








2020 Update of the quality indicators for acute myocardial infarction: a position paper of the Association for Acute Cardiovascular Care: the study group for quality indicators from the ACVC and the NSTEMI-ACS guideline group

François Schiele^{1*}, Suleman Aktaa², Xavier Rossello ^{3,4,5}, Ingo Ahrens⁶, Marc J. Claeys⁷, Jean-Philippe Collet^{8,9}, Keith A.A. Fox ¹⁰, Chris P. Gale², Kurt Huber ¹¹, Zaza Iakobishvili¹², Alan Keys¹³, Ekaterini Lambrinou¹⁴, Sergio Leonardi ¹⁵, Maddalena Lettino ¹⁶, Frederick A. Masoudi¹⁷, Susanna Price¹⁸, Tom Quinn¹⁹, Eva Swahn²⁰, Holger Thiele ²¹, Adam Timmis ²², Marco Tubaro²³, Christiaan J.M. Vrints^{7,24}, David Walker²⁵, and Hector Bueno^{5,26,27}

Document reviewers: Sigrun Halvorsen²⁸ (review coordinator) (Norway), Tomas Jernberg²⁹ (Sweden), Jarle Jortveit³⁰ (Norway), Mai Blöndal³¹ (Estonia), Borja Ibanez³² (Spain), Christian Hassager^{33,34} (Denmark)

¹University Hospital Besancon, Boulevard Fleming, 25000 Besancon, France; ²University of Leeds, Leeds, UK; ³Centro Nacional de Investigaciones Cardiovasculares (CNIC), Madrid, Spain; ⁴Cardiology Department, Hospital Universitari Son Espases & Health Research Institute of the Balearic Islands (IdISBa), Palma, Spain; ⁵CIBER de enfermedades Cardiovasculares (CIBERCV), Madrid, Spain; ⁶Cardiology and Medical Intensive Care, Augustinerinnen Hospital Cologne, Cologne, Germany; ⁷Antwerp University Hospital, Antwerp, Belgium; ⁸Sorbonne Université, ACTION Study Group, Paris, France; ⁹INSERM UMRS 1166, Institut de Cardiologie, Hôpital Pitié-Salpêtrière (AP-HP), Paris, France; ¹⁰University and Royal Infirmary of Edinburgh, Edinburgh, UK; ¹¹3rd Department of Medicine, Cardiology and Intensive Care Medicine, Wilhelminenhospital, Sigmund Freud University, Medical Faculty, Vienna, Austria; ¹²Department of Community Cardiology, Clalit Health Services, Jaffa District, Tel Aviv, Israel; ¹³Tonbridge, UK; ¹⁴Department of Nursing, School of Health Sciences, Cyprus University of Technology, Limassol, Cyprus; ¹⁵University of Pavia and Fondazione IRCCS Policlinico S. Matteo, Pavia, Italy; ¹⁶Cardio-Thoracic-Vascular Department, San Gerardo Hospital, Monza, Italy; ¹⁷University of Colorado Anschutz Medical Campus, Aurora, CO, USA; ¹⁸Royal Brompton & Harefield NHS Foundation Trust, Imperial College, London, UK; ¹⁹Kingston University & St. George's, University of London, London, UK; ²⁰Linköping University, Linköping, Sweden; ²¹Department of Internal Medicine/Cardiology, Heart Center Leipzig at University of Leipzig, Leipzig, Germany; ²²Barts Heart Centre and Queen Mary University London, London, UK; ²³San Filippo Neri Hospital, Rome, Italy; ²⁴University of Antwerp, Antwerp, Belgium; ²⁵East Sussex Healthcare NHS Trust, UK; ²⁶Cardiology Department, Hospital Universitario 12 de Octubre and Instituto de Investigación Sanitaria Hospital 12 de Octubre (imas12), Madrid, Spain; ²⁷Facultad de Medicina, Universidad Complutense de Madrid, Madrid, Spain; ²⁸Department of Cardiology, Oslo University Hospital Ullevål, University of Oslo, Oslo, Norway; ²⁹Department of Clinical Sciences, Danderyd Hospital, Karolinska Institutet, Stockholm, Sweden; ³⁰Department of Cardiology, Sørlandet Hospital Arendal, Arendal, Norway; ³¹Department of Cardiology, Tartu University, Estonia; ³²Department of Cardiology, Hospital Fundación Jiménez Díaz, Madrid, Spain; ³³Department of Cardiology, Rigshospitalet, Copenhagen, Denmark; and ³⁴Department of Clinical Medicine, University of Copenhagen, Copenhagen, Denmark

Received 27 November 2020; editorial decision 30 November 2020; accepted 10 December 2020; online publish-ahead-of-print 7 February 2021

Aims

Quality indicators (QIs) are tools to improve the delivery of evidence-based medicine. In 2017, the European Society of Cardiology (ESC) Association for Acute Cardiovascular Care (ACVC) developed a set of QIs for acute myocardial infarction (AMI), which have been evaluated at national and international levels and across different populations. However, an update of these QIs is needed in light of the accumulated experience and the changes in the supporting evidence.

* Corresponding author. Tel: +33 381 668 624, Fax: +33 381 668 582, Email: francois.schiele@univ-fcomte.fr

Published on behalf of the European Society of Cardiology. All rights reserved. © The Author(s) 2021. For permissions, please email: journals.permissions@oup.com.

Methods and results

The ESC methodology for the QI development was used to update the 2017 ACVC QIs. We identified key domains of AMI care, conducted a literature review, developed a list of candidate QIs, and used a modified Delphi method to select the final set of indicators. The same seven domains of AMI care identified by the 2017 Study Group were retained for this update. For each domain, main and secondary QIs were developed reflecting the essential and complementary aspects of care, respectively. Overall, 26 QIs are proposed in this document, compared to 20 in the 2017 set. New QIs are proposed in this document (e.g. the centre use of high-sensitivity troponin), some were retained or modified (e.g. the in-hospital risk assessment), and others were retired in accordance with the changes in evidence [e.g. the proportion of patients with non-ST segment elevation myocardial infarction (NSTEMI) treated with fondaparinux] and the feasibility assessments (e.g. the proportion of patients with NSTEMI whom risk assessment is performed using the GRACE and CRUSADE risk scores).

Conclusion

Updated QIs for the management of AMI were developed according to contemporary knowledge and accumulated experience. These QIs may be applied to evaluate and improve the quality of AMI care.

Keywords

Quality indicators • Quality improvement • Myocardial infarction

Background

Assessing the quality of care has become mandatory in many health-care systems and is an intrinsic component of quality improvement. In 2017, the European Society of Cardiology (ESC) Association for Acute Cardiovascular Care (ACVC) published a position paper defining quality indicators (QIs) for acute myocardial infarction (AMI)¹ with the aim of supporting quality improvement, and based on the assumption that rigorous measurement is fundamental. This was the first QI initiative undertaken within the ESC by one of its constituent associations, concordant with the mission statement of the ACVC to 'improve the quality of care of patients with acute cardiovascular disease'. The ACVC Study Group on QIs decided that QIs should not only reflect high-grade recommendations in ESC guidelines but also should consider the domains of care for which there is potential room for improvement, and where measurement can be performed using existing registries or databases. As a result, the ACVC QIs covered seven domains of care, including centre organization, reperfusion/invasive strategies, risk assessment, antithrombotic selection, secondary prevention, and patient experience. Lastly, two composite indicators and one outcome were defined.

Objectives

The 2017 ESC ACVC QIs were used to support quality assessment and improvement at national²⁻⁷ and international levels,⁸ and across different populations.⁹ Various studies evaluating the ESC ACVC QIs using existing registries have shown that most QIs can be captured, and, thus can guide the development of future cardiovascular registries.¹⁰ In addition, the ESC ACVC QIs identified gaps in care delivery within and between countries, highlighting missed opportunities to improve clinical outcomes.^{2,3,5,9}

Three years after the publication of the initial set of QIs, the ACVC study group on QI considered that an update was timely, because the ESC has updated its Clinical Practice Guidelines for the management of patients with AMI (with and without ST-segment elevation), and published the methodology by which the ESC QIs should be developed.¹¹ Hence, the QI update was driven by the experience

accumulated from assessment of previous QIs in existing registries (Supplementary material online, Table S1), the ESC methodology for QI development¹¹ as well as other methodologies,^{12,13} and to ensure the validity of the measurements.¹⁴

Methods

The 2017 ESC ACVC QIs were updated using the RAND/University of California–Los Angeles (UCLA) appropriateness method,^{15,16} which is recommended by the ESC methodology for QI development,¹¹ and combines best scientific evidence with the collective judgement of experts using the modified Delphi process.¹⁷

The 2020 ESC ACVC QIs for AMI

The seven domains of AMI care identified by the 2017 Study Group were retained. The list of the main and secondary QIs for each domain are presented in Figure 1 and Supplementary material online, Table S2, with the definitions of numerators and denominators, and the corresponding ESC guidelines recommendations.

Domain 1: centre organization

Network organization

Clinical relevance

In the setting of acute coronary syndrome (ACS), a network organization has a beneficial impact through the availability of different capacities, such as the use of a single telephone emergency number, early identification of ACS, transportation with ambulances with basic or advanced life support capability, direct access to catheterization laboratory, and delivery of care following written protocols.¹⁸ This organization facilitates the selection of the appropriate reperfusion strategy, and reduces times to reperfusion in ST-segment elevation myocardial infarction (STEMI) patients.¹⁹⁻²¹ Furthermore, local, regional, or national written protocols can help to reduce delays, reduce variations in the quality of care,²² and improve the quality of secondary prevention in post-discharge settings.²³

Specific aspects for selection

Two QIs are related to participation in a regional network: the main QI (1) as a measure of network organization for the management of ACS, including written protocols; and the assessment of essential components of effective systems of STEMI care.¹⁸ Similar QIs were already included in



Figure 1 Main and secondary Quality Indicators for each domain. Timely reperfusion is defined as time from ST-segment elevation myocardial infarction diagnosis to (i) infarct-related artery wire crossing: <60 min for patients presenting at a primary percutaneous coronary intervention hospital, or (ii) <90 min for patients diagnosed either in a non-percutaneous coronary intervention hospital or in the out-of-hospital setting, or (iii) injection of the bolus of fibrinolysis <10 min for patients reperused with fibrinolysis.

the 2017 ACVC QI list, are supported by class IC recommendations and also feature in the list of QIs in the 2017 STEMI²⁴ and 2020 non-ST segment elevation ACS (NSTEMI-ACS) ESC guidelines.²⁵

Availability of high-sensitivity troponin assay

Clinical relevance

Cardiac troponin (cTn) elevation is a key diagnostic and prognostic feature in NSTEMI-ACS. Only 'high-sensitivity' cardiac troponin (hs-cTn) assays have imprecision of <10% at the 99th percentile of the upper reference limit and have the ability to quantify cTn levels in >50% of apparently healthy individuals. Data have shown that more sensitive cardiac troponin assays, such as hs-troponin assay increase diagnostic accuracy with greater and more rapid ability to 'rule-in' or 'rule-out' myocardial infarction.²⁶

Specific aspects for selection

Main QI (2) relates to the availability of hs-cTn assay measured at centre level. The use of hs-cTn over less sensitive assays is recommended by guidelines.²⁵ This QI is also included in the QIs list of the 2020 ESC Guidelines for NSTEMI-ACS.²⁵

Pre-hospital interpretation of Electrocardiogram (ECG)

Clinical relevance

Timely diagnosis for patients with STEMI is determinant for clinical outcomes. The ESC guidelines for STEMI recommend acquiring and interpreting a 12-lead ECG as soon as possible following first medical contact (FMC) to facilitate early diagnosis and risk stratification.^{23,24}

Specific aspects for selection

Main QI (3) captures the availability of systems of care in which STEMI diagnosis can be performed in the pre-hospital settings, with the initiation of appropriate treatment pathways.

Participation in a regular registry or quality assessment programme

Clinical relevance

Participation in a registry for quality assessment improves adherence to guidelines.²⁷ Major improvements in hospital performance and mortality rates have been reported over short periods of time, narrowing the gap between the quality of care delivered between hospitals^{28,29} and the

association between the participation in a quality programme for timely reperfusion therapy and clinical improvement has been shown.²³ In addition, the assessment of reperfusion times for STEMI patients is an important and measurable component of STEMI care.

Specific aspects for selection

The two secondary QIs cover the quality improvement programme: participation in a regular registry, and regular monitoring of times to reperfusion. These QIs were already included in the 2017 ESC STEMI guidelines.²⁴

Domain 2: invasive strategy

Reperfusion for ST segment elevation myocardial infarction patients

Clinical relevance

Reperfusion therapy should be administered to all eligible patients presenting with STEMI. Primary percutaneous coronary intervention (PCI) is the preferred option, provided it can be performed expeditiously. Based on considerable evidence, the ESC guidelines recommend time targets for reperfusion therapy based on the strategy used and the initial healthcare facility to which the STEMI patient was admitted. As such, time from STEMI diagnosis to wire crossing is recommended to be <60 min for patients presenting at a primary PCI hospital, whereas it should be <90 min for patients diagnosed either in a non-PCI hospital or in the out-of-hospital setting. For patients treated by fibrinolysis, the recommended time between STEMI diagnosis and initiation of fibrinolysis is <10 min.²⁴

Specific aspects for selection

Both reperfusion and time to reperfusion have been used as key indicators of quality in patients with STEMI in most sets of QIs or performance measures (PMs).^{1,30,31} Main QI (1) assesses the proportion of patients with STEMI admitted within 12 h of the onset of symptoms and treated with reperfusion (irrespective of the timing). Main QI (2) assesses 'timely' reperfusion, defined for reperfusion strategy, by primary PCI or fibrinolysis.³² The time targets correspond to those recommended by the ESC Guidelines.²⁴ From a practical viewpoint, the measure of the proportion of patients with STEMI reperfused among those eligible has been measured in all publications reporting ESC-ACVC QIs assessment and ranged from 57% to 98%.

Early invasive strategy in non-ST segment elevation myocardial infarction patients

Clinical relevance

Patients with non-ST segment elevation myocardial infarction (NSTEMI) are on the spectrum of high-risk NSTEMI-ACS and, therefore, eligible for an invasive approach. The benefit of a routine over a selective invasive approach has been shown in high-risk patients and the timing of the strategy is split into immediate (for patients with very high-risk features such as persistent chest pain), early (<24 h after admission for patients with high-risk features, including those with diagnosis of NSTEMI) or <72 h.

Specific aspects for selection

Main QI (3) measures the use of an early invasive strategy and is therefore suitable for use in patients with NSTEMI. Compared with the previous QI list, the timing has been set at <24 h (instead of <72 h), in line with the ESC Guidelines.^{25,33}

The use of radial access

Clinical relevance

The use of radial access is a new QI in this domain. It is justified by the reduction in bleeding and vascular complications achieved with the radial approach,^{34,35} especially in ACS.³⁶

Specific aspects for selection

This new QI is likely to be easy to assess and will be applicable in the majority of patients, both STEMI and NSTEMI-ACS. Supported by ESC Guidelines, the 'radial-first strategy' has been referred to as 'best practice' in a position paper from the American Heart Association (AHA).³⁷

Domain 3: in-hospital risk assessment

Assessment of left ventricular ejection fraction

Clinical relevance

Left ventricular ejection fraction (LVEF) assessment is important for both prognostic and therapeutic reasons.

Specific aspects for selection

This QI was already in the previous ESC ACVC QIs set.

Assessment of LDL-cholesterol

Clinical relevance

LDL-cholesterol (LDL-c) is considered a causal factor for atherosclerosis.³⁸ Early and intense reduction of LDL-c as soon as possible after admission has been shown to be effective. The utility of LDL-c assessment is therefore not for the prescription of statins, but rather to have an initial reference value (called 'baseline', i.e. without the effect of LDL-C lowering therapy) and to estimate the potential likelihood of reaching the 2019 ESC guidelines target,³⁹ with a view to using additional therapies such as the combination with ezetimibe⁴⁰ or the early (within 4–6 weeks after discharge) introduction of a proprotein convertase subtilisin–kexin type 9 (PCSK9) inhibitor.³⁹

Specific aspects for selection

This QI is new and applicable in all patients.

Risk assessment using a validated score

Clinical relevance

Patient stratification using validated scores is important, both for ischaemic and haemorrhagic risks. Thus, the use of a validated risk score is recommended by the ESC Guidelines (Class IA) for prognosis.

Specific aspects for selection

In the 2017 ESC ACVC QIs, two specific validated scores were included as independent QIs (i.e. the GRACE risk score for ischaemic risk, and the CRUSADE score for haemorrhagic risk). The Study Group decided to retire the specification of the tool used, but to keep the recommendation to perform risk assessment using a validated method.

Domain 4: antithrombotic treatment during hospitalization

Proportion of patients with 'adequate P2Y12 inhibition'

Clinical relevance

In patients with AMI, dual antiplatelet therapy (DAPT) is recommended as soon as possible when ACS is suspected. Among patients eligible for DAPT, the choice between clopidogrel, prasugrel, and ticagrelor is mainly

driven by the results of randomized studies comparing clopidogrel to prasugrel^{41,42} and to ticagrelor,^{43,44} and the bleeding risk. 'Adequate P2Y₁₂ inhibition' is defined as the appropriate selection of the P2Y₁₂ inhibitor in accordance with the 2020 ESC Guidelines:

- the use of ticagrelor in patients without a contraindication (e.g. previous haemorrhagic stroke, high bleeding risk, treatment with fibrinolysis, or concomitant use of oral anticoagulation).
- the use of prasugrel in PCI-treated AMI patients without previous haemorrhagic or ischaemic stroke, high bleeding risk (patients 75 years of age and/or with body weight < 60 kg), fibrinolysis or oral anticoagulation
- the use of clopidogrel when there is no indication for prasugrel or ticagrelor.

Specific aspects for selection

Given the importance of selecting the most appropriate P2Y₁₂ inhibitor in patients with coronary artery disease (i.e. tailored to the patient's ischaemic and bleeding risks), a Task Force of the ESC and European Association for Cardio-Thoracic Surgery published a focused update on DAPT,⁴⁵ in line with the STEMI and NSTEMI-ACS Guidelines, all supporting the concept of 'adequate P2Y₁₂ inhibition'. This QI already featured in the previous ACVC QIs set, and is included in the list of QIs of the 2020 ESC Guidelines for NSTEMI-ACS. Experience with the assessment of the ACVC QIs shows that this QI may be measured from many, but not all, existing registries, depending on the quality of the variables recorded ([Supplementary material online, Table S1](#)).

Parenteral anticoagulant at (or before) admission

Clinical relevance

Parenteral anticoagulation is recommended in AMI from the time of diagnosis up to PCI unless otherwise indicated. Different anticoagulant agents (unfractionated heparin, enoxaparin, fondaparinux, or bivalirudin) may be used in this setting. Parenteral anticoagulation is recommended for all patients, in addition to antiplatelet therapy, at the time of diagnosis.

Specific aspects for selection

This QI replaces the previous QI relating to fondaparinux because the ESC Guidelines no longer express a strong preference for any particular drug.

Patients discharged on dual antiplatelet therapy

Clinical relevance

The need for DAPT is a cornerstone of AMI management at the time of hospital admission and discharge, unless the patient is deemed to be at high bleeding risk.⁴⁵

Specific aspects for selection

This QI is a complement to main QI (1), with the particular interest of being more straightforward, easier to assess, and including the prescription of aspirin. Contrary to 'adequate P2Y₁₂ inhibition', this QI is reported in all published assessments. Notably, patients treated with oral anticoagulation are excluded because several alternative strategies are available, including some without aspirin.

Mention the duration of dual antiplatelet therapy in the discharge letter

Clinical relevance

Although the standard duration of DAPT after AMI is 12 months, it must be determined according to the patient's risk and ischaemic profile, and

may range from 1 to 48 months.⁴⁵ At discharge, a shortening or prolongation of the DAPT duration may be proposed according to specific tools, depending on the patient's characteristics, coronary anatomy, the extent of coronary artery disease, or PCI procedure.

Specific aspects for selection

Poor quality discharge letters represent a deficit in communication between hospital specialists and primary care physicians.⁴⁶ The post-AMI discharge document is a crucial element to ensuring transmission of medical information to the corresponding physician or the patient, including the ischaemic and haemorrhagic risk as perceived during the acute hospitalization. Standardization of the discharge document, including insights about the type and duration of the anti-thrombotic treatment has been highlighted by the recent ESC guidelines²⁵ and its routine application has been accepted by a national group in France.⁴⁷

Domain 5: secondary prevention discharge treatments

After AMI, patients remain at very high-risk and secondary prevention treatment is crucial for reducing mortality and further cardiovascular events. The QIs in this domain cover the prescription of three therapeutic classes, in addition to the anti-thrombotic treatment.

High-intensity statins

Clinical relevance

Statins are fundamental to the treatment of atherosclerosis. In the setting of AMI, high intensity statins are safe and provide better prevention as compared to moderate intensity,⁴⁸ irrespective of admission LDL-c. Despite the body of evidence regarding the beneficial effects of lowering LDL-c³⁸ by statins (alone or in combination with ezetimibe or PCSK9 inhibitors), their use in current registries remains sub-optimal and the proportion of patients at LDL-c target is low: 32% in men and 23% in women in the EuroAspire V registry.⁴⁹

Specific aspects for the selection

This QI was already in the 2017 ESC-ACVC list. Experience of assessment suggests that this QI cannot be assessed from some registries, because the type and dose of statins prescribed at discharge were not recorded. In addition, it is likely that intolerance to high-intensity statins was also not recorded. In registries reporting this QI, the rate of prescription of statins (any intensity) is high, but at high intensity in only about half of the patients.⁴⁹

Patients with left ventricular ejection fraction 40% who are discharged from hospital on angiotensin-converting enzyme inhibitors (or angiotensin receptor antagonists if intolerant of ACEI)

Clinical relevance

Angiotensin-converting enzyme inhibitors (ACEIs) improve survival in patients with impaired LV systolic function, defined by an LVEF <40%. Initiation of ACEI [or angiotensin receptor antagonists (ARBs) in patients intolerant to ACEI] and prescription at the time of hospital discharge is beneficial among patients with an LVEF <40%.

Specific aspects for the selection

This QI was already in the 2017 ESC ACVC list, supported by a Class IIA recommendation. In practice, the proportion of patients with LVEF ≤40% is 15–20% in current registries; therefore, the QI applies only to a subset of high-risk patients.

Patients with left ventricular ejection fraction 40% who are discharged from hospital on beta-blockers

Clinical relevance

Beta-blockers remain a standard of care following AMI, however, the evidence was based on studies performed before the era of reperfusion.⁵⁰ In a recent large-scale observational study, a benefit with beta-blockade in post-AMI patients was shown, but only among patients with LV dysfunction.⁵¹

Specific aspects for the selection

This QI was already in the 2017 ESC-ACVC list. The exact type of beta-blocker indicated for patients with LV systolic dysfunction was not specified for the QI, given the complexity of the measure.

Domain 6: patient satisfaction

Feedback regarding the patient's experience and systematic assessment of health-related quality of life

Clinical relevance

The concept of 'patient-centred care' is based on focusing care on the patient rather than on the disease. In this approach, patients are actively involved in their own care, congruent with the principle of shared-decision making. Patient-reported outcomes (PRO, which can be seen as an assessment of the perceived level of impairment, disability, and quality of life) and patient-reported experience (PRE, which gather information on the care)⁵² can be considered as QIs. To this end, PRO and PRE can be measured through patient satisfaction questionnaires.⁵³ In the setting of AMI, patient satisfaction PRO and PRE are associated with other indices of quality of care.^{54,55}

Specific aspects for selection

This QI was already included in the 2017 ESC-ACVC QI list, but only partial assessment has been reported, except for 'referral to rehabilitation programmes' and 'pain control'. The use of a health-related quality of life questionnaire at discharge is reported in the long-term follow-up of antithrombotic management patterns in acute CORonary syndrome patients (EPICOR) and the Evaluation of the Methods and Management of Acute Coronary Events (EMMACE)-3 and -4 registries.⁸ The Study Group has defined the main QI as a 4-item composite indicator including referral to a rehabilitation programme, patient information about the disease, treatment, and pain control. The secondary QI is the assessment of the health-related quality of life in all patients using a validated instrument.

Discharge letter sent to the patient

Clinical relevance

Copying the hospital discharge letter to the patient is an essential part of communication. The UK Academy of Medical Royal Colleges has published guidance on this topic, considering that excellent written communication is essential to good quality of care and that the letter would be better addressed to the patient and not to the corresponding physician ('Write to, not about').⁵⁶ This practice of writing to the patient, compared with writing to the clinician, increases patient satisfaction, improves both the doctor-patient relationship and trust, and reduces anxiety.⁵⁷

Specific aspects for selection

To date, no similar QI or PM has been defined, but it appears to be feasible even if this currently remains undetermined.

Domain 7: outcome and composite quality indicator

Outcomes quality indicator

Thirty-day mortality rate adjusted for a validated risk score is unchanged.

Clinical relevance

All-cause mortality is a self-evident assessment of quality of care and the most easily interpretable, objective and unambiguous indicator. While the accuracy of mortality as a direct measure of quality of care is controversial,⁵⁸ the association between the ESC ACVC composite QI and the risk-adjusted outcomes is important.

Specific aspects for the selection

All-cause mortality is easy to assess and this measure provides essential information at broad-level (i.e. region-, country-, or continent-levels). At centre-level, the interpretation may be more challenging and less generalizable, depending on the size of the denominator.

Composite quality indicator

Composite quality indicators (CQIs) summarize information from different domains into a single measure. Thus, it is possible to expand the scope of the measure by including a broad range of individual indicators, to provide a single metric that enables temporal comparisons, classification of centres, and demonstration of the association between the CQI and outcomes, a way of reassuring clinicians about the validity of process instead of clinical outcome assessment.¹³

Clinical relevance

By reducing the information from all domains into a single CQI, the areas for specific improvement may be obscured. Among the different types of composites, the opportunity-based and the all-or-none are the most frequently recommended for the quality of care assessment.^{59,60} Since the two methods, while associated,⁶¹ provide different approaches, both types of CQI have been maintained in the updated version. The main CQI is an opportunity-based score, where all domains are represented and have the same weight (except in patients with LVEF $\leq 40\%$ in whom two additional items are required, giving more weight to the secondary prevention domain). This design has the advantage of increasing the number of items, which may vary according to the patient characteristics and the database used. The secondary CQI has an all-or-none design with only three individual QIs, but all three are deemed clinically relevant: the timely reperfusion or invasive strategy, the prescription of the 'appropriate' P2Y₁₂ inhibition and high-intensity statins. With this CQI, only patients who received all three processes are considered as a success and therefore, this method best reflects the patient's interest and tracks excellence.

Specific aspects for the selection

In the previous experience of assessment of the 2017 ESC ACVC QIs, the opportunity-based CQI was reported in most cases and, after transformation into categories, was associated with mortality.^{2,3,5,7,8} The Study Group decided that the opportunity-based CQI should contain one item per domain, namely the most adequate to capture quality, despite the challenges for assessment, and considering that this was more an issue related to the design of current registries than the definition of the CQI.

Comparison with previous quality metrics definitions and future developments

The comparison of QI selection between the ESC ACVC 2020 and ESC-ACCA 2017, the American College of Cardiology (ACC) and AHA

Table 1 Quality metrics selected by ESC-ACVC 2020, ESC ACCA 2017, ACC/AHA 2017, and CCS 2008

Domain	Indicators	ACVC 2020	ACCA 2017	ACC/AHA 2017	CCS 2008
Centre Organization	Network	Green	Green	Green	Green
	Availability of hs-cTn	Green	White	Orange	White
	Pre-hospital interpretation of ECG	Green	Green	White	Orange
	Quality registry programme Systematic assessment of times to reperfusion	Green	Green	Green	Green
Reperfusion—invasive coronary strategy	STEMI with reperfusion	Green	Green	Green	Green
	Timely reperfusion by PCI	Green	Orange	Green	Orange
	Time for fibrinolytic therapy	Green	Green	Green	Green
	Door to needle time	Red	Green	Green	Green
	Door in Door out time	Red	Green	Green	Green
	Time to PCI transferred patient	Green	Green	Green	Green
	Invasive strategy <24 h	Green	Orange	Green	Green
Risk assessment	Radial access	Green	Green	Green	Green
	FMC to arterial access (STEMI)	Green	Green	Green	Orange
	LVEF assessment	Green	Green	Green	Green
	LDL-c assessment	Green	Green	Red	Green
Antithrombotics	Risk assessment with a validated score	Red	Green	Green	Green
	Adequate P2Y₁₂	Green	Green	Orange	Green
	Aspirin admission	Green	Green	Green	Green
Secondary Prevention	Parenteral anticoagulation	Green	Orange	Red	Green
	DAPT at discharge	Green	Green	Green	Green
	Mention about DAPT duration	Green	Green	Green	Green
	High-intensity statins	Green	Green	Green	Orange
Patient satisfaction	Aspirin discharge	Green	Green	Green	Green
	ACEI/ARB if LVEF < 40%	Green	Orange	Green	Green
	Aldosterone antagonist at discharge	Green	Green	Green	Green
	Beta-blockers if LVEF < 40%	Green	Orange	Orange	Orange
Cardiac arrest	Feedback	Green	Green	Green	Green
	Cardiac rehabilitation	Green	Green	Green	Green
	Smoking cessation advice	Green	Green	Red	Green
Composite Indicator	Quality of life	Green	Green	Green	Green
	Discharge letter	Green	Green	Green	Green
Outcomes	Immediate angiography	Green	Green	Green	Green
	Hypothermia	Green	Green	Green	Green
Outcomes	Opportunity-based	Green	Orange	Green	Green
	All or none	Green	Green	Green	Green
Outcomes	Thirty-day risk-adjusted mortality	Green	Green	Green	Orange

In bold, the Main QIs in 2020. Green indicates quality metric with comparable definition to ESC ACVC 2020; in orange, quality metric selected items with a different definition, in white, no corresponding quality metric. In red, withdrawn indicators.

2017⁶² and Canadian Cardiovascular Society (CCS) 2008 is presented in Table 1.

- *Centre organization*: compared to the 2017 selection, the QI on availability of hs-cTn in the centre is new.
- *Reperfusion/invasive strategy*: the number of QIs has been reduced and the indicators related to the time for reperfusion have been aligned with the 2017 ESC GL and simplified as compared to the 2017 definition. As compared to the ACC/AHA measure set, the starting time is the initial diagnosis of STEMI (vs. first medical contact for ACC/AHA) and the thresholds are different: <60 min to wire crossing the lesion for patients presenting at a primary PCI hospital, or <90 min for

patients diagnosed either in a non-PCI hospital or in the out-of-hospital setting who were then transferred to a PCI-capable centre, and <10 min in case of reperfusion with fibrinolysis. The radial access QI is new and has not been presented in other selections. The reduction of the time to invasive approach to 24 h in NSTEMI is in line with comparable PM from the ACC/AHA.

- *Risk assessment*: the main change is the simplification of the overall risk assessment, without specifying specific risk scores. The assessment of LDL-c has been added as a Main QI. The ESC Guidelines recommend this measure because available evidence supports the addition of ezetimibe and PCSK9 inhibitors on top of high-intensity statins in selected patients.

- *Antithrombotic treatment during hospitalization*: the prescription of 'adequate P2Y₁₂ inhibition', already in the 2017 list, has been confirmed, despite the complexity of the assessment. The selection of an 'adequate' P2Y₁₂ inhibitor is also in the ACC/AHA PM list with two different definitions, both focusing on the safety side, without considering the potential benefit of using a more potent P2Y₁₂ inhibitor in eligible patients. The use of fondaparinux (for NSTEMI-ACS in the ACVC 2017 selection) has been replaced by the use of a parenteral agent at admission. The mention of the duration of DAPT in the discharge letter is a new indicator, never seen in previous selections. As in 2017, aspirin at admission and at discharge are not included in the list of QIs, reflecting the fact that although this treatment is of paramount importance, the Study Group considers it to be widely applied, with limited room for improvement.³⁰
- *Secondary prevention*: there has been no change to this section, compared to the 2017 selection. The prescription of high-intensity statins at discharge was also adopted by ACC/AHA, while aspirin at discharge (and at admission) is considered to be 'topped out' and not included in the ESC ACVC list.
- *Patient satisfaction*: with the exception of cardiac rehabilitation, no comparable indicators have been defined by the ACC/AHA or CCS. The Study Group consider these QI to be important, and there is a compelling need to include the necessary variables in future registries to render assessment possible.
- *Mortality*: risk-adjusted 30-day all-cause mortality has been maintained in the updated QI list, despite significant limitations for interpretation. In contrast, no outcome measure has been selected by ACC/AHA, because the outcomes are only partially dependent on the quality of care, risk adjustment is challenging and, used as PM and not a QI, inclusion of outcome measures could have potentially negative consequences.¹²

Perspectives

The first set of QIs was developed to improve quality through self-assessment. This has been possible in different countries, not carried out by health agencies or insurance companies, but by cardiologists themselves at low cost through existing registries. To facilitate such use of QIs, the Study Group considered the results of these assessments in revising the QIs. Thus, some QIs that were found to be challenging to report have been retired or modified. Conversely, despite not being measured in all registries, certain QIs have been maintained, considering that they capture important aspects of quality care. The next step will be the standardization of the main registries in Europe in order to include the specific variables needed for quality assessment according to the revised set of QIs. In most existing registries and surveys, this would correspond to the addition of a limited number of variables, which should be reliable and straightforward to assess.

Supplementary material

Supplementary material is available at *European Heart Journal: Acute Cardiovascular Care*.

Conflict of interest: Dr. Ahrens reports personal fees from Vifor-Pharma, personal fees from Daiichi Sankyo, personal fees from Bayer, personal fees from Amgen, personal fees from Astra Zeneca, personal fees from Novartis, outside the submitted work; Dr. Bueno reports grants and personal fees from Astra Zeneca, grants and personal fees from Bayer, grants and personal fees from BMS-Pfizer, grants and personal fees from Novartis, personal fees from Amgen, outside the

submitted work; Dr. Claeys reports personal fees from Astra Zeneca, personal fees from Bayer Healthcare, personal fees from Sanofi aventis, personal fees from Boehringer Ingelheim, personal fees from Abbott, outside the submitted work; Dr. Collet reports grants from Bristol-Myers Squibb, grants and personal fees from Medtronic, grants from Boston Scientific, personal fees from Bristol Myers Squibb, personal fees from Lead-Up, personal fees from MSD, personal fees from Sanofi aventis, from WebMD, outside the submitted work; Dr. Fox reports grants from Astra Zeneca, grants from Bayer/Janssen, personal fees from Sanofi/Regeneron, personal fees from Verseen, personal fees from Bayer/Janssen, outside the submitted work; Dr. Gale reports personal fees from Astra Zeneca, personal fees from Vifor Pharma, personal fees from Novartis, personal fees from Daiichi Sankyo, personal fees from Bayer, grants from Abbott, grants from BMS, outside the submitted work; Dr. Huber reports personal fees from The Medicine Company, personal fees from Amgen, personal fees from Bayer, personal fees from BMS, personal fees from Astra Zeneca, personal fees from Boehringer-Ingelheim, personal fees from Chiesi, personal fees from Portola, personal fees from Daiichi Sankyo, personal fees from Pfizer, personal fees from Sanofi, outside the submitted work; Dr. Iakobishvili reports personal fees from Astra-Zeneca, personal fees from Sanofi, personal fees from Bayer, grants and personal fees from Novo-Nordisk, personal fees from Pfizer, personal fees from Boehringer Ingelheim, grants from Medison, outside the submitted work; Dr. Keys reports personal fees from Astra Zeneca, outside the submitted work; Dr. Leonardi reports grants and personal fees from Astra Zeneca, personal fees from Bayer Healthcare, personal fees from BMS/Pfizer, from Novo Nordisk, personal fees from Chiesi, outside the submitted work; Dr. Lettino reports personal fees from Amgen, personal fees from Bayer, personal fees from Sanofi, personal fees from Pfizer, personal fees from BMS, personal fees from Daiichi Sankyo, outside the submitted work; Dr. Masoudi reports grants from NHLBI, outside the submitted work; Dr. Schiele reports personal fees from Amgen, Astra Zeneca, Bayer, BMS, MSD, Pfizer, and Sanofi, outside the submitted work; No other author has any conflict of interest to declare.

References

1. Schiele F, Gale CP, Bonnefoy E, Capuano F, Claeys MJ, Danchin N, Fox KA, Huber K, Iakobishvili Z, Lettino M, Quinn T, Rubini Gimenez M, Botker HE, Swahn E, Timmis A, Tubaro M, Vrints C, Walker D, Zaher D, Zeymer U, Bueno H. Quality indicators for acute myocardial infarction: a position paper of the acute cardiovascular care association. *Eur Heart J Acute Cardiovasc Care* 2017; **6**:34–59.
2. Araújo C, Laszczyńska O, Viana M, Dias P, Maciel MJ, Moreira I, Azevedo A. Quality of care and 30-day mortality of women and men with acute myocardial infarction. *Rev Esp Cardiol (Engl Ed)* 2019; **72**:543–552.
3. Bebb O, Hall M, Fox KAA, Dondo TB, Timmis A, Bueno H, Schiele F, Gale CP. Performance of hospitals according to the ESC ACCA quality indicators and 30-day mortality for acute myocardial infarction: national cohort study using the United Kingdom Myocardial Ischaemia National Audit Project (MINAP) register. *Eur Heart J* 2017; **38**:974–982.
4. Hudzik B, Budaj A, Gierlotka M, Witkowski A, Wojakowski W, Zdrojewski T, Gil R, Legutko J, Bartus S, Buszman P, Dudek D, Gasior M. Assessment of quality of care of patients with ST-segment elevation myocardial infarction. *Eur Heart J Acute Cardiovasc Care* 2019; **20**:48872619882360.
5. Schiele F, Gale CP, Simon T, Fox KAA, Bueno H, Lettino M, Tubaro M, Puymirat E, Ferrieres J, Meneveau N, Danchin N. Assessment of quality indicators for acute myocardial infarction in the FAST-MI (French Registry of Acute ST-Elevation or Non-ST-Elevation Myocardial Infarction) Registries. *Circ Cardiovasc Qual Outcomes* 2017; **10**:e003336.

6. Timoteo AT, Mimoso J, Pro ACS, on behalf of the ProACS Investigators. Assessment of quality performance measures in patients with acute coronary syndromes: data from the Portuguese Registry of Acute Coronary Syndromes (ProACS), a nationwide registry. *J Eval Clin Pract* 2018;**24**:439–446.
7. Zusman O, Bebb O, Hall M, Dondo TB, Timmis A, Schiele F, Fox KA, Kornowski R, Gale CP, Iakobishvili Z. International comparison of acute myocardial infarction care and outcomes using quality indicators. *Heart* 2019;**105**:820–825.
8. Rossello X, Medina J, Pocock S, Van de Werf F, Chin CT, Danchin N, Lee SW, Huo Y, Bueno H. Assessment of quality indicators for acute myocardial infarction management in 28 countries and use of composite quality indicators for benchmarking. *Eur Heart J Acute Cardiovasc Care* 2020;**9**:911–922.
9. Wilkinson C, Bebb O, Dondo TB, Munyombwe T, Casadei B, Clarke S, Schiele F, Timmis A, Hall M, Gale CP. Sex differences in quality indicator attainment for myocardial infarction: a nationwide cohort study. *Heart* 2019;**105**:516–523.
10. Wallentin L, Gale CP, Maggioni A, Bardinet I, Casadei B. EuroHeart: European unified registries on heart care evaluation and randomized trials. *Eur Heart J* 2019;**40**:2745–2749.
11. Aktaa S, Batra G, Wallentin L, Baigent C, Erlinge D, James S, Ludman P, Maggioni AP, Price S, Weston C, Casadei B, Gale CP. European Society of Cardiology methodology for the development of quality indicators for the quantification of cardiovascular care and outcomes. *Eur Heart J Qual Care Clin Outcomes* 2020.
12. Spertus JA, Bonow RO, Chan P, Diamond GA, Drozda JP Jr, Kaul S, Krumholz HM, Masoudi FA, Normand SL, Peterson ED, Radford MJ, Rumsfeld JS; Writing Committee Members. ACCF/AHA new insights into the methodology of performance measurement: a report of the American College of Cardiology Foundation/American Heart Association Task Force on performance measures. *Circulation* 2010;**122**:2091–2106.
13. Peterson ED, DeLong ER, Masoudi FA, O'Brien SM, Peterson PN, Rumsfeld JS, Shahian DM, Shaw RE. ACCF/AHA 2010 Position Statement on Composite Measures for Healthcare Performance Assessment: a report of American College of Cardiology Foundation/American Heart Association Task Force on Performance Measures (Writing Committee to Develop a Position Statement on Composite Measures). *J Am Coll Cardiol* 2010;**55**:1755–1766.
14. MacLean CH, Kerr EA, Qaseem A. Time out—charting a path for improving performance measurement. *N Engl J Med* 2018;**378**:1757–1761.
15. Brook RH, McGlynn EA, Cleary PD. Quality of health care. Part 2: measuring quality of care. *N Engl J Med* 1996;**335**:966–970.
16. Brook RH. *Clinical Practice Guideline Development: Methodology Perspectives*. Rockville, MD: Agency for Healthcare Research and Policy, 1994. The RAND/UCLA appropriateness method. In: KA McCormack, SR Moore, RA Siegel, (eds);
17. Normand SL, McNeil BJ, Peterson LE, Palmer RH. Eliciting expert opinion using the Delphi technique: identifying performance indicators for cardiovascular disease. *Int J Qual Health Care* 1998;**10**:247–260.
18. Huber K, Gersh BJ, Goldstein P, Granger CB, Armstrong PW. The organization, function, and outcomes of ST-elevation myocardial infarction networks worldwide: current state, unmet needs and future directions. *Eur Heart J* 2014;**35**:1526–1532.
19. Alexander T, Mulasari AS, Joseph G, Kannan K, Veerasekar G, Victor SM, Ayers C, Thomson VS, Subban V, Gnanaraj JP, Narula J, Kumbhani DJ, Nallamothu BK. A system of care for patients with ST-segment elevation myocardial infarction in India: the Tamil Nadu-ST-segment elevation myocardial infarction program. *JAMA Cardiol* 2017;**2**:498–505.
20. Henry TD, Sharkey SW, Burke MN, Chavez JJ, Graham KJ, Henry CR, Lips DL, Madison JD, Menssen KM, Mooney MR, Newell MC, Pedersen WR, Poulouse AK, Traverse JH, Unger BT, Wang YL, Larson DM. A regional system to provide timely access to percutaneous coronary intervention for ST-elevation myocardial infarction. *Circulation* 2007;**116**:721–728.
21. Le May MR, So DY, Dionne R, Glover CA, Froeschl MP, Wells GA, Davies RF, Sherrard HL, Maloney J, Marquis JF, O'Brien ER, Trickett J, Poirier P, Ryan SC, Ha A, Joseph PG, Labinaz M, Citywide A. protocol for primary PCI in ST-segment elevation myocardial infarction. *N Engl J Med* 2008;**358**:231–240.
22. Saia M, Mantoan D, Fonzo M, Bertonecello C, Soattin M, Sperotto M, Baldo V, Furlan P, Scapellato ML, Viel G, Baldo V, Cocchio S, Buja A. Impact of the regional network for AMI in the management of STEMI on care processes, outcomes and health inequities in the veneto region. *Italy. Int J Environ Res Public Health* 2018;**15**:1980.
23. Scholz KH, Lengenfelder B, Jacobshagen C, Fleischmann C, Moehtlis H, Olbrich HG, Jung J, Maier LS, Maier SK, Bestehorn K, Friede T, Meyer T. Long-term effects of a standardized feedback-driven quality improvement program for timely reperfusion therapy in regional STEMI care networks. *Eur Heart J Acute Cardiovasc Care* 2020;2048872620907323.
24. Ibanez B, James S, Agewall S, Antunes MJ, Bucciarelli-Ducci C, Bueno H, Caforio ALP, Crea F, Goudevanos JA, Halvorsen S, Hindricks G, Kastrati A, Lenzen MJ, Prescott E, Roffi M, Valgimigli M, Varenhorst C, Vranckx P, Widimsky P. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: the Task Force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). *Eur Heart J* 2018;**39**:119–177.
25. Collet JP, Thiele H, Barbato E, Barthelémy O, Bauersachs J, Bhatt DL, Dendale P, Dorobantu M, Edvardsen T, Folliguet T, Gale CP, Gilard M, Jobs A, Juni P, Lambrinou E, Lewis BS, Mehilli J, Meliga E, Merkely B, Mueller C, Roffi M, Rutten FH, Sibbing D, Siontis GCM. 2020 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation. *Eur Heart J* 2020;**29**:ehaa575.
26. Mueller C. Biomarkers and acute coronary syndromes: an update. *Eur Heart J* 2014;**35**:552–556.
27. Lewis WR, Peterson ED, Cannon CP, Super DM, LaBresh KA, Quealy K, Liang L, Fonarow GC. An organized approach to improvement in guideline adherence for acute myocardial infarction: results with the get with the guidelines quality improvement program. *Arch Intern Med* 2008;**168**:1813–1819.
28. Boukredid R, Abdoul H, Loustau M, Sibony O, Alberti C. Using and reporting the Delphi method for selecting healthcare quality indicators: a systematic review. *PLoS One* 2011;**6**:e20476.
29. Gitt AK, Bueno H, Danchin N, Fox K, Hochadel M, Kearney P, Maggioni AP, Opolski G, Seabra-Gomes R, Weidinger F. The role of cardiac registries in evidence-based medicine. *Eur Heart J* 2010;**31**:525–529.
30. Jneid H, Addison D, Bhatt DL, Fonarow GC, Gokak S, Grady KL, Green LA, Heidenreich PA, Ho PM, Jurgens CY, King ML, Kumbhani DJ, Pancholy S. 2017 AHA/ACC clinical performance and quality measures for adults with ST-elevation and non-ST-elevation myocardial infarction: a report of the American College of Cardiology/American Heart Association Task Force on Performance Measures. *J Am Coll Cardiol* 2017;**70**:2048–2090.
31. Anderson HV, Jacob R. Assessing performance and quality after non-ST segment elevation acute coronary syndromes. *Curr Cardiol Rep* 2018;**20**:133.
32. Cenko E, Ricci B, Kedev S, Vasiljevic Z, Dorobantu M, Gustiene O, Knezevic B, Milicic D, Dilic M, Trninc D, Smith F, Manfrini O, Badimon L, Bugiardini R. Reperfusion therapy for ST-elevation acute myocardial infarction in Eastern Europe: the ISACS-TC registry. *Eur Heart J Qual Care Clin Outcomes* 2016;**2**:45–51.
33. Roffi M, Patrono C, Collet JP, Mueller C, Valgimigli M, Andreotti F, Bax JJ, Borger MA, Brotons C, Chew DP, Gencer B, Hasenfuss G, Kjeldsen S, Lancellotti P, Landmesser U, Mehilli J, Mukherjee D, Storey RF, Windecker S. Group ESCSD. 2015 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation: Task Force for the Management of Acute Coronary Syndromes in Patients Presenting without Persistent ST-Segment Elevation of the European Society of Cardiology (ESC). *Eur Heart J* 2016;**37**:267–315.
34. Jolly SS, Yusuf S, Cairns J, Niemela K, Xavier D, Widimsky P, Budaj A, Niemela M, Valentin V, Lewis BS, Avezum A, Steg PG, Rao SV, Gao P, Afzal R, Joyner CD, Chrolavicius S, Mehta SR; RIVAL group. Radial versus femoral access for coronary angiography and intervention in patients with acute coronary syndromes (RIVAL): a randomised, parallel group, multicentre trial. *Lancet* 2011;**377**:1409–1420.
35. Valgimigli M, Gargiulo G, Juni P. Radial versus femoral access for cardiac catheterization—Authors' reply. *Lancet* 2015;**386**:2394.
36. Romagnoli E, Biondi-Zoccai G, Sciahbasi A, Politi L, Rigattieri S, Pendenza G, Summaria F, Patrizi R, Borghi A, Di Russo C, Moretti C, Agostoni P, Loschiavo P, Lioy E, Sheiban I, Sangiorgi G. Radial versus femoral randomized investigation in ST-segment elevation acute coronary syndrome: the RIFLE-STEACS (Radial Versus Femoral Randomized Investigation in ST-Elevation Acute Coronary Syndrome) study. *J Am Coll Cardiol* 2012;**60**:2481–2489.
37. Mason PJ, Shah B, Tamis-Holland JE, Bittl JA, Cohen MG, Safirstein J, Drachman DE, Valle JA, Rhodes D, Gilchrist IC; American Heart Association Interventional Cardiovascular Care Committee of the Council on Clinical Cardiology; Council on Cardiovascular and Stroke Nursing; Council on Peripheral Vascular Disease; and Council on Genomic and Precision Medicine. An update on radial artery access and best practices for transradial coronary angiography and intervention in acute coronary syndrome: a scientific statement from the American Heart Association. *Circ Cardiovasc Interv* 2018;**11**:e000035.
38. Ference BA, Ginsberg HN, Graham I, Ray KK, Packard CJ, Bruckert E, Hegele RA, Krauss RM, Raal FJ, Schunkert H, Watts GF, Borén J, Fazio S, Horton JD, Masana L, Nicholls SJ, Nordestgaard BG, van de Sluis B, Taskinen M-R, Tokgozoglu L, Landmesser U, Laufs U, Wiklund O, Stock JK, Chapman MJ, Catapano AL. Low-density lipoproteins cause atherosclerotic cardiovascular disease. 1. Evidence from genetic, epidemiologic, and clinical studies. A consensus statement from the European Atherosclerosis Society Consensus Panel. *Eur Heart J* 2017;**38**:2459–2472.
39. Mach F, Baigent C, Catapano AL, Koskinas KC, Casula M, Badimon L, Chapman MJ, De Backer GG, Delgado V, Ference BA, Graham IM, Halliday A, Landmesser U, Mihaylova B, Pedersen TR, Riccardi G, Richter DJ, Sabatine MS, Taskinen M-R, Tokgozoglu L, Wiklund O; ESC Scientific Document Group. 2019 ESC/EAS

- Guidelines for the management of dyslipidaemias: lipid modification to reduce cardiovascular risk. *Eur Heart J* 2020;**41**:111–188.
40. Cannon CP, Blazing MA, Giugliano RP, McCagg A, White JA, Theroux P, Darius H, Lewis BS, Ophuis TO, Jukema JW, De Ferrari GM, Ruzyllo W, De Lucca P, Im K, Bohula EA, Reist C, Wiviott SD, Tershakovec AM, Musliner TA, Braunwald E, Califf RM; for the IMPROVE-IT Investigators. Ezetimibe added to statin therapy after acute coronary syndromes. *N Engl J Med* 2015;**372**:2387–2397.
 41. Montalescot G, Wiviott SD, Braunwald E, Murphy SA, Gibson CM, McCabe CH, Antman EM; for the TRITON-TIMI 38 investigators. Prasugrel compared with clopidogrel in patients undergoing percutaneous coronary intervention for ST-elevation myocardial infarction (TRITON-TIMI 38): double-blind, randomised controlled trial. *Lancet* 2009;**373**:723–731.
 42. Wiviott SD, Braunwald E, McCabe CH, Montalescot G, Ruzyllo W, Gottlieb S, Neumann FJ, Ardissino D, De Servi S, Murphy SA, Riesmeyer J, Weerakkody G, Gibson CM, Antman EM. Prasugrel versus clopidogrel in patients with acute coronary syndromes. *N Engl J Med* 2007;**357**:2001–2015.
 43. Steg PG, James S, Harrington RA, Ardissino D, Becker RC, Cannon CP, Emanuelsson H, Finkelstein A, Husted S, Katus H, Kilhamn J, Olofsson S, Storey RF, Weaver WD, Wallentin L, Group PS; for the PLATO Study Group. Ticagrelor versus clopidogrel in patients with ST-elevation acute coronary syndromes intended for reperfusion with primary percutaneous coronary intervention: a Platelet Inhibition and Patient Outcomes (PLATO) trial subgroup analysis. *Circulation* 2010;**122**:2131–2141.
 44. Wallentin L, Becker RC, Budaj A, Cannon CP, Emanuelsson H, Held C,orrow J, Husted S, James S, Katus H, Mahaffey KW, Scirica BM, Skene A, Steg PG, Storey RF, Harrington RA, Freij A, Thorsen M. Ticagrelor versus clopidogrel in patients with acute coronary syndromes. *N Engl J Med* 2009;**361**:1045–1057.
 45. Valgimigli M, Bueno H, Byrne RA, Collet JP, Costa F, Jeppsson A, Juni P, Kastrati A, Kolh P, Mauri L, Montalescot G, Neumann FJ, Petricevic M, Roffi M, Steg PG, Windecker S, Zamorano JL, Levine GN; Guidelines ESCCfP, Societies ESCNC. 2017 ESC focused update on dual antiplatelet therapy in coronary artery disease developed in collaboration with EACTS: The Task Force for dual antiplatelet therapy in coronary artery disease of the European Society of Cardiology (ESC) and of the European Association for Cardio-Thoracic Surgery (EACTS). *Eur Heart J* 2018;**39**:213–260.
 46. Bado W, Williams CJ. Usefulness of letters from hospitals to general practitioners. *Br Med J (Clin Res Ed)* 1984;**288**:1813–1814.
 47. Schiele F, Lemesle G, Angoulvant D, Krempf M, Kownator S, Cheggour S, Belle L, Ferrieres J. Proposal for a standardized discharge letter after hospital stay for acute myocardial infarction. *Eur Heart J Acute Cardiovasc Care* 2019; 2048872619844444.
 48. Cannon CP, Braunwald E, McCabe CH, Rader DJ, Rouleau JL, Belder R, Joyal SV, Hill KA, Pfeffer MA, Skene AM; Pravastatin or Atorvastatin Evaluation and Infection Therapy–Thrombolysis in Myocardial Infarction 22 Investigators. Intensive versus moderate lipid lowering with statins after acute coronary syndromes. *N Engl J Med* 2004;**350**:1495–1504.
 49. De Backer G, Jankowski P, Kotseva K, Mirrakhimov E, Reiner Z, Ryden L, Tokgozoglul L, Wood D, De Bacquer D; EUROASPIRE V collaborators; Writing Committee. Management of dyslipidaemia in patients with coronary heart disease: Results from the ESC-EORP EUROASPIRE V survey in 27 countries. *Atherosclerosis* 2019;**285**:135–146.
 50. Poole-Wilson PA, Swedberg K, Cleland JG, Di Lenarda A, Hanrath P, Komajda M, Lubsen J, Lutiger B, Metra M, Remme WJ, Torp-Pedersen C, Scherhag A, Skene A; Carvedilol Or Metoprolol European Trial I. Comparison of carvedilol and metoprolol on clinical outcomes in patients with chronic heart failure in the Carvedilol Or Metoprolol European Trial (COMET): randomised controlled trial. *Lancet* 2003;**362**:7–13.
 51. Bangalore S, Steg G, Deedwania P, Crowley K, Eagle KA, Goto S, Ohman EM, Cannon CP, Smith SC, Zeymer U, Hoffman EB, Messerli FH, Bhatt DL; Reach Registry Investigators. beta-Blocker use and clinical outcomes in stable outpatients with and without coronary artery disease. *JAMA* 2012;**308**:1340–1349.
 52. Anker SD, Agewall S, Borggrefe M, Calvert M, Jaime Caro J, Cowie MR, Ford I, Paty JA, Riley JP, Swedberg K, Tavazzi L, Wiklund I, Kirchhof P. The importance of patient-reported outcomes: a call for their comprehensive integration in cardiovascular clinical trials. *Eur Heart J* 2014;**35**:2001–2009.
 53. Ware JE Jr, Davies-Avery A, Stewart AL. The measurement and meaning of patient satisfaction. *Health Med Care Serv Rev* 1978;**1**:3–15.
 54. Lee DS, Tu JV, Chong A, Alter DA. Patient satisfaction and its relationship with quality and outcomes of care after acute myocardial infarction. *Circulation* 2008; **118**:1938–1945.
 55. Doyle F, Rohde D, Rutkowska A, Morgan K, Cousins G, McGee H. Systematic review and meta-analysis of the impact of depression on subsequent smoking cessation in patients with coronary heart disease: 1990 to 2013. *Psychosom Med* 2014;**76**:44–57.
 56. National Health Service England: ROAN information sheet 23: Quality improvement: best practice for clinical letters. 2018. <https://www.england.nhs.uk/medical-revalidation/ro/info-docs/roan-information-sheets/quality-improvement-best-practice-for-clinical-letters/> (31 December 2020).
 57. Weetman K, Wong G, Scott E, MacKenzie E, Schnurr S, Dale J. Improving best practice for patients receiving hospital discharge letters: a realist review. *BMJ Open* 2019;**9**:e027588.
 58. Shahian DM, Wolf RE, Iezzoni LI, Kirl L, Normand SL. Variability in the measurement of hospital-wide mortality rates. *N Engl J Med* 2010;**363**: 2530–2539.
 59. Weston CF. Performance indicators in acute myocardial infarction: a proposal for the future assessment of good quality care. *Heart* 2008;**94**: 1397–1401.
 60. Simms AD, Batin PD, Weston CF, Fox KA, Timmis A, Long WR, Hall AS, Gale CP. An evaluation of composite indicators of hospital acute myocardial infarction care: a study of 136,392 patients from the Myocardial Ischaemia National Audit Project. *Int J Cardiol* 2013;**170**:81–87.
 61. Eapen ZJ, Fonarow GC, Dai D, O'Brien SM, Schwamm LH, Cannon CP, Heidenreich PA, Bhatt DL, Peterson ED, Hernandez AF; Get With The Guidelines Steering Committee and Hospitals. Comparison of composite measure methodologies for rewarding quality of care: an analysis from the American Heart Association's Get With The Guidelines program. *Circ Cardiovasc Qual Outcomes* 2011;**4**:610–618.
 62. Tu JV, Khalid L, Donovan LR, Ko DT. Indicators of quality of care for patients with acute myocardial infarction. *Canadian Medical Association Journal* 2008;**179**: 909–915. 10.1503/cmaj.080749