European Society of Cardiology quality indicators for the management of acute coronary syndrome

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Developed by the Working Group for Acute Coronary Syndrome Quality Indicators in collaboration with the Association for Acute CardioVascular Care and the European Association of Percutaneous Cardiovascular Interventions

Short running head: ESC quality indicators in acute coronary syndrome

Xavier Rossello[1,2,16], Maribel Gonzalez-Del-Hoyo[2], Suleman Aktaa[3,4,5], Chris P Gale[3,4,5], Israel Barbash (EAPCI)[6], Marc J Claeys (ACVC)[7], JJ Coughlan[8,9], Joao Pedro Ferreira[10,11], Mary Galbraith (Patient Forum)[12], Margret Leosdottir[13], Francois Schiele (ACVC) [14], Sergio Raposeiras-Roubin[15], Maria Rubini Gimenez[1,16], Robert A. Byrne #[8,9], Borja Ibanez #[1,17,18]

[1] *Centro Nacional de Investigaciones Cardiovasculares Carlos III (CNIC), Madrid, Spain*

[2] *Cardiology Department, Institut d'Investigació Sanitària Illes Balears (IdISBa), Hospital Universitari Son Espases, Palma de Mallorca, Islas Baleares, Spain*

[3] *Leeds Institute of Cardiovascular and Metabolic Medicine, University of Leeds, Leeds, UK*

[4] *Leeds Institute for Data Analytics and Leeds Institute of Cardiovascular and Metabolic Medicine, University of Leeds, Leeds, UK*

[5] *Department of Cardiology, Leeds Teaching Hospitals NHS Trust, Leeds, UK*

[6] *Leviev Heart Center, Chaim Sheba Medical Center, Ramat Gan, Israel; Affiliated to Sackler School of Medicine, Tel Aviv University, Tel Aviv, Israel.*

[7] *Cardiology, Antwerp University Hospital, Edegem, Belgium*

[8] *Cardiovascular Research Institute, Mater Private Network, Dublin, Ireland*

[9] *School of Pharmacy and Biomolecular Sciences, RCSI University of Medicine and Health Sciences, Dublin, Ireland*

[10] *Department of Surgery and Physiology, UnIC@RISE, Cardiovascular Research and Development Center, Faculty of Medicine of the University of Porto, Porto, Portugal*

[11] *Heart Failure Clinic, Internal Medicine Department, Unidade Local de Saude de Gaia, Espinho, Portugal & Centre d'Investigations Cliniques Plurithématique 1433, INSERM, Université de Lorraine, CIC 1439, Institut Lorrain du Coeur et des Vaisseaux, CHU, Vandoeuvre-lès-Nancy & F-CRIN INI-CRCT (Cardiovascular and Renal Clinical Trialists), INSERM U1116, Centre Hospitalier Régional Universitaire de Nancy, Nancy, France.* [12] *ESC Patient Forum, Sophia Antipolis, France*

[13] *Department of Cardiology, Skane University Hospital, Malmö, Sweden*

[14] *Department of Cardiology University Hospital Besançon France*

[15] *Department of Cardiology, Hospital Álvaro Cunqueiro University Hospital of Vigo Pontevedra Spain.*

[16] *Department of Cardiology, Ascires Biomedical Group, Valencia, Spain*

[17] *Cardiology Department, IIS-Fundación Jiménez Díaz University Hospital, Madrid, Spain*

[18] *Centro de Investigación Biomédica en Red de Enfermedades Cardiovasculares (CIBERCV), Madrid, Spain*

 # The two authors contributed equally to the document and are joint senior authors.

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Address for correspondence:

Xavier Rossello, Centro Nacional de Investigaciones Cardiovasculares (CNIC) & Cardiology Department, Hospital Universitari Son Espases-IDISBA. Carretera de Valldemossa, 79, 07120 Palma, Illes Balears, Spain. E-mail address: x.rossello@ucl.ac.uk

ABSTRACT

Background: Closing the evidence-practice gap for the treatment of acute coronary syndrome (ACS) is central to improving quality of care. Under the European Society of Cardiology (ESC) framework, we aimed to develop updated quality indicators (QIs) for the evaluation of quality of care and outcomes for patients with ACS.

Methods: A Working Group of experts including members of the ESC Clinical Practice Guidelines Task Force for ACS, Acute CardioVascular Care Association and European Association of Percutaneous Cardiovascular Interventions followed the ESC methodology for QI development. This methodology involved (i) the identification of the domains of ACS care for the diagnosis and management of ACS; (ii) the construction of candidate QIs through a systematic review of the literature; and (iii) the selection of the final set of QIs (using a modified Delphi method).

Results: Five domains of care for the diagnosis and management of ACS were identified: (1) structural framework and logistics, (2) in-hospital non-invasive care, (3) invasive strategy and periprocedural management, (4) secondary prevention interventions, and (5) outcomes. In total, 21 main QIs were selected, covering all five domains of care for the diagnosis and management of ACS.

Conclusions: This document defines five domains of ACS care, and provides 21 QIs for the diagnosis and management of ACS. The updated ESC QIs for ACS may be used for quality improvement initiatives.

Keywords: Acute Coronary Syndrome; Quality Indicator; Quality of Care; Quality Improvement

INTRODUCTION

Acute coronary syndrome (ACS) is one of the leading causes of morbidity and mortality worldwide.[1] Randomised clinical trials (RCTs) have provided a number of evidence-based interventions in recent decades,[2,3] leading to widespread improvement in long-term prognosis.[4,5] However, there is a disconnect between the development of new therapies and their implementation in clinical practice, known as the second translational gap.[6] This is illustrated by numerous studies reporting marked disparities in ACS management and outcomes,[7,8] in spite of the standardized translation of available evidence by international guidelines. Thus, addressing the persistent 'evidence-practice' gap is central to improve quality of care in ACS.[6]

Quality indicators (QIs) are tools specifically designed to assess the quality of care. They are linked to clinical guidelines and intended for use in quality control, a critical step in programs aimed at improving care quality and clinical outcomes.[9] QIs are derived from evidence and should be feasible, concretely interpretable, and usable.[10] In 2017, the Association for Acute Cardiovascular Care (ACVC), developed a set of 20 QIs for the management of acute myocardial infarction (AMI),[11] all aligned with the 2017 European Society of Cardiology (ESC) guidelines for the management of patients with ST-segment elevation acute myocardial infarction (STEMI).[12] An update of these QIs was published in 2021,[13] aligning with the publication of the 2020 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation (NSTE-ACS).[14] A number of international real-world studies assessing QIs for AMI have not only highlighted gaps in care delivery and room for improvement,[15–17] but have also demonstrated the feasibility of the QIs and their association with outcomes.[10]

In collaboration with the ACVC and the European Association of Percutaneous Cardiovascular Interventions (EAPCI) of the ESC, the Working Group for ACS QIs was established to develop an updated set of QIs for the management of patients with ACS. Work took place in parallel with the writing of the 2023 ESC Guidelines for the management of ACS,[18] and in collaboration with Task Force members of the guidelines. Here we present QIs that encompass the spectrum of ACS using the ESC methodology for the development of QIs and in line with the most recent ESC guidelines for the management of ACS. It is anticipated that the set of QIs may be employed for the evaluation of guideline adherence, identification of priority areas for quality improvement, and reducing the burden of ACS.

METHODS

The ESC methodology for the development of QIs for the quantification of cardiovascular care and outcomes was applied.[6] Briefly, the methodology involves four steps: (i) setting a conceptual framework of ACS care delivery to identify key domains of care for the management of ACS, (ii) developing candidate QIs by conducting a systematic review of the literature, (iii) selecting the final set of QIs using a modified Delphi method, and (iv) evaluating the feasibility of the developed QIs.[6]

There are three types of ESC QIs.[6] Those measuring the quality of care at the institutional level (structural QIs), at individual patient level (process QIs) and those capturing the outcomes of care (outcome QIs). Furthermore, the ESC QIs can be classified into main and secondary indicators. Whilst both may be used for local quality improvement activities, the main QIs are deemed to have stronger validity and feasibility by the Working Group members and therefore may be used for performance measurement across regions and over time.

Members of the Working Group

The Working Group comprised of Task Force the chairpersons of the 2023 ESC Clinical Practice Guidelines for ACS (Robert Byrne, Borja Ibanez), members of the ACVC (Marc Claeys, Francois Schiele) and the EAPCI (Israel Barbash), Quality Indicator Committee (Xavier Rossello, Maribel Gonzalez del Hoyo, Suleman Aktaa, Chris Gale), experts in the management of patients with ACS (Margret Leosdottir, Sergio Raposeiras-Roubin, Joao Pedro Ferreira, JJ Coughlan, Maria Rubini Gimenez) and a patient representative (Mary Galbraith). Several virtual meetings were convened between the members of the Working Group between October 2022 and July 2024.

Domains of acute coronary syndrome

During the initial phases of the development process, the Working Group defined the target population as those for whom the QIs are applicable and identified the key domains for ACS care. The target population was defined as patients with an ACS, which comprises a continuum of conditions (unstable angina [UA], NSTEMI, and STEMI), defined based on changes on 12-lead electrocardiography (ECG), and elevation in cardiac biomarkers.[18] QIs that are only relevant to a particular ACS type were defined accordingly. Seven key domains of care were established by constructing a conceptual illustration of the multi-faceted journey for patients with ACS. However, only five domains were included in the final selection. The conceptual "Patient" domain was not fulfilled with any QI and was therefore removed, whilst the "Initial assessment and management" domain was merged to 'in hospital non-invasive care domain' for the sake of simplicity.

Systematic review

Search strategy

We conducted a systematic review of the published literature in accordance with the Preferred Reporting Items for Systematic Review and Meta-analyses statement (**online supplementary Table S1**). We searched two online bibliographic databases; MEDLINE and Embase via OVID®. The initial search strategy was developed in MEDLINE using keywords and, a wide range of medical subject headings (MeSH) terms, and was based on 4 pillars: (1) the target population, (2) terms related to the selected domains, (3) RCTs and observational human studies, and (4) the time period (2016-2022 for STEMI, and 2020-2022 for NSTE-ACS) (**online supplementary Figure S1**). The search was restricted to English language and publication dates between 1 January 2016 and 21 June 2022 given the year 2016 was immediately before the publication of the ESC guidelines for STEMI and the first set of QIs for AMI. A similar approach was taken for the development of QIs for heart failure regarding the timeframe of the search strategy.[19] The full search strategy is provided in **online supplementary Table S2** and **Table S3** for MEDLINE and EMBASE, respectively.

Eligibility criteria

We included articles fulfilling the following eligibility criteria: (i) the study population was adult patients (≥18 years old) with ACS; (ii) the study defined an intervention (structural or process aspect of ACS management) for which at least one outcome measure was reported; (iii) the outcome measures were hard endpoints (e.g., mortality, re-admission), or patient-reported outcomes (e.g., quality of life); (iv) the study provided definitions for the intervention and outcome measure(s) evaluated; and (v) the study was a peer-reviewed RCT or an observational study (i.e., clinical practice guidelines, systematic reviews, metanalyses, letters, editorials, and conference abstracts were excluded). No restriction was placed on sample size, though generalisability (single-centre small studies) was an exclusion criterion.

Study selection

A reference manager (Mendeley) was used for duplicates removal and data management. Two reviewers (MG-H and XR) independently examined the abstracts of the studies retrieved from the search against the inclusion criteria. Disagreements were resolved through a full text review of the article or by consulting a third author (SA).

Data extraction

All studies that met the eligibility criteria were included in the initial phase of the review. This broad inclusion was important to ensure that the list of candidate QIs was

representative of a wide range of ACS care. The full texts of the included articles were then reviewed to identify the list of candidate QIs. Of note, some studies were used to support the same potential QI (e.g., there were many studies evaluating risk scores in the initial assessment, or the invasive approach in patients with multivessel disease).

Existing quality indicators

In addition to the systematic review, existing ESC QIs were carefully reviewed. [11,13] For the period 2016-2022, supporting evidence was found for 20 out of 24 QIs.

Data synthesis

Modified Delphi process

Candidate QIs derived from the aforementioned process were evaluated by the Working Group members using the modified Delphi method.[6] The ESC criteria for QI development (**online supplementary Table S4**) were shared with the Working Group members prior to voting in order to standardize the selection process. All proposed QIs were individually graded by each panellist via online questionnaires using a 9-point ordinal scale for both validity and feasibility. Two rounds in total were conducted, with a teleconference after each round to discuss the results of the vote and address any concerns or ambiguities.

Analysing voting results

The 9-point ordinal scale used for voting implied that ratings of 1 to 3 meant that the QI is not valid/feasible; ratings of 4 to 6 meant that the QI is of an uncertain validity/feasible; and ratings of 7 to 9 meant that the QI is valid/feasible. For each candidate QI, the median and the mean deviation from the median were calculated to evaluate the central tendency and the dispersion of the votes. Indicators, with median scores ≥7 for validity, ≥4 for feasibility, and with minimal dispersion, were included in the final set of QIs.[6] The candidate QIs that met the inclusion criteria in the first voting round, with those that have a strong recommendation in the 2023 ESC guidelines for ACS,[18] were defined as main QIs. Should any QI have met the inclusion criteria after the second round of voting, this would have been defined as secondary indicators. However, all QIs were selected on the first round of voting, with none during e the second voting round.

RESULTS

Domains of acute coronary syndrome care

Five domains of care for the management of ACS were identified . These domains included: (1) structural framework, (2) in-hospital non-invasive care, (3) invasive strategy and periprocedural management, (4) secondary prevention interventions, and (5) outcome (**Figure 1**).

Systematic review and Modified Delphi voting results

The literature search retrieved 7637 articles, of which 206 met the inclusion criteria (PRISMA flow diagram in **Figure 2**). These articles were used to extract 116 candidate QIs (**online supplementary Table S5**), which were voted on in the first Delphi round. A total of 21 main QIs were selected after this voting round, with 23 potential secondary QIs re-voted on in the second Delphi round. None of the potential secondary QIs met the eligibility criteria, so the final set of measures included only the 21 main QIs. Further details regarding how each QI can be calculated are demonstrated in **Table 1**.

Quality indicators

Domain 1: structural framework

Structural QIs have a role in the implementation of evidence-based interventions for ACS, and address aspects of ACS care that are influenced by policy makers. Five main QIs were proposed in this domain: (i) participation in a network organisation with written protocols for rapid and efficient management (**QI 1**); (ii) hospital availability of hs-cTn (**QI 2**); (iii) availability of systems for pre-hospital ECG interpretation and transfer decisions (**QI 3**); (iv) participation in a regular registry or programme for quality assessment (**QI 4**); and (v) routine monitoring of relevant reperfusion times in primary percutaneous coronary intervention (PCI) programmes (**QI 5**). These are key aspects of pre-hospital and initial ACS care and have been shown to be associated with clinical outcomes.[18]

Domain 2: in-hospital non-invasive care

Three main QIs were proposed for this domain: (i) percentage of patients who have both their LDL-cholesterol and HbA1c levels measured during hospitalization (**QI 6**); (ii) percentage of patients who have an assessment of their left ventricular ejection fraction (LVEF) before hospital discharge (**QI 7**); (iii) percentage of patients with no indication of anti-coagulation who are prescribed either prasugrel or ticagrelor (**QI 8**). The first two are key for subsequent clinical

decision-making (e.g., lipid-lowering treatment, anti-remodelling therapy), whilst QI 8 is associated with clinical outcomes.[18]

Domain 3: invasive strategy and periprocedural management

Six main QIs were proposed: (i) percentage of patients with STEMI who are reperfused among those eligible (onset of symptoms to diagnosis <12 h) (**QI 9**); (ii) percentage of patients with STEMI who receive timely reperfusion (**QI 10**); (iii) percentage of patients who underwent radial access in case of invasive strategy (**QI 11**); (iv) percentage of patients receiving a parenteral anticoagulant on admission (**QI 12**); v) door-to-balloon time in STEMI patients who underwent primary PCI (PPCI) (**QI 13**), and (vi) STEMI diagnosis to wire crossing time in patients who underwent PPCI (**QI 14**). The last two QIs should be expressed in time units (e.g., hours).

Domain 4: secondary prevention interventions

Six main QIs were selected in this domain: (i) percentage of PCI patients needing oral anticoagulation who receive appropriate triple antithrombotic therapy during a short time period (one week to one month) (**QI 15**); (ii) mention the intended duration of the antithrombotic strategy in the discharge letter (**QI 16**); (iii) percentage of patients discharged from hospital on high-potency high-dose statin (**QI 17**); (iv) percentage of patients with LVEF <40% who are discharged from hospital on ACEI (or ARBs if intolerant of ACEI) (**QI 18**); (v) percentage of patients with LVEF <40% who are discharged from hospital on beta-blockers (**QI 19**), and (vi) percentage of patients referred to an exercise-based cardiac rehabilitation and prevention programme (**QI 20**).

Domain 5: outcome

The main QIs for this domain is in-hospital all-cause mortality (**QI 21**), which was selected among the 21 potential QI candidates.

DISCUSSION

This document presents the revised version of ESC QIs for the evaluation of ACS care and outcomes.[11,13] These QIs are derived from evidence, underpinned by expert consensus, and provide tools to develop quality improvement initiatives. The participation of Task Force members of the 2023 ESC Clinical Practice Guidelines for ACS, as well as from other ESC

association and backgrounds, have paved the way to a fair QI extraction as well as a good alignment between guideline recommendations and QIs, facilitating the translation of evidence-based interventions into measurable indicators. In contrast to earlier iteration of ESC QIs for AMI, these updated QIs extend to include the spectrum of ACS. It is anticipated that they may be used internationally to provide a standardized evaluation of guideline adherence, identify priority areas for quality improvement, and reduce the burden of ACS.

Domain 1: structural framework and logistics

All five QIs in this domain are reflected in recommendations provided by the 2023 ESC guidelines for ACS,[18] which recommended that a pre-hospital management of patients with a working diagnosis of STEMI is based on regional networks designed to deliver reperfusion therapy expeditiously and effectively. The guidelines also recommend that a 12-lead ECG should be interpreted as soon as possible at the point of FMC (including the prehospital setting), with a target of <10 min. All hospitals and EMS participating in the care of patients with suspected STEMI should record and audit delay times and work together to achieve and maintain quality targets. Regarding high sensitivity troponin availability, it is recommended to measure cardiac troponins with high-sensitivity assays immediately after presentation and to obtain the results within 60 min of blood sampling. All these are class I recommendations in the 2023 ESC ACS guideline.

Domain 2: in-hospital non-invasive care

The in-hopsital non-invasive care domain contains three QIs. The 2023 ESC guidelines for ACS provide a Class I recommendation for routine echocardiographic assessment during hospitalization, in order to assess regional and global left ventriclular function. It is also recommended to reduce LDL-C levels by ≥50% from baseline, and to assess glycaemic status during the initial hospitalisation in all patients with ACS. With respect to the use of potent $P2Y_{12}$ inhibitors, the Working Group acknowledges the complexity of the issue. Whilst the previous version of QIs advocated for an "adequate $P2Y_{12}$ inhibition" (ticagrelor, prasugrel, clopidogrel) based on the contraindications of each drug, we simplified the issue by excluding clopidogrel from the equation, and by including the two potent $P2Y_{12}$ inhibitors at the same level. This solution aims for simplicity and feasibility, rather than favouring one potent $P2Y_{12}$ inhibitor over another.[20]

Domain 3: invasive strategy and periprocedural management

The 2023 ESC guidelines for ACS recognise radial access as the default approach for the invasive strategy in patients presenting with ACS. Regarding the QIs related with time, it should be noted that a timely reperfusion refers to PCI-mediated reperfusion within 120 min from STEMI diagnosis according to the ESC guidelines. However, it is also acknowledged that the ideal time aim set in the refers to <60 from STEMI diagnosis to wire crossing for those presenting in a PCI centre, <90 min for those presenting in a non-PCI setting, and 10 min from STEMI diagnosis to bolus of fibrinolytics in those undergoing pharmacological reperfusion). Given that QIs aims to improve care delivery, the Working Group voted to keep the standards at the maximum level, and maintained unaltered the QI already set in 2017-2020. The door-to-balloon time was implemented as a measure of hospital care delivery, whilst the STEMI diagnosis to wire crossing time was implemented as a measure of system (prehospital and hospital) care delivery.[21] However, the Working Group acknowledges that sometimes there are no doors anymore (patients not directly attending the emergency department go straight to the cath lab), and the word ballon has been replaced by wire crossing, so “door-to-ballon” is an outdated term. However, the QI was maintained to be able to make historical comparisons with in-hospital care delivery, and because the essence of term still applies to patients attending the Emergency Department, or those already hospitalized for other reasons.

Domain 4: secondary prevention interventions

Four out of six QIs relative to secondary prevention management are present in form of class I recommendations of the 2023 ESC guidelines for the management of patients with ACS.[18] Hence, it is recommended that all ACS patients participate in a medically supervised, structured, comprehensive, multidisciplinary exercise-based cardiac rehabilitation and prevention programme. Regardless of baseline LDL-C values, a high-potency high-dose statin should be initiated or continued as early as possible. For those patients with LVEF ≤40%, both beta-blocker and ACE inhibitors (or ARB) are indicated.

The use of triple antithrombotic therapy (TAT) in patients with ACS and with an indication for oral anticoagulation has a class I recommendation for up to one week and a class IIa recommendation for prolonging TAT to over one week and up to one month. Regarding the intended duration of DAPT for patients with ACS, it is important to mention that the default strategy recommended by the guideline is 12-months of DAPT in patients without high bleeding risk. However, DAPT abbreviation and de-escalation strategies can be employed based on the ischemic and bleeding risk of the patient.

Domain 5: outcome

All-cause mortality is the most objective and unambiguous clinical outcome, making it appropriate for the assessment of quality of care. While the accuracy of mortality as a direct measure of quality of care is a long-lasting controversial issue, it provides essential, readily available information at broad levels (i.e., region-, country-, or type of hospital-levels).[17,22] At centre-level, comparison can be made between periods of time. Of note, the 2020 QI was risk-adjusted 30-day mortality rate. In-hospital all-cause mortality can be collected alongside most of QIs, and does not introduce the type of adjustment as an extra layer of complexity to make comparisons between different cohorts.

Overall remarks and comparison to previous QIs

Among the 21 QIs, 5 only apply to STEMI patients (QI 5, 9, 10, 13, 14; all of them related to reperfusion times or the invasive approach). Relative to the 2020 QIs for ACS,[13] 14 remained unaltered, whilst two were substantially modified, and five were new. The following QIs were part of the 2020 set, and were not selected by the current TF: (i) time between initial STEMI diagnosis and arterial access (absolute value); (ii) percentage of patients who have been stratified according to a validated risk score to assess the ischemic and haemorrhagic risk; (iii) rate of NSTEMI patients who receive invasive coronary angiography within 24h of their diagnosis, (iv) feedback regarding the patient's experience systematically collected in an organized way from all patients; (v) systematic assessment of health-related quality of life in all patients using a validated instrument, (vi) the discharge letter should be sent to the patient; and (vii) risk adjusted 30-day mortality rate. Notably, the systematic review approach and the Delphi process did not result in the inclusion of patient-reported outcomes measures (PROMs) and patient-reported experience measures (PREMs), though the Working Group acknowledges their importance.[23] In this new set, there are no composite QIs. This is because all QIs were included in the first round of voting, and there was no rationale for combining QIs (ie., evidence showing better outcomes if QIs are combined, as it happens in heart failure).

Study limitations

Although an established methodology was used in the development of this QI update, potential limitations in our approach should be acknowledged. First, the reliance on experts to select the QIs following the systematic review is prone to some degree of subjectivity. By employing the modified Delphi method and adhering to the ESC criteria, the process was consistent. Second, the QIs described in this article are a product of both the results of the literature review, the

clinical practice guideline recommendations, and the consensus reached by the development group. Third, whilst alignment with the 2023 ESC guidelines for ACS was sought throughout the process, some QIs do not have a corresponding guideline recommendation. The QIs presented in this document reflect the findings of the literature review and the consensus of the development group. Following the inverse rationale, relevant evidence-based aspects of ACS care were not represented in any QI because of their feasibility to be captured in practice. Fourth, the composition of the working group determined the selection of the final set of QIs. Our group comprised mostly clinical and interventional cardiologists, as well as guideline TF members, TF members from previous ESC QIs for ACS publications, and a patient. Collaborating with other members of the multidisciplinary team (e.g. imaging cardiologists, nurses) would have enriched the project. The level of attainment to QIs should be collected prospectively, instead of being assessed retrospectively.[10,24]

CONCLUSION

This document defines 21 main QIs across five domains of care for the management of ACS: (1) Structural framework and logistics, (2) In-hospital non-invasive care , (3) Invasive strategies and periprocedural management , (4) Secondary prevention interventions, and (5) Outcomes. This set of update ESC QIs for ACS aim to facilitate the implementation of clinical practice guidelines as well as to assess its adherence. From a pragmatic perspective, they are freely available tools to enable institutions, scientific societies and policy makers to monitor, compare, and improve quality of care in patients with ACS.

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Conflict of interest

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Data availability

Data available on reasonable request.

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TABLES

Table 1. ESC quality indicators for the management of patients with acute coronary syndrome

Domain 1. STRUCTURAL FRAMEWORK AND LOGISTICS	
1	The centre should be part of a network organisation with written protocols for rapid and efficient management ***Numerator:*** *centres participating in a network with written protocols for the management of ACS*
2	Hospital availability of hs-cTn ***Numerator:*** *availability of hs-cTn*
3	Pre-hospital interpretation of ECG for 1) diagnosis, 2) decision for immediate transfer to a centre with catheterisation laboratory facilities, and 3) pre-hospital activation of the catheterisation laboratory ***Numerator:*** *availability of systems for pre-hospital ECG interpretation and transfer decisions*
4	The centre should participate in a regular registry or programme for quality assessment ***Numerator:*** *centres participating regularly in local, regional, or international registries for quality assessment.*
5	Routine assessment of relevant times for the reperfusion process in STEMI patients (i.e. times from 'call to first medical contact', 'first medical contact to arrival at PCI centre, arrival at PCI centre to arterial access) ***Numerator:*** *routine monitoring of relevant reperfusion times in primary PCI programmes*
Domain 2. IN-HOSPITAL NON-INVASIVE CARE	
6	Percentage of patients who have their LDL-cholesterol and HbA1c levels measured during hospitalization* **both conditions should be met* ***Numerator:*** *number of ACS patients who have their LDL-cholesterol and HbA1c levels measured during hospitalization* ***Denominator:*** *total number of patients with ACS*
7	Percentage 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 ACS patients who have their LVEF measured during hospitalization* ***Denominator:*** *total number of patients with ACS*
8	Percentage of patients not on anti-coagulation who are prescribed either ticagrelor or prasugrel, ***Numerator:*** *number of ACS patients on either ticagrelor or prasugrel* ***Denominator:*** *total number of patients with ACS* who have no indication for anti-coagulation
Domain 3. INVASIVE STRATEGY AND PERIPROCEDURAL MANAGEMENT	
9	Percentage of patients with STEMI reperfused among those eligible (onset of symptoms to diagnosis <12 h) ***Numerator:*** *number of STEMI patients who underwent reperfusion within the first 12h from symptom onset* ***Denominator:*** *total number of STEMI patients*
10	Percentage of patients with STEMI who receive timely reperfusion. 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 center: <90 min from initial STEMI diagnosis to infarct-related artery wire crossing 3) For patients treated with fibrinolysis, initiation of fibrinolysis within 10 minutes after STEMI diagnosis ***Numerator:*** *number of STEMI patients who received timely reperfusion either with primary PCI or fibrinolysis* ***Denominator:*** *total number of STEMI patients eligible for* reperfusion therapy
11	Percentage of patients who underwent radial access in case of invasive strategy ***Numerator:*** *number of ACS patients who underwent an invasive strategy and undewernt radial access* ***Denominator:*** *number of ACS patients treated with PCI*
12	Percentage of patients receiving parenteral anticoagulant on admission ***Numerator:*** *number of ACS patients who received parenteral anticoagulation on admission* ***Denominator:*** *total number of ACS patients*
13	The door to balloon time <u>(absolute value)</u> in STEMI patients who underwent PPCI

	Numerator: *median time hospital door and the balloon time in STEMI patients who underwent PPCI*
14	The STEMI diagnosis to wire crossing time (absolute value) in patients who underwent PPCI ***Numerator:*** *median time between the STEMI diagnosis and the wire crossing time in patients who underwent PPCI*
Domain 4. SECONDARY PREVENTION INTERVENTIONS	
15	Percentage of patients needing oral anticoagulation who receive appropriate triple antithrombotic therapy during a short time period (one week to one month) ***Numerator:*** *number of PCI patients needing oral anticoagulation who received appropriate triple antithrombotic therapy (NOAC, aspirin, clopidogrel)* ***Denominator:*** *total number of ACS patients needing oral anticoagulation*
16	Mention the intended duration of the antithrombotic strategy in the discharge letter ***Numerator:*** *number of ACS patients with a discharge letter reflecting the intended duration of the antithrombotic strategy* ***Denominator:*** *total number of ACS patients with dual antiplatelet therapy at the time of hospital discharge*
17	Percentage of patients discharged from hospital on high-potency high-dose statins ***Numerator:*** *number of ACS patients on high-potency high-dose statins at the time of hospital discharge* ***Denominator:*** *total number of ACS patients*
18	Percentage of patients with LVEF <40% who are discharged from hospital on ACEI (or ARBs if intolerant of ACEI) ***Numerator:*** *number of ACS patients with LVEF <40% who received ACEi or ARB at the time of hospital discharge* ***Denominator:*** *total number of ACS patients*
19	Percentage of patients with LVEF <40% who are discharged from hospital on beta-blockers ***Numerator:*** *number of ACS patients with LVEF <40% who received beta-blockers at the time of hospital discharge* ***Denominator:*** *total number of ACS patients*

20	Percentage of patients referred to an exercise-based cardiac rehabilitation and prevention programme ***Numerator:*** *number of ACS patients referred to an exercise-based cardiac rehabilitation and prevention programme at the time of hospital discharge* ***Denominator:*** *total number of ACS patients*
Domain 5. OUTCOMES	
21	In-hospital all-cause mortality ***Numerator:*** *patients with ACS who died during hospitalization* ***Denominator:*** *all patients hospitalized with ACS*

Table 2. Comparison between the 2020 ESC QIs for AMI and the 2024 QIs for ACS

Domain 1. STRUCTURAL FRAMEWORK AND LOGISTICS		**2020**
1	The centre should be part of a network organisation with written protocols for rapid and efficient management	=
2	Hospital availability of hs-cTn	=
3	Pre-hospital interpretation of ECG for 1) diagnosis, 2) decision for immediate transfer to a centre with catheterisation laboratory facilities, and 3) pre-hospital activation of the catheterisation laboratory	=
4	The centre should participate in a regular registry or programme for quality assessment	=
5	Routine assessment of relevant times for the reperfusion process in STEMI patients (i.e. times from 'call to first medical contact', 'first medical contact to arrival at PCI centre, arrival at PCI centre to arterial access)	=
Domain 2. IN-HOSPITAL NON-INVASIVE CARE		
6	Percentage of patients who have their LDL-cholesterol and HbA1c levels measured during hospitalization ***** **both conditions should be met*	≠
7	Percentage of patients who have an assessment of LVEF before hospital discharge (LVEF should be assessed and the numerical value recorded for all patients)	=
8	Percentage of patients on either ticagrelor or prasugrel, if not receiving triple antithrombotic therapy	≠
Domain 3. INVASIVE STRATEGY AND PERIPROCEDURAL MANAGEMENT		
9	Percentage of patients with STEMI reperfused among those eligible (onset of symptoms to diagnosis <12 h)	=
10	Percentage of patients with STEMI who receive timely reperfusion. 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 center: <90 min from initial STEMI diagnosis to infarct-related artery wire crossing 3) For patients treated with fibrinolysis, initiation of fibrinolysis within 10 minutes after STEMI diagnosis	=
11	Percentage of patients who underwent radial access in case of invasive strategy	=
12	Percentage of patients receiving parenteral anticoagulant on admission	=
13	The door to balloon time (absolute value) in STEMI patients who underwent PPCI	**NEW**

14	STEMI diagnosis to wire crossing time in patients who underwent PPCI	**NEW**
Domain 4. SECONDARY PREVENTION INTERVENTIONS		
15	Percentage of patients needing oral anticoagulation who receive appropriate triple antithrombotic therapy during a short time period (one week and to one month)	**NEW**
16	Mention the intended duration of the antithrombotic strategy in the discharge letter	=
17	Percentage of patients discharged from hospital on high-potency high-dose statins	=
18	Percentage of patients with LVEF <40% who are discharged from hospital on ACEI (or ARBs if intolerant of ACEI)	=
19	Percentage of patients with LVEF <40% who are discharged from hospital on beta-blockers	=
20	Percentage of patients referred to an exercise-based cardiac rehabilitation and prevention programme	**NEW**
Domain 5. OUTCOMES		
21	In-hospital all-cause mortality	**NEW**

The QIs that remain unchanged relative to the 2020 publication are marked with a green symbol. Those modified have been marked with an orange symbol.

FIGURES

Figure 1. ESC quality indicators for the management of patients with acute coronary syndrome.

Figure 2. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart for the studies included in the systematic review.

Graphical abstract

We have provided a low-quality Graphical abstract, though expect the Journal Illustrator to produce a better version. Example from previous QI ESC paper:

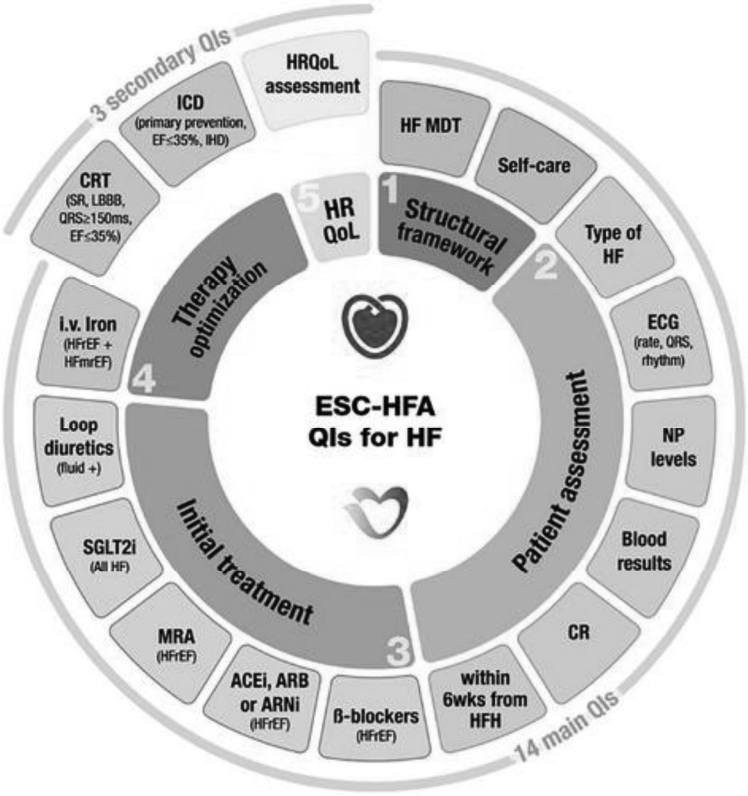

Figure 1

Click here to access/download;Figure;Figure 1 - QIs for ACS.tif

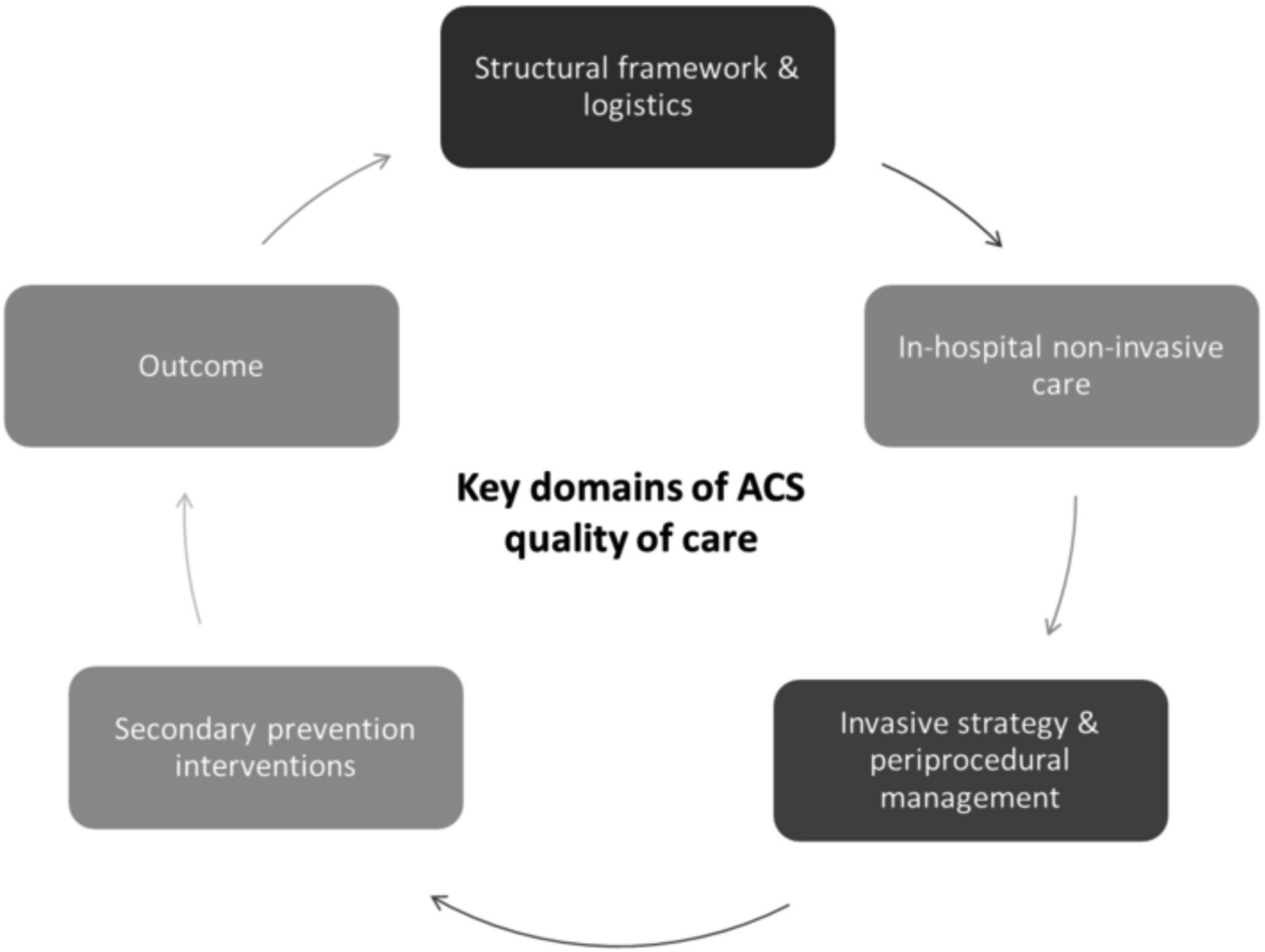

Figure 2

Click here to access/download;Figure;Figure 2 - QIs for ACS.tif