Data standards for acute coronary syndrome and percutaneous coronary intervention: the European Unified Registries for Heart Care Evaluation and Randomised Trials (EuroHeart)

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Received 18 June 2021; revised 14 February 2022; accepted 1 March 2022; online publish-ahead-of-print 5 April 2022

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**Graphical Abstract** Domains of the 2021 EuroHeart acute coronary syndrome and percutaneous coronary intervention data standards with the number of Level 1 (mandatory) variables.

**Abstract**

Standardized data definitions are essential for monitoring and benchmarking the quality of care and patient outcomes in observational studies and randomized controlled trials. There are no contemporary pan-European data standards for the acute coronary syndrome (ACS) and percutaneous coronary intervention (PCI). The European Unified Registries for Heart Care Evaluation and Randomised Trials (EuroHeart) project of the European Society of Cardiology (ESC) aimed to develop such data standards for ACS and PCI. Following a systematic review of the literature on ACS and PCI data standards and evaluation of contemporary ACS and PCI registries, we undertook a modified Delphi process involving clinical and registry experts from 11 European countries, as well as representatives from relevant ESC Associations, including the European Association of Percutaneous Cardiovascular Interventions (EAPCI) and Acute CardioVascular Care (ACVC). This resulted in final sets of 68 and 84 ‘mandatory’ variables and several catalogues of optional variables for ACS and PCI, respectively. Data definitions were provided for these variables, which have been programmed as the basis for continuous registration of individual patient data in the online EuroHeart IT platform. By means of a structured process and the interaction with major stakeholders, internationally harmonized data standards for ACS and PCI have been developed. In the context of the EuroHeart project, this will facilitate country-level quality of care improvement, international observational research, registry-based randomized trials, and post-marketing surveillance of devices and pharmacotherapies.

**Keywords** Data standards • Data variables • Data definitions • Acute coronary syndrome • Percutaneous coronary intervention • EuroHeart

**Introduction**

Standardized data definitions are essential for the reliable investigation of quality of care and outcomes in observational studies and randomized controlled trials. Heterogeneity in such definitions impedes benchmarking and leads to inconsistencies that directly impact the interpretation of clinical studies and the implementation of their findings. With the advent of large-scale registries, administrative databases, and the widespread use of electronic health records in routine
clinical practice, opportunities to deliver cost-efficient investigator-initiated observational and randomized studies of both devices and pharmacological treatments have been realized. Yet, between-country comparisons remain challenging. This is often driven by a variation in the variables and their definitions. This restricts the ability to combine and efficiently compare data across databases. In countries where registry-based randomized controlled trials (R-RCTs) are feasible, country-specific definitions of outcomes or disease states that inform patient recruitment can limit the international generalizability of the study findings. Standardized data variables and definitions would provide means to overcome these limitations and enable international R-RCTs and the evaluation of the quality of care according to guideline-recommended quality indicators in multi-country observational cohorts.

Currently, there are no contemporary pan-European data standards for cardiovascular disease. The Cardiology Audit and Registration Data Standards (CARDS) was developed in 2004 and was the first European initiative to address this gap in knowledge. The European Unified Registries for Heart Care Evaluation and Randomised Trials (EuroHeart) is an international collaboration initiated and supported by the European Society of Cardiology (ESC) that aims to improve the quality of cardiovascular care through continuous capture of individual patient data. EuroHeart is underpinned by a purpose-built IT platform enabling real-time data recording, monitoring of standards of care, data linkages, and the delivery of R-RCTs and observational studies. During the pilot phase, EuroHeart will focus on four clinical domains, the first of which is the acute coronary syndrome (ACS) and percutaneous coronary intervention (PCI). Here, we describe the development process and the resultant standardized data variables and definitions for ACS and PCI based on the EuroHeart methodology for the development of data standards.

Methods

Working Group composition
A Data Science Group under the auspice of EuroHeart was established in August 2019. This comprised a project chair (C.P.G.), two medical experts (G.B. and S.A.), and a project manager. An international ACS/PCI Working Group was established and included 22 ACS/PCI and registry.

![Figure 1 EuroHeart data standards structure.](image-url)
Defining data standards
The goal of the development process was to select and define a catalogue of ACS/PCI variables, the extent of which was balanced between all-encompassing and parsimonious. For instance, whereas some registries collect up to 370 variables, the Data Science Group opted to limit the number of ‘mandatory’ variables to between 50 and 100. Three levels of variables were proposed (Figure 1). Level 1: ‘mandatory’ variables that also are pre-programmed into the EuroHeart IT platform and include quality indicators and variables pertinent to accountability and public reporting of quality of care. Level 2: ‘additional’ variables that are provided together with definitions, but collection not being mandatory and not pre-programmed into the IT platform. Level 3: country- or centre-specific variables that address local regulatory and/or administrative requirements and that are not defined or programmed into the IT platform.

Literature search and evaluation of registries
A systematic review of the published literature (1 January 2004–4 August 2020) identified 554 ACS/PCI variables with accompanying definitions. Evaluation of contemporary national registries in Sweden [Swedish Web-system for Enhancement and Development of Evidence-based care in Heart Disease Evaluated according to Recommended Therapies (SWEDHEART)], UK [Myocardial Ischaemia National Audit Project (MINAP), National Audit of Percutaneous Coronary Intervention (NAPCI)], and USA [National Cardiovascular Data Registry (NCDR)] was performed. Variables defined as quality indicators for ACS were automatically selected as candidate variables. Other variables were assessed according to their evidence base, validity, reliability, feasibility, and applicability. Candidate variables were classified according to the time point of care delivery and, where possible, reconciled with Clinical Practice Guidelines and quality indicators.

Consensus development
The modified Delphi method was used to draw from the candidate variables a final set of ACS/PCI variables. To achieve this, candidate variables were shared with the Working Group, who were asked to assess them for inclusion against the pre-defined criteria and to evaluate the associated definitions. Responses and feedback were evaluated by the Data Science Group and the candidate variable catalogue was updated accordingly. In total, 11 peer-to-peer meetings were held during 2020. The developed variables were thereafter reviewed by the Association for Acute CardioVascular Care (ACVC), European Association of Percutaneous Cardiovascular Interventions (EAPCI), ESC Working Group on Thrombosis, Association of Cardiovascular Nursing and Allied Professions (ACNAP), ESC Patient Forum, and ESC Committee for Young Cardiovascular Professionals.

Results
In total, 302 variables were included in the EuroHeart ACS/PCI catalogue: 152 Level 1 ‘mandatory’ variables (68 for ACS and 84 for PCI) with 20 variables common to both datasets, and 150 Level 2 ‘additional’ variables (Graphical Abstract). Tables 1–7 show the ‘mandatory’ variables, with condensed definitions. Detailed information about the ‘mandatory’ variables are provided in Supplementary material online, Tables S1–S7, whereas ‘additional’ variables are provided in Supplementary material online, Tables S8–S14.

Demographics
There are seven ‘mandatory’ variables in this section, all of which are common between the ACS and PCI data standards (Table 1). The section will be replicated in the other EuroHeart clinical domains so that time-independent patient information (e.g. date of birth) may be collected once and applied to all subsequent episodes of care. This section allows the use of permanent unique personal identification numbers to identify patients. When matching the identification number with other data sources, information such as forename, surname, sex, and postal code may be extracted automatically. The EuroHeart IT platform will generate unique patient identifiers for those countries that do not use them, which once assigned may not be changed or reassigned to other patients. Each patient’s geolocation is collected as their current residential postal code.

Patient characteristics and comorbidities
The patient characteristics and comorbidities section comprises 13 ‘mandatory’ variables collecting comorbidities relevant to ACS and/or PCI (Table 2). The choice of comorbidities was prioritized according to what the Working Group perceived to be information available in an average medical case record. Many of the variables are also relevant when characterizing the patient’s risk and are essential when reporting underlying medical history in observational and randomized trials, when understanding trends in quality improvement, and when assessing treatment strategies.

### Table 1 Demographics data variables and definitions

| Variable                        | Registry | Definition and permissible values |
|---------------------------------|----------|-----------------------------------|
| Patient identification number   | ACS/PCI  | Enter the patient’s national identification number or a registry generated unique patient identification number |
| Hospital identification number  | ACS/PCI  | Enter the hospital’s unique identification number |
| Date of birth                   | ACS/PCI  | Enter the patient’s date of birth |
| Forename                        | ACS/PCI  | Enter the patient’s forename      |
| Surname(s)                      | ACS/PCI  | Enter the patient’s surname(s)    |
| Sex                             | ACS/PCI  | Enter the patient’s sex at birth as either female or male  |
| Postal code                     | ACS/PCI  | Enter the postal code for the patient’s current residence |

Additional details and complete definitions are available in Supplementary material online, Table S1.
### Table 2  Patient characteristics and comorbidities data variables and definitions

| Variable                      | Registry  | Definition and permissible values                                                                 |
|-------------------------------|-----------|-----------------------------------------------------------------------------------------------------|
| Height                        | ACS/PCI   | Enter the patient’s height on admission (in cm)                                                      |
| Weight                        | ACS/PCI   | Enter the patient’s weight on admission (in kg)                                                     |
| Smoking                       | ACS/PCI   | Enter patient’s tobacco smoking status                                                             |
|                               |           | • Never smoked                                                                                     |
|                               |           | • Former smoker                                                                                    |
|                               |           | • Current smoker                                                                                   |
|                               |           | • Unknown                                                                                          |
| Hypertension                  | ACS/PCI   | Enter whether the patient is known to have a diagnosis of hypertension made by a healthcare professional prior to this care encounter |
|                               |           | • No                                                                                               |
|                               |           | • Yes                                                                                              |
|                               |           | • Unknown                                                                                          |
| Diabetes mellitus             | ACS/PCI   | Enter whether the patient is known to have a diagnosis of diabetes mellitus made by a healthcare professional prior to this care encounter |
|                               |           | • No                                                                                               |
|                               |           | • Diabetes mellitus Type 1                                                                         |
|                               |           | • Diabetes mellitus Type 2                                                                         |
|                               |           | • Diabetes mellitus of other/unspecified type                                                      |
|                               |           | • Unknown                                                                                          |
| Chronic obstructive pulmonary disease | ACS/PCI | Enter whether the patient is known to have a diagnosis of chronic obstructive pulmonary disease (COPD) made by a healthcare professional prior to this care encounter |
|                               |           | • No                                                                                               |
|                               |           | • Yes                                                                                              |
|                               |           | • Unknown                                                                                          |
| Moderate or severe chronic kidney disease | ACS/PCI | Enter whether the patient is known to have a moderate or severe chronic kidney disease prior to this care encounter |
|                               |           | • No                                                                                               |
|                               |           | • Yes                                                                                              |
|                               |           | • Unknown                                                                                          |
| Prior stroke                  | ACS/PCI   | Enter whether the patient is known to have had a stroke                                            |

**Table 2  Continued**

| Variable                          | Registry  | Definition and permissible values                                                                 |
|-----------------------------------|-----------|-----------------------------------------------------------------------------------------------------|
| Prior myocardial infarction       | ACS/PCI   | Enter whether the patient is known to have had a myocardial infarction prior to this care encounter |
|                                   |           | • No                                                                                               |
|                                   |           | • Yes                                                                                              |
|                                   |           | • Unknown                                                                                          |
| Heart failure                     | ACS/PCI   | Enter whether the patient is known to have a diagnosis of heart failure made by a healthcare professional prior to this care encounter |
|                                   |           | • No                                                                                               |
|                                   |           | • Yes                                                                                              |
|                                   |           | • Unknown                                                                                          |
| Atrial fibrillation or atrial flutter | ACS/PCI | Enter whether the patient is known to have a diagnosis of atrial fibrillation (AF) or atrial flutter (AFL) made by a healthcare professional prior to this care encounter |
|                                   |           | • No                                                                                               |
|                                   |           | • Yes                                                                                              |
|                                   |           | • Unknown                                                                                          |
| Prior percutaneous coronary intervention | ACS/PCI | Enter whether the patient is known to have had a percutaneous coronary intervention (PCI) of any type (not diagnostic angiography) performed prior to this care encounter |
|                                   |           | • No                                                                                               |
|                                   |           | • Yes                                                                                              |
|                                   |           | • Unknown                                                                                          |
| Prior coronary artery bypass grafting | ACS/PCI | Enter whether the patient is known to have had a coronary artery bypass grafting (CABG) performed prior to this care encounter |
|                                   |           | • No                                                                                               |
|                                   |           | • Yes                                                                                              |
|                                   |           | • Unknown                                                                                          |

Additional details and complete definitions are available in Supplementary material online, Table S2.
### Table 3 Admission data variables and definitions

| Variable                              | Registry | Definition and permissible values |
|---------------------------------------|----------|-----------------------------------|
| Presenting symptoms                   | ACS      | Enter the patient’s symptoms that prompted this presentation. Select the main reason for presentation: • Chest pain/discomfort • Dyspnoea • Cardiac arrest • Other • Unknown |
| Cardiac arrest prior to hospital arrival | ACS      | Enter whether the patient had a cardiac arrest prior to hospital arrival: • No • Yes • Unknown |
| Symptom onset, date/time              | ACS      | Enter the date and time of symptom onset |
| Arrival method                        | ACS      | Enter the method of current hospital arrival: • Self-presenter • Ambulance from home/community • Transportation from another hospital • Already in the hospital • Unknown |
| First contact with ambulance, date/time| ACS      | Enter the date and time of when the ambulance arrived to the patient |
| Hospital arrival, date/time           | ACS      | Enter the date and time when the patient arrived in the hospital |
| Diagnostic ECG, ST/T morphology       | ACS      | Enter the findings of the diagnostic ECG regarding the ST/T morphology. The first option that best describes the findings should be selected: • Normal • ST-segment elevation • ST-segment depression • T-wave inversion • Other • Unknown |
| Diagnostic ECG, QRS morphology        | ACS      | Enter the findings of the diagnostic ECG regarding the QRS morphology. The first option that best describes the findings should be selected: • Normal • Ventricular paced rhythm • Left bundle branch block (LBBB) • Right bundle branch block (RBBB) • Pathological Q wave • Other • Unknown |
| Diagnostic ECG, rhythm                | ACS      | Enter the findings of the diagnostic ECG regarding the rhythm. The first option that best describes the findings should be selected: • Sinus rhythm • Atrial fibrillation or atrial flutter • Ventricular tachycardia • Other • Unknown |
| ECG establishing need for revascularization, date/time | ACS | Enter the date and time of the first ECG establishing need for coronary revascularization. In cases where imminent revascularization was not indicated, enter the date and time of the first ECG (either before or after hospital arrival) |
| Heart rate                            | ACS      | Enter the patient’s heart rate (in b.p.m.) |
| Systolic blood pressure               | ACS      | Enter the patient’s systolic blood pressure (in millimetres of mercury) |
| Killip class                          | ACS      | Enter the patient’s Killip class at the time of hospital admission: • Killip Class I • Killip Class II • Killip Class III • Killip Class IV • Unknown |
| Thrombolysis, prehospital             | ACS      | Enter whether thrombolysis therapy was initiated or administered prior to hospital arrival: • No • Yes • Unknown |

Additional details and complete definitions are available in Supplementary material online, Table S3.
| Variable                          | Registry | Definition and permissible values |
|----------------------------------|----------|-----------------------------------|
| Troponin, elevated               | ACS      | Enter whether cardiac troponin was elevated during the hospital stay |
|                                  |          | • No                               |
|                                  |          | • Yes                              |
|                                  |          | • Unknown                          |
| Troponin assay                   | ACS      | Enter the assay used for analysis of cardiac troponin levels |
|                                  |          | • Troponin T                       |
|                                  |          | • Troponin I                       |
|                                  |          | • High-sensitivity Troponin T      |
|                                  |          | • High-sensitivity Troponin I      |
|                                  |          | • Unknown                          |
| Haemoglobin                      | ACS      | Enter the first recorded level of haemoglobin during the hospital stay (in g/L) |
| Creatinine                       | ACS      | Enter the first recorded level of creatinine during the hospital stay (in µmol/L) |
| LDL cholesterol                  | ACS      | Enter the first recorded level of LDL cholesterol during the hospital stay (in mmol/L). This is not necessarily fasting LDL cholesterol |
| Left ventricular ejection fraction, assessment method | ACS | Enter the method used to assess left ventricular ejection fraction (LVEF) during hospital stay |
|                                  |          | • Not performed                     |
|                                  |          | • Echocardiography                  |
|                                  |          | • Other method                      |
|                                  |          | • Unknown                           |
| Left ventricular ejection fraction | ACS  | Enter the left ventricular ejection fraction (LVEF) measured during the hospital stay by echocardiography, angiography, radionuclide, magnetic resonance imaging, or by other methods |
|                                  |          | • ≥50%                              |
|                                  |          | • 41–49%                           |
|                                  |          | • 30–40%                           |
|                                  |          | • <30%                             |
|                                  |          | • Unknown                           |
| Coronary anatomy, assessment method | ACS | Enter the method used to assess the coronary anatomy during the hospital stay |
|                                  |          | • Not performed                     |
|                                  |          | • Invasive coronary angiography     |

Continued
Table 4  Continued

| Variable                                           | Registry | Definition and permissible values                                                                 |
|----------------------------------------------------|----------|---------------------------------------------------------------------------------------------------|
| In-hospital events, myocardial re-infarction       | ACS      | Enter whether the patient had a myocardial re-infarction during the hospital stay                |
|                                                    |          | • No                                                                                              |
|                                                    |          | • Yes                                                                                             |
|                                                    |          | • Unknown                                                                                         |
| In-hospital events, cardiogenic shock               | ACS      | Enter whether the patient had an episode of cardiogenic shock during the hospital stay            |
|                                                    |          | • No                                                                                              |
|                                                    |          | • Yes                                                                                             |
|                                                    |          | • Unknown                                                                                         |
| In-hospital events, cardiac arrest                  | ACS      | Enter whether the patient had cardiac arrest during the hospital stay                              |
|                                                    |          | • No                                                                                              |
|                                                    |          | • Yes                                                                                             |
|                                                    |          | • Unknown                                                                                         |
| In-hospital events, major bleeding                  | ACS      | Enter whether the patient had a major bleeding event during the hospital stay. More than one option can be selected |
|                                                    |          | • No                                                                                              |
|                                                    |          | • Fatal bleeding                                                                                   |
|                                                    |          | • Intracranial haemorrhage                                                                        |
|                                                    |          | • Bleeding requiring surgery                                                                        |
|                                                    |          | • Bleeding requiring transfusion                                                                   |
|                                                    |          | • Other major bleeding                                                                             |
|                                                    |          | • Unknown                                                                                         |
| In-hospital events, new-onset atrial fibrillation or atrial flutter | ACS | Enter whether a new diagnosis of atrial fibrillation (AF) or atrial flutter (AFL) was made during the hospital stay for patients with no prior history of AF or AFL |
|                                                    |          | • No                                                                                              |
|                                                    |          | • Yes                                                                                             |
|                                                    |          | • Unknown                                                                                         |

Additional details and complete definitions are available in Supplementary material online, Table S4.

Table 5  Diagnostic coronary angiography data variables and definitions

| Variable                                     | Registry | Definition and permissible values                                                                 |
|----------------------------------------------|----------|---------------------------------------------------------------------------------------------------|
| Procedure indication PCI                     | PCI      | Enter the main indication for performing the coronary angiography                                  |
| Procedure urgency PCI                        | PCI      | Enter the procedure urgency                                                                      |
| ECG establishing need for revascularization, date/time PCI | PCI | Enter the date and time of the first ECG establishing need for coronary revascularization          |
| Killip class PCI                             | PCI      | Enter the patient’s Killip class at the time of hospital admission or during the hospital stay (prior to the procedure) |
| CCS angina grade PCI                         | PCI      | Enter the grade of angina pectoris according to the Canadian Cardiovascular Society (CCS) grading scale |
| Creatinine PCI                               | PCI      | Enter the most recent level of creatinine, but within the last 3 months (in µmol/L)               |

Continued
| Variable                        | Registry | Definition and permissible values                                                                                                                                                                                                 |
|--------------------------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Circulatory support PCI       |          | Enter whether any circulatory support was used during the hospital stay prior to the procedure. More than one option can be selected • No • Intra-aortic balloon pump (IABP) • Cardiopulmonary bypass • Impella • AutoPulse • Extracorporeal membrane oxygenation (ECMO) • Other • Unknown |
| Inotropes PCI                 |          | Enter whether inotropic therapy was administered during the hospital stay prior to the procedure • No • Yes • Unknown                                                                                                                                                            |
| Arterial access PCI           |          | Enter the arterial access(es) punctured/attemed during the procedure. More than one option can be selected • Right radial artery • Left radial artery • Right femoral artery • Left femoral artery • Right ulnar artery • Left ulnar artery • Other • Unknown |
| Arterial access, date/time PCI|          | Enter the date and time when the arterial access for the procedure was accomplished                                                                                                                                                                                                   |
| Segments 1–20 PCI             |          | Enter the per cent estimate (0–29, 30–49, 50–69, 70–89, 90–99, 100%, N/A) of the most severe stenosis in Segments 1–20 as determined by coronary angiography. This does not include collateral circulation. Not applicable (N/A) may be selected when the segment is not visualized |
| CABG graft, type PCI          |          | Enter whether a CAGB graft is present and enter the type of the graft • Venous graft • Arterial graft                                                                                                                                                                                      |
| Overall finding in the native coronary arteries PCI |          | Automatically generated overall finding in the native coronary arteries based on the responses in Segments 1–20 • Normal/atheroma • 1 vessel disease, not left main coronary artery • 2 vessels, not left main coronary artery • 3 vessels, not left main coronary artery • Left main coronary artery + 1 vessel disease • Left main coronary artery + 2 vessel disease • Left main coronary artery + 3 vessel disease • Isolated left main coronary artery • Inconclusive assessment |
| Chronic total occlusion PCI   |          | Enter whether the lesion in the current segment is a chronic total occlusion (CTO) • No • Yes • Unknown                                                                                                                                                                             |
| Chronic total occlusion, segment PCI |          | Enter the coronary segment in which the lesion is a chronic total occlusion (CTO) • Segment 1 • Segment 20                                                                                                                                                                         |
| Restenosis PCI                |          | Enter whether the lesion in the current segment is a restenosis • No                                                                                                                                                                                                                  |
Table 3 depicts the ‘mandatory’ variables for the admission section. Information about care time points can be difficult to collect but is important given it is used for the derivation of quality indicators. Medications at the time of admission form ‘additional’ variables and are defined in Supplementary material online, Table S10.

In-hospital management
This section collects information concerning investigations, treatments, and events occurring in-hospital (Table 4). Laboratory results

### Table 5 Continued

| Variable                              | Registry | Definition and permissible values                                                                 |
|---------------------------------------|----------|---------------------------------------------------------------------------------------------------|
| Restenosis, segment                   | PCI      | Enter the coronary segment in which the lesion is a restenosis                                      |
|                                       |          | • Segment 1                                                                                       |
|                                       |          | • Segment 20                                                                                      |
| Stent thrombosis                      | PCI      | Enter whether the lesion in the current segment is a stent thrombosis                               |
|                                       |          | • No                                                                                              |
|                                       |          | • Yes                                                                                             |
|                                       |          | • Unknown                                                                                         |
| Stent thrombosis, segment             | PCI      | Enter the coronary segment in which the lesion is a stent thrombosis                               |
|                                       |          | • Segment 1                                                                                       |
|                                       |          | • Segment 20                                                                                      |
| Spontaneous coronary artery dissection| PCI      | Enter whether there was a spontaneous coronary artery dissection (SCAD)                            |
|                                       |          | • No                                                                                              |
|                                       |          | • Yes                                                                                             |
|                                       |          | • Suspected                                                                                        |
|                                       |          | • Unknown                                                                                         |
| Invasive intracoronary diagnostics    | PCI      | Enter whether any invasive intracoronary diagnostic assessment was performed before the PCI procedure |
|                                       |          | • No                                                                                              |
|                                       |          | • Yes                                                                                             |
|                                       |          | • Unknown                                                                                         |
| Invasive intracoronary diagnostics,   | PCI      | Enter what invasive intracoronary diagnostics method(s) were performed before the PCI procedure.   |
| method                               |          | More than one option can be selected                                                               |
|                                       |          | • Not performed                                                                                    |
|                                       |          | • Hyperaemia-based method (e.g. FFR)                                                               |
|                                       |          | • Hyperaemia-free method (e.g. iFR, DFR, RFR)                                                      |
|                                       |          | • Coronary flow reserve (CFR)                                                                     |
|                                       |          | • Intravascular ultrasound (IVUS)                                                                  |
|                                       |          | • Optical coherence tomography (OCT)                                                               |

Additional details and complete definitions are available in Supplementary material online, Table S5.

Admission
Table 3 depicts the ‘mandatory’ variables for the admission section. Information about care time points can be difficult to collect but is important given it is used for the derivation of quality indicators. Medications at the time of admission form ‘additional’ variables and are defined in Supplementary material online, Table S10.

In-hospital management
This section collects information concerning investigations, treatments, and events occurring in-hospital (Table 4). Laboratory results
## Table 6  Percutaneous coronary intervention and events data variables and definitions

| Variable                        | Registry | Definition and permissible values                                                                 |
|--------------------------------|----------|---------------------------------------------------------------------------------------------------|
| PCI attempted                   | PCI      | Enter whether percutaneous coronary intervention (PCI) was attempted                              |
|                                |          | • No                                                                                               |
|                                |          | • Yes                                                                                              |
| Passage of wire, date/time      | PCI      | Enter the date and time when the first guidewire successfully crossed the culprit lesion, not the date when flow was restored |
| Segment attempted               | PCI      | Enter the segment attempted during PCI                                                              |
|                                |          | • Segment 1                                                                                         |
|                                |          | ...                                                                                               |
|                                |          | • Segment 20                                                                                        |
| Graft attempted                 | PCI      | Enter whether a graft lesion was attempted during PCI                                              |
|                                |          | • No                                                                                               |
|                                |          | • Venous graft                                                                                     |
|                                |          | • Arterial graft                                                                                   |
| Type of PCI attempt             | PCI      | Enter the type of the procedure performed. More than one option can be selected                    |
|                                |          | • Plain balloon                                                                                    |
|                                |          | • Drug-eluting balloon                                                                             |
|                                |          | • Stent                                                                                            |
| Drug-eluting balloon, type      | PCI      | Enter the drug-eluting balloon that was used in the specific segment. (Device names of drug-eluting balloons used in the specific country) |
| Drug-eluting balloon, diameter  | PCI      | Enter the diameter of the drug-eluting balloon. Nominal diameter (in mm) of the drug-eluting balloon that is used should be entered |
| Stent, type                     | PCI      | Enter the stent that was used in the specific segment. (Device names of stents used in the specific country) |
| Stent, diameter                 | PCI      | Enter the diameter of the stent. Nominal diameter (in mm) of the stent balloon should be entered    |
| Stent, length                   | PCI      | Enter the length of the stent (in mm)                                                              |
| Adjuvant therapies/equipment    | PCI      | Enter if any adjuvant therapies were used during the procedure                                      |

## Table 6  Continued

| Variable                        | Registry | Definition and permissible values                                                                 |
|--------------------------------|----------|---------------------------------------------------------------------------------------------------|
| Lesion success                  | PCI      | Enter whether the attempted lesion was successfully treated                                      |
|                                |          | • No                                                                                               |
|                                |          | • Yes                                                                                              |
| TIMI flow, prior to PCI         | PCI      | Enter the TIMI flow prior to the PCI procedure                                                     |
|                                |          | • TIMI 0                                                                                            |
|                                |          | • TIMI I                                                                                            |
|                                |          | • TIMI II                                                                                           |
|                                |          | • TIMI III                                                                                         |
|                                |          | • Unknown                                                                                          |
| TIMI flow, after PCI            | PCI      | Enter the TIMI flow after the PCI procedure                                                        |
|                                |          | • TIMI 0                                                                                            |
|                                |          | • TIMI I                                                                                            |
|                                |          | • TIMI II                                                                                          |
|                                |          | • TIMI III                                                                                         |
|                                |          | • Unknown                                                                                          |
| Complete revascularization      | PCI      | Enter whether a complete revascularization was achieved by the end of the current procedure       |
|                                |          | • No                                                                                               |
|                                |          | • Yes                                                                                              |
|                                |          | • Unknown                                                                                          |
| Additional PCI procedures planned | PCI  | Enter whether any additional PCI procedure(s) is planned (either during this hospital stay or after discharge) |
|                                |          | • No                                                                                               |
|                                |          | • Yes                                                                                              |
|                                |          | • Unknown                                                                                          |
| Peri-procedural events          | PCI      | Enter whether any events occurred during the procedure. More than one option can be selected       |
|                                |          | • No                                                                                               |
|                                |          | • Procedure-related myocardial infarction                                                          |
|                                |          | • Vascular access complication                                                                     |
|                                |          | • Side branch occlusion                                                                            |
for diagnosis (e.g. cardiac biomarkers), risk stratification (e.g. serum creatinine), and risk factors modification (e.g. low-density lipoprotein cholesterol) are ‘mandatory’ variables.7,8,18 Laboratory results for specific situations or subgroups (e.g. N-terminal prohormone of brain natriuretic peptide, C-reactive protein, cholesterol, glucose, and haemoglobin A1c) are ‘additional’ variables and are detailed in Supplementary material online, Table S11. The 2020 ESC guidelines for the management of ACSs in patients presenting without persistent ST-segment elevation recommends the assessment of the left ventricular ejection fraction (LVEF) during the hospital stay, and thus forms a ‘mandatory’ variable.7 Categorization of LVEF aligns with the 2021 ESC guidelines for the diagnosis and treatment of acute and chronic heart failure.21 Given that reperfusion is the cornerstone for the management of patients with ACS, five ‘mandatory’ variables are dedicated to the evaluation of the coronary artery anatomy and reperfusion strategy.7,8

**Coronary angiography and percutaneous coronary intervention**

This section has two parts. The first part captures information about invasive coronary angiography (ICA) (Table 3) and includes an interactive diagram of the coronary tree (Figure 2). It provides a solution for the fact that there are international differences in the extent of information recorded in registries (e.g. all ICA procedures in Sweden14 vs. all PCI procedures in the UK16). Equally, the Data Science Group reviewed coronary anatomy visualization tools including the Bypass Angioplasty Revascularisation Investigation (BARI) and the Coronary Artery Surgery Study (CASS) schemes describing coronary anatomy.22,23 The consensus of the Working Group was to adopt a simplified 20-segment system adapted from the SWEDEHEART registry, which enables interactive reporting of stenoses found in major coronary arteries (Figure 2).14

**Table 6** Continued

| Variable                  | Registry | Definition and permissible values |
|---------------------------|----------|-----------------------------------|
| Coronary perforation      |          |                                   |
| Coronary dissection       |          | persisting at the end of the procedure |
| Brady-arrhythm           |          | requiring pacing                  |
| Arrhythmia               |          | requiring DC cardioversion        |
| Cardiogenic shock        |          |                                   |
| Cardiac tamponade        |          |                                   |
| Acute surgical intervention from cath lab | | |
| Stroke or transient ischaemic attack (TIA) | | |
| Death                     |          |                                   |
| Other                     |          |                                   |
| Unknown                   |          |                                   |

Addition details and complete definitions are available in Supplementary material online, Table S6.

**Table 7** Discharge management data variables and definitions

| Variable                  | Registry | Definition and permissible values |
|---------------------------|----------|-----------------------------------|
| Hospital discharge, date  | ACS      | Enter the date when the patient was discharged from the hospital or died during this hospital stay |
| In-hospital death         | ACS      | Enter whether the patient died during the hospital stay |
|                           |          | • No                                |
|                           |          | • Yes                               |
| Final diagnosis at discharge | ACS  | Enter the final diagnosis at discharge |
|                           |          | • Unstable angina                   |
|                           |          | • NSTEMI                            |
|                           |          | • STEMI                             |
|                           |          | • Other (including no diagnosis of ACS) |
| Final diagnosis at discharge, ICD-10 code | ACS  | Enter the main final diagnosis at discharge according to the International Classification of Diseases (ICD) 10 standard |
|                           |          | • I20.0 Unstable angina             |
|                           |          | • I21.0 Acute transmural myocardial infarction of the anterior wall |
|                           |          | • I21.1 Acute transmural myocardial infarction of the inferior wall |
|                           |          | • I21.2 Acute transmural myocardial infarction of other sites |
|                           |          | • I21.3 Acute transmural myocardial infarction of the unspecified site |
|                           |          | • I21.4 Acute subendocardial myocardial infarction |
|                           |          | • I21.9 Acute myocardial infarction, unspecified |
|                           |          | • I22.0 Subsequent myocardial infarction of the anterior wall |
|                           |          | • I22.1 Subsequent myocardial infarction of the inferior wall |
|                           |          | • I22.8 Subsequent myocardial infarction of other sites |
|                           |          | • I22.9 Subsequent myocardial infarction of the unspecified site |

**Continued**

The second part captures information about the procedural indication, urgency, findings, and complications (Table 6). It collects information such as date, time, and type of the arterial access, given the use of radial access is recommended as a quality indicator in the
| Variable                              | Registry | Definition and permissible values |
|--------------------------------------|----------|-----------------------------------|
| Aspirin at discharge                 | ACS      | Enter whether the patient was discharged on acetylsalicylic acid (aspirin)  |
|                                      |          | • No                               |
|                                      |          | • Yes                              |
|                                      |          | • Unknown                          |
| P2Y12 inhibitors at discharge        | ACS      | Enter whether the patient was discharged on P2Y12 inhibitors  |
|                                      |          | • No                               |
|                                      |          | • Clopidogrel                      |
|                                      |          | • Prasugrel                        |
|                                      |          | • Ticagrelor                       |
|                                      |          | • Other                            |
|                                      |          | • Unknown                          |
| Oral anticoagulants at discharge     | ACS      | Enter whether the patient was discharged on oral anticoagulants. Vitamin K antagonists include warfarin  |
|                                      |          | • No                               |
|                                      |          | • Vitamin K antagonist             |
|                                      |          | • Dabigatran                       |
|                                      |          | • Rivaroxaban                      |
|                                      |          | • Apixaban                         |
|                                      |          | • Edoxaban                         |
|                                      |          | • Other                            |
|                                      |          | • Unknown                          |
| Beta-blockers at discharge           | ACS      | Enter whether the patient was discharged on beta-blockers  |
|                                      |          | • No                               |
|                                      |          | • Yes                              |
|                                      |          | • Unknown                          |
| Angiotensin-converting enzyme inhibitors at discharge | ACS | Enter whether the patient was discharged on angiotensin-converting enzyme (ACE) inhibitors. For combination drugs, enter details about both drug classes  |
|                                      |          | • No                               |
|                                      |          | • Yes                              |
|                                      |          | • Unknown                          |
| Angiotensin II receptor blocker at discharge | ACS | Enter whether the patient was discharged on angiotensin II receptor blockers (ARB). For combination drugs (except angiotensin receptor-neprilysin inhibitors), enter details about both drug classes  |
|                                      |          | • No                               |
|                                      |          | • Yes                              |
|                                      |          | • Unknown                          |
| Mineralocorticoid receptor antagonist at discharge | ACS | Enter whether the patient was discharged on mineralocorticoid receptor antagonists (MRA)  |
|                                      |          | • No                               |
|                                      |          | • Spironolactone                   |
|                                      |          | • Eplerenone                       |
|                                      |          | • Other                            |
|                                      |          | • Unknown                          |
| Lipid-lowering treatment at discharge | ACS      | Enter whether the patient was discharged on lipid-lowering treatment. More than one option can be selected  |
|                                      |          | • No                               |
|                                      |          | • Statins                          |
|                                      |          | • Ezetimibe                        |
|                                      |          | • Fibrates                         |
|                                      |          | • PCSK9 inhibitors                 |
|                                      |          | • Other                            |
|                                      |          | • Unknown                          |
| Diuretics at discharge               | ACS      | Enter whether the patient was discharged on diuretics. For combination drugs, enter details about both drug classes. More than one option can be selected  |
|                                      |          | • No                               |
|                                      |          | • Loop diuretics                   |
|                                      |          | • Thiazide diuretics               |
|                                      |          | • Unknown                          |
| Sodium-glucose cotransporter-2 inhibitors at discharge | ACS | Enter whether the patient was discharged on sodium-glucose cotransporter-2 (SGLT2) inhibitors. For combination drugs, enter details about both drug classes  |
|                                      |          | • No                               |
|                                      |          | • Yes                              |
|                                      |          | • Unknown                          |
| Oral/subcutaneous antidiabetics at discharge | ACS | Enter whether the patient was discharged on oral or subcutaneous antidiabetic medications. More than one option can be selected  |
|                                      |          | • No                               |
|                                      |          | • Statins                          |
|                                      |          | • Glimepiride                      |
|                                      |          | • Other                            |
|                                      |          | • Unknown                          |
2020 ESC guidelines for the management of ACSs in patients presenting without persistent ST-segment elevation. In addition, thrombolysis in myocardial infarction (TIMI) grades before and following the procedure, and intracoronary equipment and devices used are captured in this section.

**Discharge**

This section collects information about the final ACS diagnosis and medications prescribed at the time of discharge from the hospital (**Table 7**). The final diagnosis includes ST-elevation myocardial infarction, non-ST-elevation myocardial infarction, and unstable angina [with accompanying World Health Organisations (WHO) standardized International Classification of Diseases (ICD-10) codes]. Medication information includes Anatomical Therapeutic Chemical codes and drug dosages as ‘additional’ variables (**Supplementary material online, Table S14**).

**Discussion**

The adoption of harmonized data collections is central for the continuous improvement of cardiovascular care. The lack of internationally recognized data standards has led to large inequalities in monitoring and standards of care within and between European
countries and also resulted in expensive and inefficiently coordinated and delivered studies of cardiovascular treatments.\textsuperscript{25} Currently, there are no contemporary pan-European data standards for ACS and PCI. The EuroHeart project of the ESC, by means of a structured methodology, has defined a catalogue of data standards for ACS and PCI, which will be implemented into a bespoke IT platform to facilitate harmonized country-level quality improvement, international observational and registry-based randomized research, and post-marketing surveillance of devices and pharmacotherapies.

The existing European national cardiovascular registries comprise distinct and discordant entities with differing data variables and definitions.\textsuperscript{26} This substantially limits their usability in collaborative large-scale studies. Data standards and case report forms presented by CARDS, the EURObservational Research Programme (EORP), and the American College of Cardiology (ACC) and the American Heart Association (AHA) have been used in national registries and in clinical trials,\textsuperscript{11,27,28} but differ in their data variables and definitions. Furthermore, no previous international cardiovascular data standards initiative has provided the means by which data may be efficiently collected in ‘real-world’ settings. Moreover, the ACC/AHA data standards for coronary artery disease and PCI contain over 300 variables that make it difficult to implement in a pragmatic registry.\textsuperscript{28,29} In contrast, the EuroHeart data standards presented in this article have a restricted number of mandatory ACS/PCI variables, bolted onto an IT platform for effective data collection.

After years of steady decline, the reduction of mortality rates post-myocardial infarction has plateaued in many countries; cardiovascular disease remains the main cause of death worldwide and its burden is increasing in low- to middle-income economies.\textsuperscript{30} The standardized collection of cardiovascular data and the understanding of how to use observational and randomized data in cardiovascular medicine is a clear unmet need and an important next step towards defining variation in cardiovascular care and facilitating continuous quality improvement.\textsuperscript{4} The emergence of new devices and drugs for the management of cardiovascular disease provides opportunities for improved outcomes but requires post-marketing surveillance. In addition, the growing complexity and financial burden of traditional randomized controlled trials create a need to develop innovative ways to conduct high-quality, yet cost-effective research. National registries which implement uniform data standards will facilitate rapid and efficient post-marketing surveillance of device therapies and pragmatic R-RCT with pooled data from multiple geographical locations.\textsuperscript{6}

Since 2021, the EuroHeart IT platform collects all ‘mandatory’ variables and supports the development of ‘additional’ variables in participating countries. Furthermore, the EuroHeart IT infrastructure includes applications for clinical reporting in the local healthcare system and provides tools for observational research, R-RCTs, and post-marketing surveillance of drugs and devices. Patient data are collected continuously in the healthcare system on a country level, and the national or regional registry centres are responsible for the storage and data protection according to the existing legal framework. Signed informed consent will not be required for data collection for quality development in most countries. For planned reports presenting the standards of care in different countries participating in EuroHeart, only deidentified and aggregated data will be shared by the participating registries/countries. Thus, for the collaboration on the development of quality of care, no individual patient-level data will be transferred outside the local country/region. However, for prospective research projects, such as R-RCTs or drug and device monitoring, informed consent from participants will be required as for any clinical trial. In these cases, selected anonymized individual study data may be transferred for analysis to a central repository according to clinical trial protocols. Finally, as part of mutually agreed international epidemiological research projects and based on ethical and regulatory approval, anonymized retrospective registry cohorts may be transferred to a central repository for pre-defined statistical analysis. In all cases, the national/regional registry parties are responsible for defining the legal framework applicable to their participation in EuroHeart and its various features, and for ensuring that they do not violate either local or international law.

We recognize the limitations of the EuroHeart data standards development process. This includes the use of expert opinion (which may be biased) for the selection of the final data variables and definitions from those identified in the literature review. However, the EuroHeart ACS and PCI data standards were developed using a structured and recognized methodology for selecting the expert panel and for obtaining their opinion and feedback. Likewise, the inclusiveness of the Working Group, which comprised experts from many European countries, provided a robustness and transparent framework for the development of the variables and definitions. Despite the data standards being reviewed by the ESC Patient Forum, future Working Groups may benefit from the inclusion of patients and wider members of the multidisciplinary team for ACS and PCI such as nurses and pharmacists. Of note, the data standards proposed in this document are based on the evidence available at the time of development. Accordingly, updates may be required as more and new knowledge becomes available.

Conclusions

This document presents the first set of data standards, developed as part of the EuroHeart project, which aims to harmonize data variables and definitions across common cardiovascular domains. In total, 68 and 84 ‘mandatory’ variables for ACS and PCI domains have been proposed, respectively. Also, several ‘additional’ variables have been defined. Once fully adopted into the EuroHeart IT platform, the data standards will facilitate country-level quality improvement, observational and registry-based randomized research, and post-marketing surveillance of new devices and pharmacotherapies.

Supplementary material

Supplementary material is available at European Heart Journal online.

Acknowledgements

We thank the members of the ACS/PCI Working Group for their expertise when developing the ACS and PCI data standards; Joakim Alfredsson (Sweden), Branko Beleslin (Serbia), Mark de Belder (UK), Ana Djordjevic-Dikic (Serbia), Jorge Ferreira (Portugal), Sudhakar George (UK), Claes Held (Sweden), Alar IRS (Estonia), András Jánosi (Hungary), Zumreta Kušljugić (Bosnia and
Herzogovina), Silvia Monteiro (Portugal), Belma Pojskić (Bosnia and Herzegovina), Svein Rotevatn (Norway), Andrea Rubboli (Italy), Rui Teles (Portugal), José María de la Torre Hernández (Spain), Cristian Udriou (Romania), Clive Weston (UK), and Troels Yndigegn (Sweden). We also thank Adrian Banning (UK), Scot Garg (UK), David Hildick-Smith (UK), Tim Kinnaird (UK), and Rod Stables (UK) for their support and expertise during the development of the ACS and PCI data standards. We thank Catherine Reynolds (EuroHeart Project Manager, Leeds Institute of Cardiovascular & Metabolic Medicine, University of Leeds, Leeds, UK), Ebba Bergman and Lan Vu Thi (EuroHeart Project Managers, Uppsala Clinical Research Center, Uppsala, Sweden) for their support and contribution to the EuroHeart project. We thank Ida Björkgren (Uppsala Clinical Research Center, Uppsala, Sweden) for the editorial support.

**Funding**

This work was supported by the European Society of Cardiology.

**Conflict of interest:** G.B. has nothing to declare with respect to this manuscript. Outside this work, G.B. has received lecture/speaker fees from AstraZeneca and Boehringer Ingelheim; expert committee fees from Novo Nordisk. S.A. and P.L. have nothing to declare. L.W. has nothing to declare with respect to this manuscript. Outside this work, L.W. reports institutional research grants from AstraZeneca, Roche Diagnostics; consulting fees from Abbott. A.P.M. has nothing to declare with respect to this manuscript. Outside this work, A.P.M. received personal fees for participation in committees of studies sponsored by Astra Zeneca, Bayer, Fresenius, Novartis, D.E. has nothing to declare with respect to this manuscript. Outside this work, D.E. reports speaker and advisory board fees from AstraZeneca, Sanofi, Bayer, Roche Diagnostics, and Chiesi. B.C. has nothing to declare with respect to this manuscript. Outside this work, B.C. has received in kind support from Roche Diagnostics and iRhythm for clinical studies of atrial fibrillation. C.P.G. has nothing to declare with respect to this manuscript. Outside this work, C.P.G. has received grants from Abbott and BMS; honoraria for lectures and scientific advice from Amgen and AstraZeneca.

**Appendix**

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**In collaboration with:** The Association of Cardiovascular Nursing and Allied Professions (ACNAP), Association for Acute CardioVascular Care (ACVC), European Association of Percutaneous Cardiovascular Interventions (EAPCI), EURObservational Research Programme (EORP), ESC Patient Forum, ESC Working Group on Thrombosis, and the ESC Committee for Young Cardiovascular Professionals have endorsed and were involved in the review of the EuroHeart ACS/PCI data standards.

**References**

1. Gregson J, Stone GW, Ben-Yehuda O, Redfors B, Kandzari DE, Morice M-C, et al. Implications of alternative definitions of peri-procedural myocardial infarction after coronary revascularization. J Am Coll Cardiol 2020;76:1609–1621.

2. Fritbo J, Lagerqvist B, Oliveira GC, Omerovic E, Gudnason T, Maeng M, et al. Thrombus aspiration during ST-segment elevation myocardial infarction. N Engl J Med 2013;369:1587–1597.

3. Erldinge D, Omerovic E, Fritbo J, Linder R, Danielowicz M, Hamid M, et al. Bivalirudin versus heparin monotherapy in myocardial infarction. N Engl J Med 2017;377:1132–1142.

4. Bowman L, Baras A, Bombien R, Califf RM, Chen Z, Gale CP, et al. Understanding the use of observational and randomized data in cardiovascular medicine. Eur Heart J 2020;41:2571–2578.

5. Rapsomaniki E, Thuresson M, Yang E, Bin Lin P, Hunp P, Chung S-C, et al. Using big data from health records from four countries to evaluate chronic disease outcomes: a study in 114 364 survivors of myocardial infarction. Eur Heart J Qual Care Clin Outcomes 2016;2:172–183.

6. James S, Rao SV, Granger CB. Registry-based randomized clinical trials—a new clinical trial paradigm. Not Rec Cord 2015;12:312–316.

7. Collet JP, Thiele H, Barbato E, Barthélémy O, Bauersachs J, Bhatt DL, et al. 2020 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation. Eur Heart J 2020;41:1289–1367.

8. Ibanez B, James S, Agewall S, Antunes MJ, Bucciarelli-Ducci C, Bueno H, et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. Eur Heart J 2017;39:119–177.

9. Aktaa S, Batra G, Wallentin L, Bagert C, Erldinge D, James S, et al. European Society of Cardiology methodolology for the development of quality indicators for the quantification of cardiovascular care and outcomes. Eur Heart J Qual Care Clin Outcomes 2022;8:4–13.

10. Schiele F, Aktaa S, Rossoollo X, Ahrens I, Claeyys MJ, Collet JP, et al. 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. Eur Heart J Acute Cardiovasc Care 2021;10:224–233.

11. Flynn MR, Barrett C, Cosio FG, Gitt AK, Wallentin L, Kearney P, et al. The Cardiology Audit and Registration Data Standards (CARDS), European data standards for clinical cardiology practice. Eur Heart J 2003;26:308–313.

12. Wallentin L, Gale CP, Maggioni A, Bardinet I, Casadei B, et al. The Myocardial Outcomes in Patients with Unstable Angina: An International Multinational Registry (MONTUS): a report of the European Society of Cardiology Working Group for Data Science Group. Eur Heart J 2019;40:2745–2749.

13. Batra G, Aktaa S, Wallentin L, Maggioni AP, Wilkinson C, Casadei B, et al. Methodology for the development of international clinical data standards for common cardiovascular conditions: European Unified Registries for Heart Care Evaluation and Randomised Trials (EuroHeart). Eur Heart J Qual Care Clin Outcomes; https://doi.org/10.1093/ehjqcc/qca052.

14. Jernberg T, Attebring MF, Hambraeus K, Ivert T, James S, Jeppsson A, et al. The Swedish web-system for enhancement and development of evidence-based care for universal health coverage. Eur Heart J 2010;31:968–975.

15. Wilkinson C, Weston C, Timmins A, Quinn T, Keys A, Gale CP. The Myocardial Ischaemia National Audit Project (MINAP). Eur Heart J Qual Care Clin Outcomes 2020;6:9–22.

16. Ludman PF. British Cardiovascular Intervention Society Registry for audit and quality assessment of percutaneous coronary interventions in the United Kingdom. Heart 2011;97:1293–1297.

17. Messenger JC, Ho KKL, Young CH, Stlattry LE, Draouc JC, Curtis JP, et al. The National Cardiovascular Data Registry (NCDR) data quality brief: the NCDR data quality program in 2012. J Am Coll Cardiol 2012;60:1448–1448.

18. Thygesen K, Alpert JS, Jaffe AS, Chaitman BR, Fox KM, et al. Myocardial infarction redefined—universal definition. Eur Heart J 2012;33:2567–2602.

19. Kastrati A, Banning AP, Koller A, Alfonso F, Banning AP, Benedetto U, et al. ESC/EACTA Consensus document on myocardial revascularization. Eur Heart J 2018;39:87–165.

20. Mills S, Lee JK, Rassekh BM, Zorko Kodelja M, Bae G Kang M, et al. Unique health identifiers for universal health coverage. J Health Popul Nutr 2019;38:22.

21. McDonagh TA, Metra M, Adamo M, Gardner RS, Baumbach A, Böhm M, et al. 2019 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure. Eur Heart J 2021;42:3599–3726.

22. Rogers J, Alderman EL, Chapman BR, D’Ascenzo G, Horan M, Lyle B, et al. Bypass angioplasty revascularization investigation (BARI): baseline clinical and angiographic data. Am J Cardiol 1995;75:9C–17C.
Corrigendum
https://doi.org/10.1093/eurheartj/ehac187
Online publish-ahead-of-print 8 April 2022

Corrigendum to: P2Y₁₂ inhibitor adherence trajectories in patients with acute coronary syndrome undergoing percutaneous coronary intervention: prognostic implications

European Heart Journal, https://doi.org/10.1093/eurheartj/ehac116.

In the originally published version of this manuscript, the graphical abstract had two errors, as follows: (1) The legend incorrectly labeled Group 5 as “persistent nonadherence”; the correct label for this group is “persistent adherence”. (2) The rightmost graphical abstract figure was a duplicate of the middle figure; it has been replaced with the correct figure, a Kaplan-Meier plot of major adverse cardiovascular events by P2Y₁₂ inhibitor adherence trajectory group, stratified by stent type. These errors have been corrected.

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