, patient satisfaction, rehabilitation, follow-up and clinical outcomes. The model highlights the importance of rapid diagnosis, timely interventions and coordinated discharge planning. Early initiation of intensive lipid-lowering therapy and systematic monitoring of targets such as LDL-c and mortality are emphasized.

Conclusion: The proposed QIs and organizational model can be valuable tools for optimizing care and coordination for patients with AIHD and atherothrombotic stroke. They enable the monitoring and improvement of critical aspects of the care process.

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Introduction

Acute ischaemic heart disease (AIHD) and atherothrombotic stroke are major causes of global cardiovascular mortality, significantly burdening healthcare systems.[1] Both conditions share common risk factors and are significantly influenced by the speed and quality of acute medical care.[2–5] Atherosclerosis, primarily driven by low-density lipoprotein cholesterol (LDL-c), is the key pathological process linking these conditions. Strong evidence from clinical and genetic studies establishes LDL-c as the cause of atherosclerosis, leading to atherosclerotic cardiovascular disease (ASCVD).[6] Beyond acute management, long-term follow-up is essential. Secondary prevention strategies, such as lifestyle changes, patient education, and strict blood pressure and lipid control, are crucial for reducing recurrent events and enhancing survival in patients with AIHD or stroke.[2,7] Regular follow-ups and adherence to preventive medications like statins and antiplatelet therapy significantly lower the risk of further cardiovascular events.[2,7]

Quality indicators (QIs) are vital in enhancing clinical outcomes in cardiovascular care. They provide standardized benchmarks for healthcare providers to assess care effectiveness, adhere to evidence-based guidelines and pinpoint improvement areas. Studies suggest that adherence to QIs reduces mortality and morbidity in ASCVD.[8–11] Thus, consistent QI use evaluates and refines clinical pathways, ensuring timely, effective care throughout treatment, from acute management to long-term follow-up, and contributing to better outcomes and reduced healthcare costs.[12,13] Despite benefits, QI implementation faces challenges, such as inconsistent application, scattered adoption and numerous indicators, complicating the selection of suitable QIs for specific contexts. Variability in hospital resources and policies causes disparities in QI use, particularly in lower-resource settings.[14] Ensuring adherence to standardized guidelines across all care levels, from emergency to primary care, requires coordinated communication systems. These limitations highlight the need for robust, adaptable models in diverse healthcare environments to optimize ASCVD management.

This article aims to develop an organizational model for caring for patients with ASCVD, including AIHD and atherothrombotic stroke, using validated, measurable QIs. The model integrates cardiology, neurology, primary care and internal medicine, guided by these QIs, to improve coordination and treatment effectiveness for both conditions.

Methods

A multidisciplinary expert panel (cardiology, neurology, internal medicine, primary care, nursing) conducted a structured consensus process. The selection of QIs followed a stepwise consensus procedure. During an in-person meeting, all experts jointly reviewed the available evidence and proposed an initial list of validated, easily measurable indicators covering acute management, secondary prevention, follow-up, patient satisfaction, rehabilitation, and clinical outcomes for patients with AIHD or atherothrombotic stroke. Several rounds of online iteration were subsequently conducted to refine definitions, ensure measurability and confirm applicability across settings. All QIs were approved only when full unanimity was reached amongst all authors; therefore, no formal scoring system or Delphi rounds were required. For each QI, the panel also defined the responsible roles, measurement points and quality standards. Whenever quality standards were explicitly defined in international guidelines or existing quality documents, these were adopted as reference values. In the absence of pre-existing standards, the panel established consensus-based benchmarks that reflected high-quality care and were deemed clinically meaningful and feasible to implement. In addition to selecting QIs, the panel designed a care pathway that integrates these indicators from the pre-hospital phase to long-term follow-up. This pathway enables a structured and coordinated application and monitoring of QIs, promoting standardized, evidence-based care

and continuous improvement. Following the consensus phase, the expert panel has initiated the design of a prospective multicentre validation study, which will include a pilot phase to assess feasibility, prospective monitoring of QI adherence and iterative refinement of the model based on real-world data. The literature search was narrative and pragmatic, focusing on clinical guidelines, consensus statements and high-impact reviews from leading scientific societies. Literature search details are available in the Supplementary Material (available at: https://www.drugsincontext.com/wp-content/uploads/2026/01/dic.2025-9-3-Suppl.pdf).

Results

Key QIs for timely and effective management of AIHD and atherothrombotic stroke

Tables 1 and 2 present the QIs selected from the literature, along with their corresponding standards. The tables display 16 key QIs for AIHD and 16 key QIs for ischaemic stroke, organized into comparable sections. These sections cover time-to-reperfusion metrics and reperfusion strategies, in-hospital risk evaluation, secondary prevention, patient satisfaction, rehabilitation, follow-up, and clinical outcomes. For stroke, several indicators are specific to atherothrombotic stroke, emphasizing areas like LDL-c measurement, timely vascular imaging and revascularization.

Coordinated care pathway for acute cardiovascular events: from onset to long-term follow-up

From the onset of acute symptoms to hospitalization and reperfusion/invasive strategy

The management of ASCVD relies heavily on the rapid identification and treatment of symptoms. For instance, management of ST-elevation myocardial infarction (STEMI) prioritizes timely reperfusion as a key QI to optimize patient outcomes.[2,15] Primary percutaneous coronary intervention (PCI) should be performed within 60 minutes from the initial diagnosis to the crossing of the infarct-related artery wire for patients presenting at PCI-capable hospitals.[15] In cases where patients are diagnosed at non-PCI hospitals or in out-of-hospital settings and subsequently transferred to a PCI-capable centre, the recommended time frame is extended to 90 minutes.[15] Alternatively, for patients treated with fibrinolysis, the initiation of therapy must occur within 10 minutes of diagnosis.[15] These time-sensitive measures are crucial to minimizing delays, improving survival rates and reducing adverse events.[2,15] Similarly, for ischaemic stroke, a door-to-needle time of ≤60 minutes for intravenous thrombolysis remains the minimum standard but current recommendations, such as those from the Registry of Stroke Care Quality (RES-Q), now advocate for a target of <45 minutes to optimize patient outcomes further.[16] The onset-to-needle time remains a key metric, with a target of 157 minutes.[17] Regional care systems, including pre-hospital ECG transmission for STEMI, if needed,[2] or rapid triage systems for stroke,[18] are key to reducing time-to-treatment intervals and improving outcomes.

A set of specific QIs was selected to optimize the care process from symptom onset to reperfusion (Tables 1 and 2). For STEMI, these include the proportion of patients receiving timely reperfusion; for non-ST-elevation myocardial infarction, the proportion of patients undergoing coronary angiography within 24 hours. In stroke management, key QIs focus on door-to-needle time for intravenous thrombolysis, the proportion of eligible patients undergoing thrombolysis, or metrics for mechanical thrombectomy such as the proportion treated with this procedure or door-to-groin time.

In-hospital risk assessment

Effective in-hospital risk assessment is crucial for optimizing outcomes in patients with ASCVD.[2,19] For AIHD, the measurement of left ventricular ejection fraction (LVEF) before discharge is essential to identify patients at high risk and tailor secondary prevention strategies.[2,15,20] Similarly, for ischaemic stroke, imaging studies to identify vascular pathology and assessments for atrial fibrillation are standard.[19,21] Amongst these, the evaluation of a complete lipid profile, rather than focusing solely on LDL-c levels, stands out as a critical component for both conditions. This comprehensive assessment should include the basic lipid profile – total cholesterol, high-density lipoprotein cholesterol (HDL-c), LDL-c and triglycerides – as well as additional markers such as non-HDL cholesterol, apolipoprotein B (ApoB) and lipoprotein(a) (Lp(a)). Given that Lp(a) levels are primarily genetically determined, measuring them at least once in a lifetime, if not previously assessed, is recommended. Additionally, HbA1c measurement should be included to better stratify cardiovascular risk in hospitalized patients with vascular disease.[15,20–22] A timely lipid profile to guide lipid-lowering management during hospitalization can provide a pivotal foundation for secondary prevention and long-term patient care. The experts have emphasized the critical importance of this QI, highlighting that the standard should aim for 100% of patients hospitalized for AIHD or atherothrombotic stroke.

Discharge planning

After the patient has been stabilized, discharge and long-term follow-up care are planned. This includes implementing secondary prevention treatments, such as

lipid-lowering therapies and antiplatelets, antihypertensive agents, and other drugs with proven vascular protection such as sodium-glucose cotransporter 2 (SGLT2) inhibitors or glucagon-like peptide 1 (GLP1) receptor agonists.[2,17] Referring most patients to cardiac or neurological rehabilitation programmes is also essential.[2,17] Discharge planning must include coordination between the hospital and primary care services to ensure the patient receives proper follow-up and continuous treatment.[22,23] This coordination is further strengthened by the secondary prevention nurse, who plays a central role in laboratory monitoring and ensuring appropriate follow-up by the different healthcare professionals involved in the patient's care.

Secondary prevention

The authors emphasize the vital role of global secondary prevention, which includes lipid-lowering therapies, blood pressure control, glycaemic management, lifestyle modifications and antithrombotic strategies to reduce the risk of recurrent cardiovascular and cerebrovascular events. Regarding lipid-lowering therapies, historically, guidelines for ASCVD focused on high-intensity statins.[2,15,21] However, current evidence and expert consensus have expanded this approach to encompass the broader concept of high-intensity lipid-lowering therapies.[24] This shift acknowledges the enhanced efficacy of combination regimens, such as statins paired with ezetimibe and, when necessary, PCSK9 inhibitors, as well as other lipid-lowering agents, including inclisiran and bempedoic acid, in achieving greater LDL-c reductions compared with statin monotherapy.[25,26] Additionally, in the context of comprehensive lipid management, future therapies targeting Lp(a), though not yet commercially available, may further enhance cardiovascular risk reduction strategies.

The early initiation of combination therapy, encapsulated in the Strike Early and Strike Strong approach, is increasingly favoured as the preferred strategy.[27,28] Current recommendations emphasize that patients should be discharged from hospital with high-intensity combination lipid-lowering therapy, ensuring early and sustained LDL-c reduction.[27,28] Observational studies show that patients discharged with a high-intensity statin–ezetimibe combination are significantly more likely to meet LDL-c targets by the first follow-up visit than those prescribed statins alone.[25] This approach not only improves the likelihood of achieving lipid goals but also minimizes the need for more intensive and costly interventions such as PCSK9 inhibitors.[25]

A QI for AIHD related to lipid-lowering therapy included in this work highlights the prescription of high-intensity statins or a combination of statins with ezetimibe, or PCSK9 inhibitors alone or in combination with statins before discharge (Table 1). Whilst the original wording retains the term 'high-intensity statins', it is acknowledged that 'high-intensity lipid-lowering therapies' would better reflect current practices and evidence. This QI has also been adapted for atherosclerotic stroke (Table 2), recognizing its equivalent validity.

Rehabilitation

For AIHD, cardiac rehabilitation is another cornerstone of secondary prevention, aiming to reduce recurrent cardiovascular events and improve survival. These structured programmes encompass supervised exercise, dietary counselling and psychosocial support, collectively mitigating modifiable risk factors and enhancing adherence to long-term preventive therapies.[21,29–31] Evidence from recent studies highlights the high efficacy of cardiac rehabilitation programmes in achieving secondary prevention targets, with up to 70% of patients reaching LDL-c goals.[32] A key QI included in this work is the proportion of patients referred to cardiac rehabilitation at discharge following an acute cardiovascular event, ensuring systematic access to these services (Table 1).

Similarly, rehabilitation following an ischaemic stroke is integral to restoring functionality and minimizing long-term disability. Neurological rehabilitation addresses deficits in mobility, communication and cognition, supporting patients in regaining independence and improving their quality of life.[21,31,33] To optimize outcomes, standardized global rehabilitation programmes should be implemented, incorporating not only functional recovery but also vascular risk management as performed in cardiac rehabilitation. These programmes should include cognitive rehabilitation, occupational therapy, speech therapy, dysphagia evaluation and management, and social support, ensuring a comprehensive approach to stroke recovery.[34] Timely rehabilitation initiation is essential, with QIs emphasizing assessment of rehabilitation needs within 48 hours of admission.[17] Specifically, the QI in Table 2 underscores that at least 80% of stroke patients should be evaluated for rehabilitation within this timeframe.

Patient satisfaction

Assessing patient satisfaction is a vital component of evaluating healthcare quality, particularly for patients with ASCVD.[15,20,21] In this work, we include a specific QI focused on measuring satisfaction during hospitalization (Tables 1 and 2). Whilst numerous tools are available for assessing patient-reported outcomes,[35] these can be time-consuming and resource-intensive. We align with current guidelines[15,20,21] in not making specific recommendations regarding which tool to use, instead suggesting that healthcare teams adopt instruments they are familiar with to ensure feasibility and consistency.

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Table 1. Key quality indicators for managing ischaemic acute heart disease.

Indicator		Assessment	Location	Responsibility	Frequency	Standard[a]	Adapted from:
Reperfusion/invasive strategy							
Q1	Proportion of patients with STEMI who receive timely reperfusion[b]	**Numerator:** number of patients with STEMI undergoing timely reperfusion with primary PCI or fibrinolysis **Denominator:** all patients with STEMI eligible for reperfusion	Inpatient	Clinical and interventional cardiologist	Quarterly evaluation	>90%	ESC quality indicators for acute myocardial infarction[15]
Q2	Proportion of patients with NSTEMI who receive invasive coronary angiography within 24 hours of their diagnosis	**Numerator:** number of patients with NSTEMI who receive invasive coronary angiography within 24 hours of their diagnosis **Denominator:** all patients with NSTEMI without contraindications	Inpatient	Clinical and interventional cardiologist	Quarterly evaluation	>90%	ESC guidelines for the management of ACS in patients presenting without persistent ST-segment elevation[20]
Q3	Proportion of patients with STEMI reperfused amongst those eligible (onset of symptoms to diagnosis <12 h)	**Numerator:** number of eligible patients with STEMI <12 hours undergoing reperfusion **Denominator:** number of patients with STEMI eligible for reperfusion and without contraindications	Inpatient	Clinical and interventional cardiologist	Quarterly evaluation	>90%	ESC quality indicators for acute myocardial infarction[15]
Q4	Sex ratio of the rate of reperfusion in patients with STEMI, eligible for PCI: onset of symptoms <12 hours and anatomy suitable for angioplasty	**Sex ratio (women/men achieving reperfusion)** **Numerator:** number of eligible patients with STEMI <12 hours undergoing reperfusion **Denominator:** number of patients with STEMI eligible for reperfusion and without contraindications	Inpatient	Clinical and interventional cardiologist	Quarterly evaluation	>90% (per guidelines)	ESC; Management of cardiac emergencies in women[47]
In-hospital risk assessment							
Q5	Proportion of patients who have an assessment of LVEF before hospital discharge (LVEF should be assessed and the numerical value recorded for all patients)	**Numerator:** number of patients with ACS who have their LVEF measured before hospital discharge **Denominator:** number of patients with ACS	Inpatient	Attending physician	Quarterly evaluation	>90%	ESC quality indicators for acute myocardial infarction[15] ESC guidelines for the management of ACS in patients presenting without persistent ST-segment elevation[20]

(*Continued*)

Table 1. (Continued)

Indicator		Assessment	Location	Responsibility	Frequency	Standard[a]	Adapted from:
Q6	LDL-c assessment should be performed during hospitalization	**Numerator:** number of patients with ACS who have their LDL-c measured during hospitalization **Denominator:** number of patients with ACS	Inpatient	Attending physician	Quarterly evaluation	100%	ESC quality indicators for acute myocardial infarction[15] ESC guidelines for the management of ACS in patients presenting without persistent ST-segment elevation[20]
Secondary prevention discharge treatments							
Q7	Proportion of patients with adequate P2Y12 inhibition[c]	**Numerator:** number of patients with ACS prescribed adequate P2Y12 inhibitor at the time of hospital discharge (prasugrel, ticagrelor or clopidogrel) **Denominator:** number of patients with ACS discharged who have an indication for dual antiplatelet therapy	Inpatient	Attending physician	Quarterly evaluation	100%	ESC quality indicators for acute myocardial infarction[15] ESC guidelines for the management of ACS in patients presenting without persistent ST-segment elevation[20]
Q8	Proportion of patients discharged from hospital on high-intensity statins or a combination of a statin plus ezetimibe, or a prescription of PCSK9-directed therapies; alone or combined with statins	**Numerator:** number of patients with ACS who receive high-intensity statins before discharge or a combination of a statin plus ezetimibe, or a prescription of PCSK9-directed therapies; alone or combined with statins at the time of hospital discharge **Denominator:** number of patients with ACS alive at the time of hospital discharge and without contraindications, refusal, side-effects or history of intolerance to high-intensity statin therapy, statin plus ezetimibe or PCSK9-directed therapies	Inpatient	Attending physician	Quarterly evaluation	100%	ESC; Quality control to improve LDL-cholesterol management[25]

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Table 1. (Continued)

Indicator		Assessment	Location	Responsibility	Frequency	Standard[a]	Adapted from:
Patient satisfaction							
Q9	Systematic assessment of health-related quality of life in all patients using a validated instrument	**Numerator:** number of patients with ACS alive at the time of hospital discharge who have their health-related quality of life assessed during hospitalization using a validated instrument **Denominator:** number of patients with ACS discharged from hospital	Inpatient	Attending physician or nursing staff	Quarterly evaluation	>90%	ESC quality indicators for acute myocardial infarction[15] ESC guidelines for the management of ACS in patients presenting without persistent ST-segment elevation[20]
Rehabilitation							
Q10	Proportion of patients who participate in a cardiac rehabilitation programme following an acute cardiovascular event or an elective revascularization procedure	**Numerator:** patients who are referred to cardiac rehabilitation programme at the time of hospital discharge following an acute cardiovascular event or an elective revascularization procedure **Denominator:** patients with established ASCVD following an acute cardiovascular event or an elective revascularization procedure who have not refused referral to cardiac rehabilitation programme	Outpatient cardiac rehabilitation centres or primary care referral system	Attending physician and PCP or cardiac rehabilitation programme coordinator	Quarterly evaluation	>70%	ESC; Quality indicators for cardiovascular disease prevention[29]
Long-term follow-up							
Q11	Proportion of patients who had an LDL-c level <55 mg/dL at the 2-month follow-up after discharge	**Numerator:** number of patients discharged after an ACS who achieved an LDL-c level <55 mg/dL at the 2-month follow-up after discharge **Denominator:** total number of patients discharged after an atherothrombotic stroke who were eligible for follow-up LDL-c measurement and had no contraindications, refusal, or history of intolerance to lipid-lowering therapies	Primary care, hospital outpatient clinics, or virtual/telemedicine follow-up (nurse or cardiologist led)	Attending physician or nursing staff	Quarterly evaluation	>70%	ESC; Quality control to improve LDL-cholesterol management[25]

(*Continued*)

Table 1. (Continued)

Indicator		Assessment	Location	Responsibility	Frequency	Standard[a]	Adapted from:
Q12	Proportion of patients who had an LDL-c level <55 mg/dL at the 6-month follow-up after discharge	**Numerator:** number of patients discharged after an ACS who achieved an LDL-c level <55 mg/dL at the 6-month follow-up after discharge **Denominator:** total number of patients discharged after an atherothrombotic stroke who were eligible for follow-up LDL-c measurement and had no contraindications, refusal, or history of intolerance to lipid-lowering therapies	Primary care, hospital outpatient clinics, or virtual/telemedicine follow-up (nurse or cardiologist led)	Attending physician or nursing staff	Quarterly evaluation	>85%	ESC; Quality control to improve LDL-cholesterol management[25]
Outcomes							
Q13	In-hospital mortality due to STEMI (excluding patients in Killip class IV and those who received cardiopulmonary resuscitation)	**Numerator:** patients admitted for STEMI who died during their hospital stay **Denominator:** total number of patients admitted for STEMI (excluding those in Killip class IV and those who underwent cardiopulmonary resuscitation)	Inpatient	Attending physician	Quarterly evaluation	<5% (per guidelines)	López-Sendón et al. Quality Markers in Cardiology[37] González-Juantey et al. Clinical management in cardiology[36]
Q14	In-hospital mortality due to NSTEMI (excluding patients in Killip class IV and those who received cardiopulmonary resuscitation)	**Numerator:** patients admitted for NSTEMI who died during their hospital stay **Denominator:** total number of patients admitted for NSTEMI (excluding those in Killip class IV and those who underwent cardiopulmonary resuscitation).	Inpatient	Attending physician	Quarterly evaluation	<2% (per guidelines)	López-Sendón et al. Quality Markers in Cardiology[37] González-Juantey et al. Clinical management in cardiology[36]
Q15	Risk-adjusted 30-day mortality (STEMI patients)	**Numerator:** all patients with STEMI who died within the first 30 days after admission **Denominator:** all patients with STEMI at 30-day follow-up	Hospital and outpatient records	Attending physician	Quarterly evaluation	Risk-adjusted rates per guidelines and hospital-specific benchmarks	ESC quality indicators for acute myocardial infarction[15]

(*Continued*)

Table 1. (Continued)

Indicator		Assessment	Location	Responsibility	Frequency	Standard[a]	Adapted from:
Q16	Risk-adjusted 30-day mortality (NSTEMI patients)	**Numerator:** all patients with NSTEMI who died within 30 days after admission **Denominator:** all patients with NSTEMI at 30-day follow-up	Hospital and outpatient records	Attending physician	Quarterly evaluation	Risk-adjusted rates per guidelines and hospital-specific benchmarks	ESC guidelines for the management of ACS in patients presenting without persistent ST-segment elevation[20]

ACS, acute coronary syndrome; ASCVD, atherosclerotic cardiovascular disease; ESC, European Society of Cardiology; LDL-c, low-density lipoprotein cholesterol; LVEF, left ventricular ejection fraction; NSTEMI, non-ST-elevation myocardial infarction; PCI, percutaneous coronary intervention; PCP, primary care physician; STEMI, ST-elevation myocardial infarction.

[a] The standards have been established by consensus amongst the authors, except for those expressly designated as recommended by the guidelines.

[b] Timely is defined as:

1) For patients presenting at primary PCI hospitals: <60 min from initial STEMI diagnosis to infarct-related artery wire crossing.
2) For patients diagnosed either in a non-PCI hospital or in the out-of-hospital setting and then transferred to a PCI-capable centre: <90 min from initial STEMI diagnosis to infarct-related artery wire crossing.
3) For patients treated with fibrinolysis, initiation of fibrinolysis within 10 min after STEMI diagnosis.

[c] Eligible is defined as follows:

- For ticagrelor: Patients with acute myocardial infarction without previous haemorrhagic stroke, high bleeding risk, fibrinolysis or oral anticoagulation.
- For prasugrel: PCI-treated patients with acute myocardial infarction without previous haemorrhagic or ischaemic stroke, high bleeding risk (patients ≥75 years and/or <60 kg body weight are also considered as high bleeding risk features), fibrinolysis or oral anticoagulation.
- For clopidogrel: no indication for prasugrel or ticagrelor and no high bleeding risk.

Table 2. Key quality indicators for the management of atherothrombotic stroke.

Indicator		Assessment	Location	Responsibility	Frequency	Standard[a]	Adapted from
Reperfusion/invasive strategy							
Q1	Onset-to-needle time	Time (in minutes) to initiate intravenous thrombolysis from onset of first symptoms	Stroke unit	Stroke neurologist or emergency care team	Quarterly evaluation	157 min (per guidelines)	Navarro Soler et al. A set of care quality indicators for stroke management[17]
Q2	Door-to-needle time	Time (in minutes) to initiate intravenous thrombolysis from patient arrival at hospital	Stroke unit	Stroke neurologist or emergency care team	Quarterly evaluation	60 min (per guidelines)	Navarro Soler et al. A set of care quality indicators for stroke management[17]
Q3	Patients undergoing intravenous thrombolysis	**Numerator:** number of patients with ischaemic stroke treated with intravenous thrombolysis **Denominator:** total number of patients with ischaemic stroke admitted to the centre during the same period	Stroke unit	Stroke neurologist or emergency care team	Quarterly evaluation	8–10% (per guidelines)	Navarro Soler et al. A set of care quality indicators for stroke management[17]
Q4	Sex ratio of the rate of reperfusion in patients with acute atherothrombotic stroke eligible for intravenous thrombolysis	**Sex ratio (women/men achieving reperfusion)** **Numerator:** number of eligible patients with atherothrombotic stroke who received intravenous thrombolysis **Denominator:** total number of patients with atherothrombotic stroke eligible for intravenous thrombolysis and without contraindications	Stroke unit	Stroke neurologist or emergency care team	Quarterly evaluation	>90% (per guidelines)	ESC; Management of cardiac emergencies in women[47]
Q5	Proportion of patients with ischaemic stroke treated with mechanical thrombectomy	**Numerator:** number of patients with ischaemic stroke treated with mechanical thrombectomy **Denominator:** total number of patients with ischaemic stroke admitted to the centre during the same period	Inpatient	Stroke neurologist or stroke neurointerventionist	Quarterly evaluation	8–10%	Navarro Soler et al. A set of care quality indicators for stroke management[17]
Q6	Door-to-groin time (minutes)	Time (in minutes) from hospital arrival to the initiation of the thrombectomy procedure (groin puncture)	Inpatient	Stroke neurologist or stroke neurointerventionist	Quarterly evaluation	<120 min	RES-Q Recommendations[16]

(*Continued*)

Table 2. (Continued)

Indicator		Assessment	Location	Responsibility	Frequency	Standard[a]	Adapted from
In-hospital risk assessment							
Q7	Carotid imaging measure: percentage of patients aged ≥18 years with symptoms or a diagnosis of TIA or non-disabling[b] ischaemic stroke[c] receiving timely vascular imaging and carotid revascularization referral if appropriate	**Numerator:** patients aged ≥18 years with symptoms or a diagnosis of TIA or non-disabling[b] ischaemic stroke[c] for whom cross sectional imaging of the cervical cerebral vasculature, which at a minimum includes imaging[d] of the carotid artery, was performed for patients within 24 hours of inpatient admission or for patients attending an outpatient visit within 2 days For those patients identified as having symptomatic stenosis between ≥70% and <100% based on the NASCET method, order for referral to carotid revascularization practice within 24 hours of imaging result availability. If stenosis is less than 70%, documentation of degree of stenosis fulfils this measure **Denominator:** All patients aged ≥18 years with symptoms or a diagnosis of TIA or non-disabling[b] ischaemic stroke[c]	Inpatient	Attending physician	Quarterly evaluation	>90%	AAN; Quality improvement in neurology[21]
Q8	LDL-c assessment should be performed during hospitalization	**Numerator:** number of patients with atherothrombotic stroke who have their LDL-c measured during hospitalization **Denominator:** total number of patients with atherothrombotic stroke	Inpatient	Attending physician	Quarterly evaluation	100%	AAN; Quality improvement in neurology[21]; AHA/ASA Get With The Guidelines – Stroke[48]

(*Continued*)

Table 2. (Continued)

Indicator		Assessment	Location	Responsibility	Frequency	Standard[a]	Adapted from
Secondary prevention							
Q9	Defect free acute inpatient ischaemic stroke measure bundle: percentage of patients aged ≥18 years with a diagnosis of ischaemic stroke OR TIA who were admitted to hospital for inpatient care and received all appropriate interventions for optimal care prior to discharge	**Numerator:** patients aged ≥18 years with a diagnosis of ischaemic stroke or TIA who were admitted to hospital for inpatient care and received all three component interventions: • Component 1: early antithrombotic therapy received by end of hospital day 2 OR documentation of medical/patient exception • Component 2: discharged on appropriate antithrombotic • Component 3: Tobacco use management **Denominator:** total number of patients with acute ischaemic stroke and TIA aged ≥18 years admitted for inpatient care	Inpatient	Attending physician	Quarterly evaluation	>90%	AAN; Quality improvement in neurology[21]
Q10	Proportion of patients discharged from hospital on high-intensity statins or a combination of a statin plus ezetimibe, or a prescription of PCSK9-directed therapies; alone or combined with statins	**Numerator:** number patients with atherothrombotic stroke who receive high-intensity statins before discharge or a combination of a statin plus ezetimibe, or a prescription of PCSK9-directed therapies; alone or combined with statins **Denominator:** total number of patients with atherothrombotic stroke alive at the time of hospital discharge and without contraindications, refusal, side-effects or history of intolerance to high-intensity statin therapy, statin plus ezetimibe or PCSK9-directed therapies	Inpatient	Attending physician	Quarterly evaluation	100%	ESC; Quality control to improve LDL-cholesterol management[25]

(*Continued*)

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Table 2. (Continued)

Indicator		Assessment	Location	Responsibility	Frequency	Standard[a]	Adapted from
Patient satisfaction							
Q11	Systematic assessment of health-related quality of life in all patients using a validated instrument	**Numerator:** number of patients with stroke alive at the time of hospital discharge who have their health-related quality of life assessed during hospitalization using a validated instrument **Denominator:** total number of patients with stroke discharged from hospital	Inpatient	Attending physician or nursing staff	Quarterly evaluation	>90%	ESC quality indicators for acute myocardial infarction[15] Navarro Soler et al. A set of care quality indicators for stroke management[17]
Rehabilitation							
Q12	Rehabilitation assessment	**Numerator:** number of patients with stroke assessed for rehabilitation treatment needs within 48 hours after admission **Denominator:** total number of patients with stroke receiving treatment at the centre during the same period	Inpatient	Attending physician or rehabilitation specialist	Quarterly evaluation	80% (per guidelines)	Navarro Soler et al. A set of care quality indicators for stroke management[17]
Long-term follow-up							
Q13	Proportion of patients who had an LDL-c level <55 mg/dL at the 2-month follow-up after discharge	**Numerator:** number of patients discharged after an atherothrombotic stroke who achieved an LDL-c level <55 mg/dL at the 2-month follow-up after discharge **Denominator:** total number of patients discharged after an atherothrombotic stroke who were eligible for follow-up LDL-c measurement and had no contraindications, refusal or history of intolerance to lipid-lowering therapies	Primary care, hospital outpatient clinics, or virtual/ telemedicine follow-up (nurse or neurologist led)	Attending physician or nursing staff	Quarterly evaluation	>70%	ESC; Quality control to improve LDL-cholesterol management[25]
Q14	Proportion of patients who had an LDL-c level <55 mg/dL at the 6-month follow-up after discharge	**Numerator:** number of patients discharged after an atherothrombotic stroke who achieved an LDL-c level <55 mg/dL within 6 months after discharge **Denominator:** total number of patients discharged after an atherothrombotic stroke who were eligible for follow-up LDL-c measurement and had no contraindications, refusal or history of intolerance to lipid-lowering therapies	Primary care, hospital outpatient clinics, or virtual/ telemedicine follow-up (nurse or neurologist led)	Attending physician or nursing staff	Quarterly evaluation	>85%	ESC; Quality control to improve LDL-cholesterol management[25]

(*Continued*)

Table 2. (Continued)

Indicator		Assessment	Location	Responsibility	Frequency	Standard[a]	Adapted from
Outcomes							
Q15	In-hospital mortality	**Numerator:** number of patients with ischaemic stroke who die from any cause during admission **Denominator:** total number of patients with ischaemic stroke under treatment at the centre during admission	Inpatient	Attending physician	Quarterly evaluation	7% (per guidelines)	Navarro Soler et al. A set of care quality indicators for stroke management[17]
Q16	Risk-adjusted 30-day mortality rate	**Numerator:** number of patients with ischaemic stroke who died within 30 days after admission **Denominator:** total number of patients with ischaemic stroke at 30-day follow-up (TIA should be excluded)	Hospital and outpatient records	Attending physician	Quarterly evaluation	Risk-adjusted rates per guidelines and hospital-specific benchmarks	Canadian stroke best practices[38]

AAN, American Academy of Neurology; AHA, American Heart Association; ASA, American Stroke Association; ESC, European Society of Cardiology; LDL-c, low-density lipoprotein cholesterol; NASCET, North American Symptomatic Carotid Endarterectomy Trial; RES-Q, Registry of Stroke Care Quality; TIA, transient ischaemic attack.

[a] The standards have been established by consensus amongst the authors, except for those expressly designated as recommended by the guidelines.

[b] Non-disabling – is defined as any neurological symptom or sign lasting >24 hours but producing no disability of functional significance (Modified Rankin score <3).

[c] TIA or ischaemic stroke – acute onset within seven calendar days.

[d] Imaging is defined as computed tomography angiography, magnetic resonance angiography or Duplex Doppler ultrasonography.

Long-term follow-up and continuity of care

Achieving optimal outcomes in patients with ASCVD requires a robust framework for long-term follow-up and continuity of care. Effective management hinges on adherence to preventive treatments, regular monitoring, and timely therapy adjustments. Seamless communication between the hospital, nursing and primary care services is essential to proactively address risk factors and ensure consistent care delivery across all levels. Nurses, particularly those specialized in secondary prevention and cardiovascular risk management, play a central role in this continuum. Their responsibilities extend beyond ensuring medication adherence to include lifestyle counselling, patient education and structured follow-up (both telephonic and in-person) to optimize long-term outcomes.

Overall, attainment of the LDL-c objective was one of the main priorities after smoking cessation and diabetes control when managing patients after ASCVD.[25] The EuroPath IV study, an observational analysis involving 2650 patients with ACS, aimed to assess lipid-lowering therapy practices and outcomes in patients at high risk.[25] Cardiologists expected 68% of patients to achieve >50% LDL-c reduction and 42% to reach LDL-c levels <55 mg/dL within 6 months. However, during the first follow-up visit at a mean of 16 weeks (~4 months), only 18% of patients with LDL-c measurements achieved LDL-c <55 mg/dL. By the second follow-up visit, conducted in 53% of patients, this figure rose to 34%. Only 31% of patients with at least one LDL-c measurement during follow-up achieved the target, highlighting a substantial gap between expectations and real-world outcomes.[25] These findings underscore the effectiveness of early initiation of combination lipid-lowering therapy, including high-intensity statins with ezetimibe and, when necessary, PCSK9 inhibitors or other lipid-lowering agents, in real-world clinical settings. The study demonstrates explicitly how intensive post-discharge strategies tailored to patients with very high baseline LDL-c levels or those who do not respond adequately to statin monotherapy can substantially improve lipid control.

Recognizing the significance of these results, the authors included LDL-c <55 mg/dL at 2 and 6 months as key QIs in our framework. These QIs serve as benchmarks to evaluate the effectiveness of secondary prevention strategies, including maintenance or even intensification of lipid-lowering therapies during follow-up when needed, and to guide improvements in care delivery for both patients with AIHD or with atherothrombotic stroke (Tables 1 and 2).

Outcomes related to mortality

Outcomes such as mortality represent critical indicators of healthcare quality and are considered robust metrics to assess the effectiveness of clinical interventions and overall care delivery. In this work, we have included in-hospital mortality and 30-day risk-adjusted mortality rates for both AIHD and atherothrombotic stroke as essential QIs (Tables 1 and 2). Risk-adjusted mortality accounts for differences in patient characteristics, such as age, comorbidities and severity of the condition, ensuring fair comparisons across healthcare providers and systems.[17,36–38]

The inclusion of mortality-related outcomes emphasizes the importance of hard clinical endpoints, which reflect the overall impact of the care continuum, spanning from acute management to long-term secondary prevention. Additionally, in ischaemic stroke, functional outcomes should be assessed using the modified Rankin Scale at 3 months post-stroke to evaluate long-term patient recovery and the effectiveness of implemented care strategies.[39]

Integration of QIs in the care model

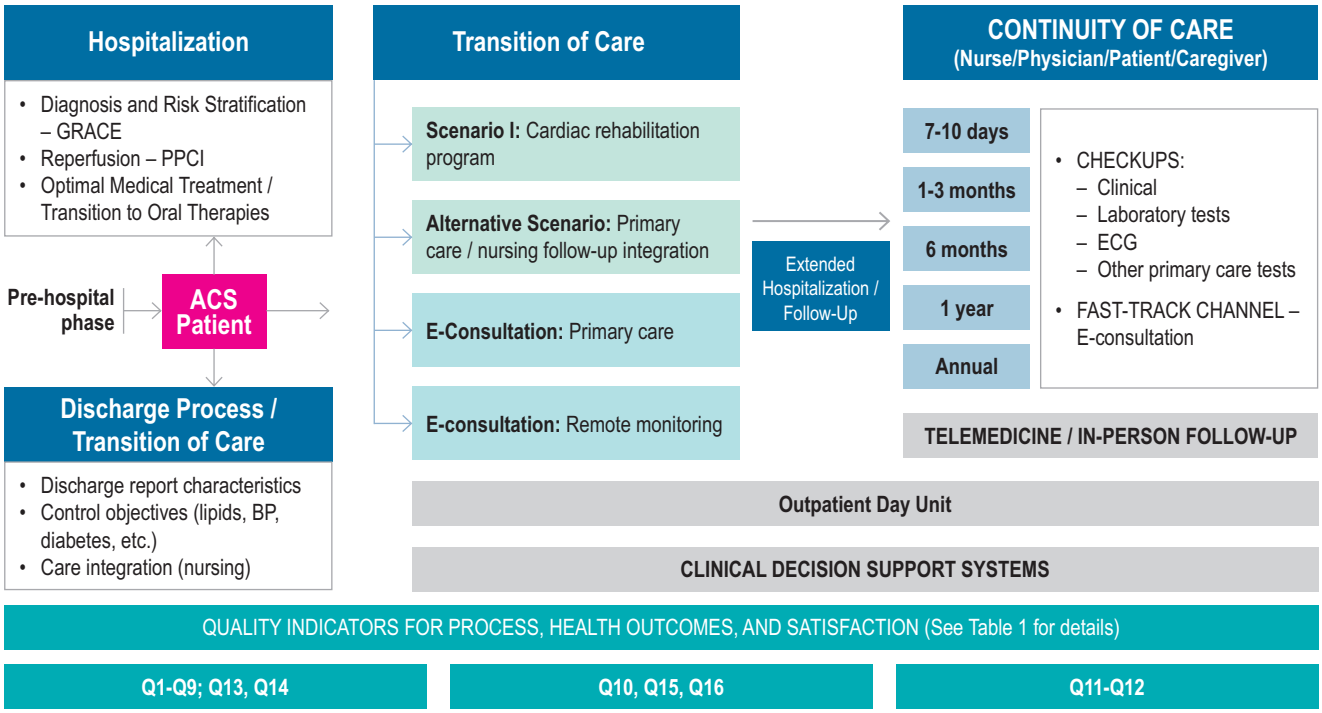
The authors developed a follow-up model for AIHD and atherothrombotic stroke that integrates nursing staff and primary care physicians with hospital specialists, including cardiologists, neurologists, internal medicine physicians and rehabilitation specialists (Figures 1–3).[40–42] Key QIs in the model include timely acute interventions, LDL-c goal achievement, patient satisfaction and critical outcomes like in-hospital and 30-day risk-adjusted mortality. These QIs provide a framework for monitoring and enhancing recovery, optimizing secondary prevention, and improving long-term health outcomes for populations at high risk.

Discussion

This work presents a comprehensive framework for improving care in patients with AIHD and atherothrombotic stroke by QIs into a structured care model. The emphasis on linking acute care with long-term follow-up through standardized metrics that assess clinical outcomes, process efficiency and patient satisfaction aligns with contemporary approaches to improving healthcare delivery.

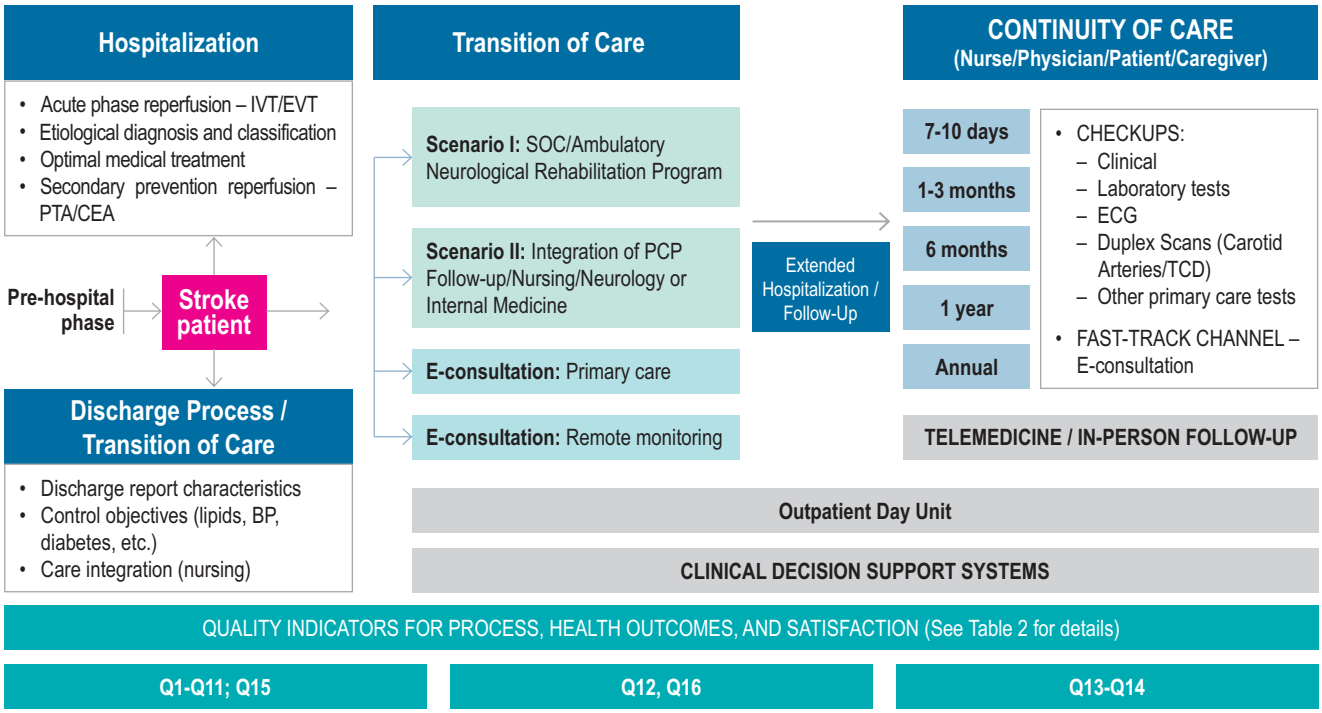
In line with the principle of 'measuring to improve', highlighted by González-Juanatey et al.,[36] the study underscores the critical role of systematically monitoring outcomes and processes to identify gaps and promote continuous improvement. Measuring key outcomes, such as timely acute interventions, LDL-c goal achievement and mortality rates, provides actionable insights into the effectiveness of care pathways and ensures alignment with evidence-based practices.

Figure 1. Care process for acute ischaemic heart disease, starting from ACS.



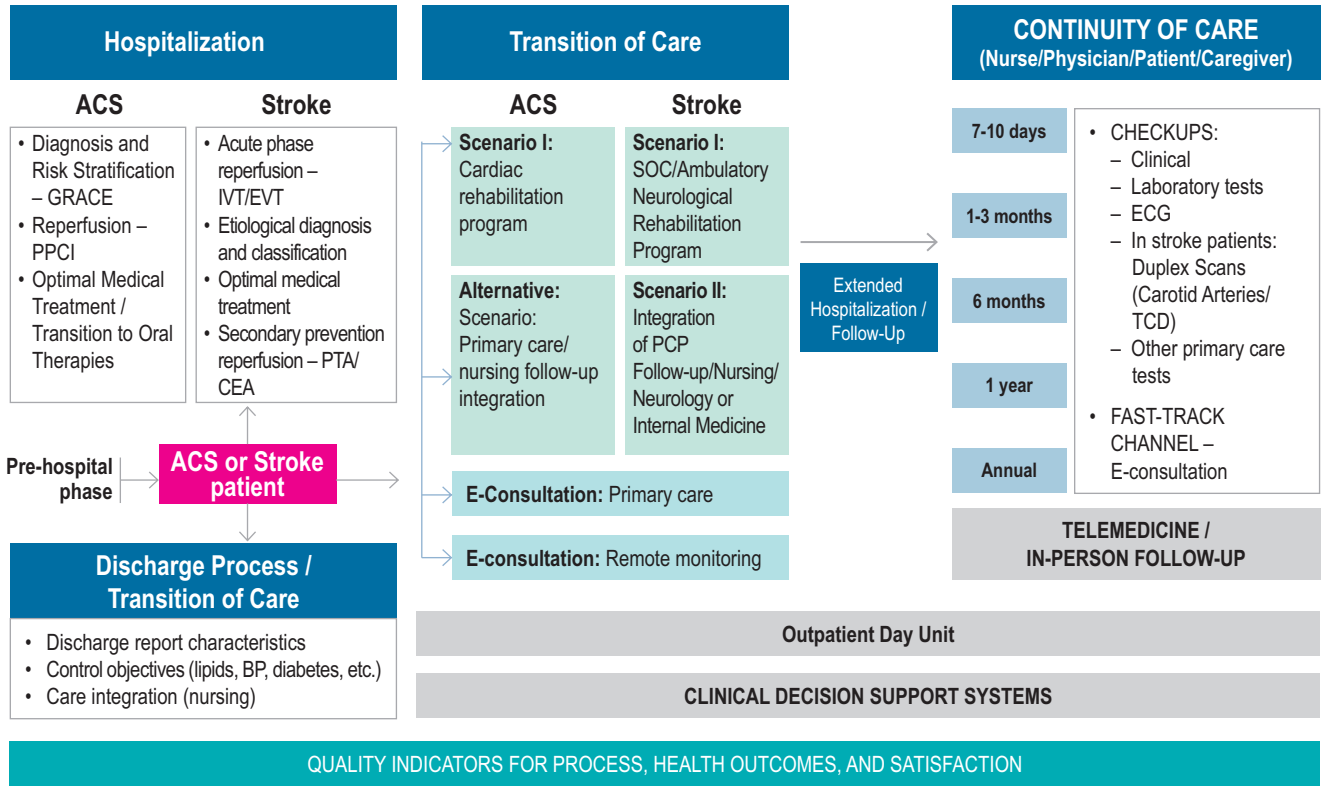
ACS, acute coronary syndrome; BP, blood pressure; ECG, electrocardiogram; GRACE, Global Registry of Acute Coronary Events; PPCI, primary percutaneous coronary intervention.

Figure 2. Care process for atherothrombotic stroke starting from the acute phase.



BP, blood pressure; CEA, carotid endarterectomy; ECG, electrocardiogram; EVT, endovascular thrombectomy; IVT, intravenous thrombolysis; PCP, primary care physician; PTA, percutaneous transluminal angioplasty; SOC, specialized outpatient centre; TCD, transcranial Doppler.

Figure 3. Integrated care pathway for acute ischaemic heart disease and stroke.



ACS, acute coronary syndrome; BP, blood pressure; CEA, carotid endarterectomy; ECG, electrocardiogram; EVT, endovascular thrombectomy; GRACE, Global Registry of Acute Coronary Events; IVT, intravenous thrombolysis; PCP, primary care physician.

Furthermore, integrating robust QIs serves as a foundation for benchmarking and fostering accountability, ultimately leading to enhanced patient outcomes.

The relevance of these strategies is supported by the 2022 Cardiovascular Health Strategy[43] and the 2024 Stroke Strategy[44] of the Spanish National Health System, which emphasize the critical role of structured monitoring and auditing to ensure adherence to evidence-based guidelines. These national strategies advocate for multidisciplinary approaches to secondary prevention and underscore the importance of QIs in reducing morbidity and mortality, reinforcing the model proposed in this paper.

A major strength of the model is its multidisciplinary nature, involving nursing staff, primary care physicians and hospital-based specialists such as cardiologists, neurologists, internal medicine specialists and rehabilitation experts. This collaboration ensures smooth transitions across care phases, from pre-hospital recognition to rehabilitation and long-term management.

The relevance of this work is further supported by the objectives outlined in the EU4Health Programme 2021–2027,[45] which emphasizes the importance of strengthening healthcare systems across Europe to deliver equitable, high-quality care. This initiative prioritizes investments in preventive care, healthcare workforce development and digital innovation – key elements that resonate with the structured follow-up model proposed in this study. The alignment with EU health priorities underscores the potential for this model to serve as a blueprint for implementing QIs to improve outcomes in populations at high risk across diverse healthcare systems. This is also consistent with WHO guidance, which states that quality of care should be measured and monitored continuously to drive improvement.[46]

Beyond defining the organizational model and selecting measurable QIs, the present work did not aim to evaluate the resources, costs or operational steps required for real-world implementation. Adoption of this framework will depend on workforce availability, digital infrastructure and coordination across care levels, which may introduce barriers such as workflow fragmentation, variability in local pathways, and limited access to rehabilitation or follow-up services. Patient-centred metrics, including satisfaction, health-related quality of life and functional outcomes, are essential components of quality assessment and will be specifically incorporated into

the prospective multicentre validation study currently in development. These aspects, whilst beyond the scope of this consensus model, represent the next phase of evaluation of its feasibility and clinical impact.

Conclusion

Integrating QIs into AIHD and atherothrombotic stroke care improves clinical outcomes and promotes evidence-based practices. This multidisciplinary model ensures smooth transitions across care phases, focusing on secondary prevention and long-term follow-up. Aligned with national and European strategies, the framework emphasizes measuring and auditing care processes for continuous improvement, providing equitable, high-quality care to populations at high risk such as those with ASCVD. Implementing these measurements is vital for optimizing cardiovascular care and enhancing long-term outcomes.

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