ESC EUROHEART REPORT 2024

ESC
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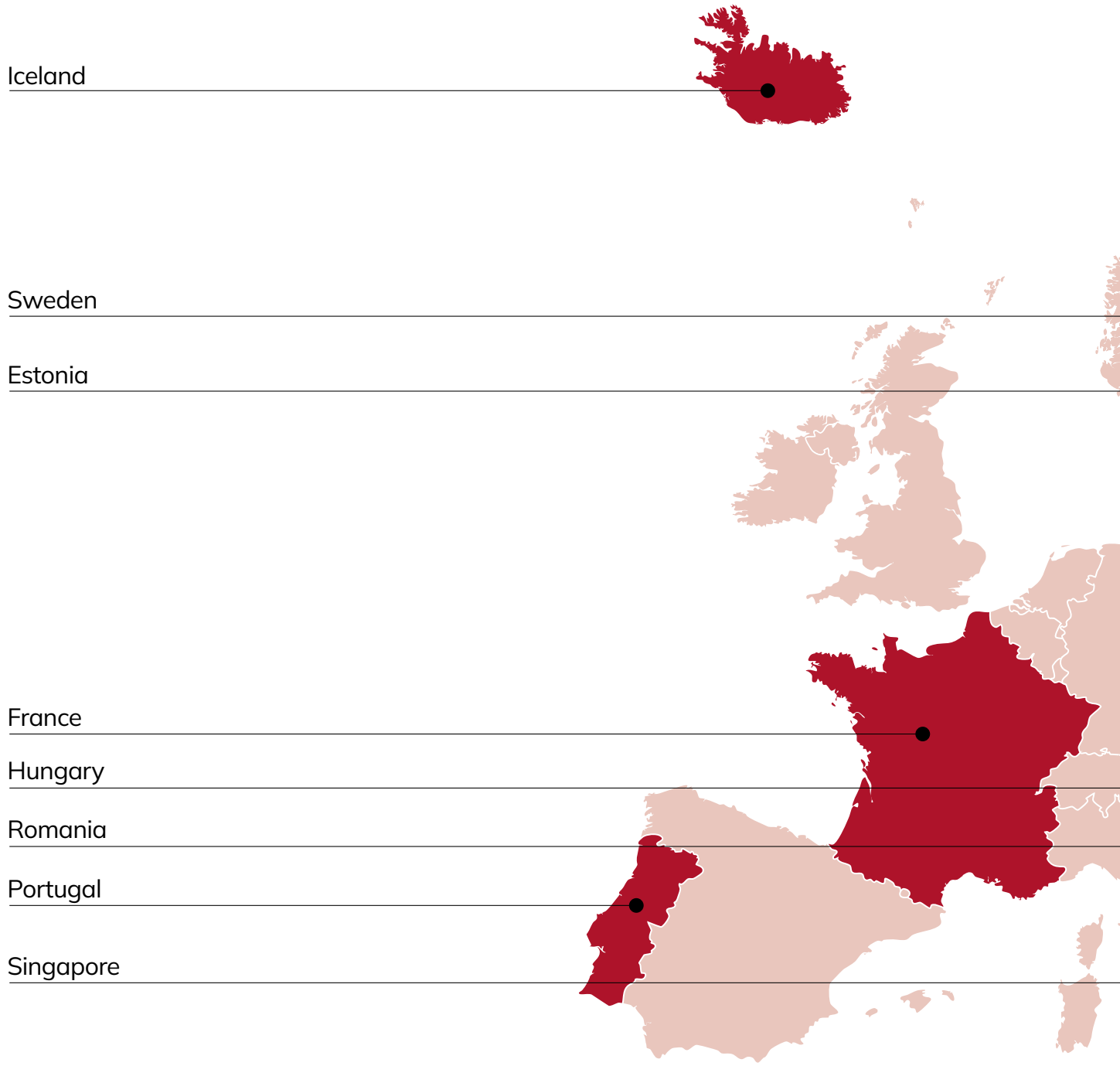
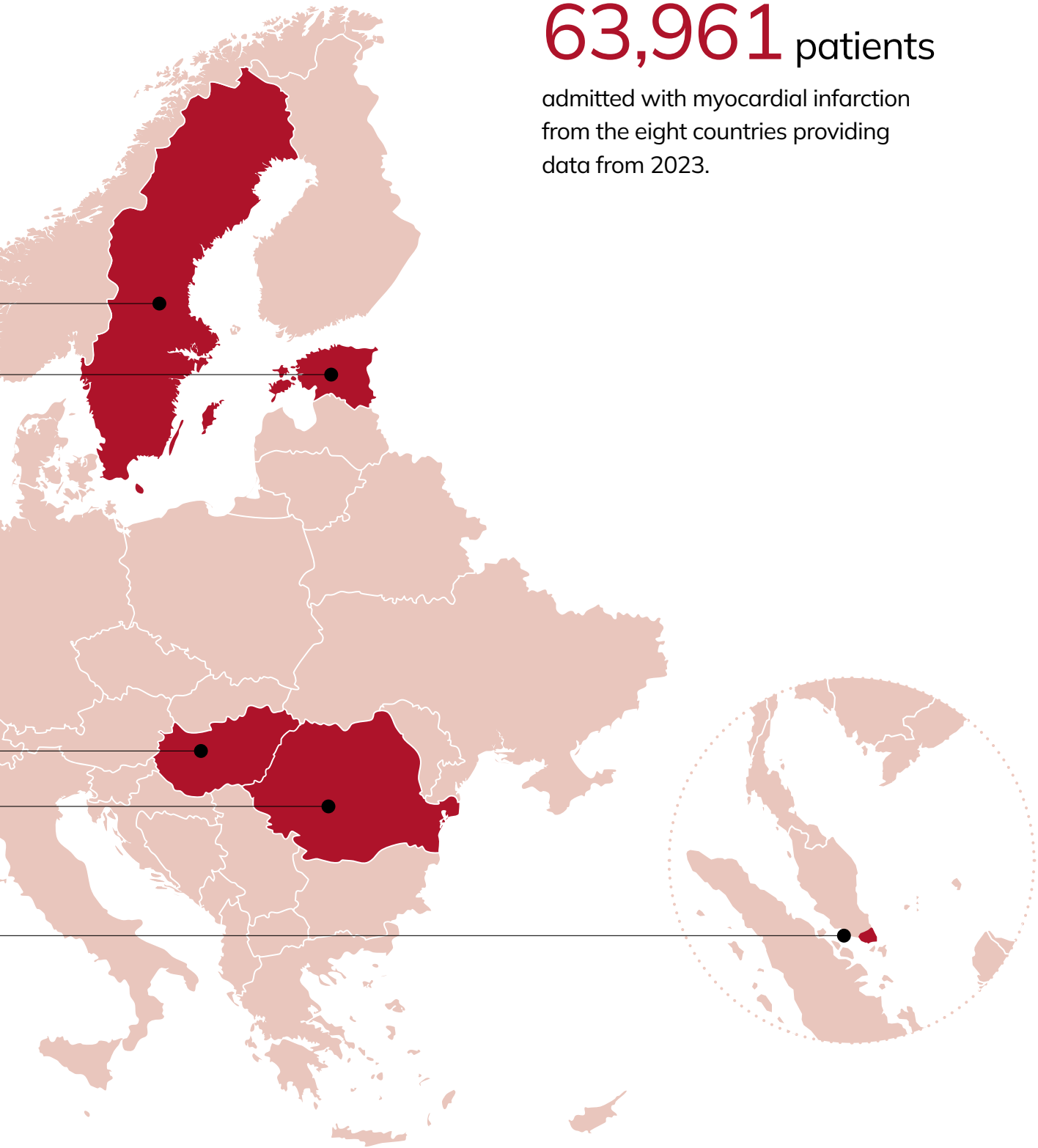
EuroHeart annual report 2024 exposes details on patients with ST-elevation (STEMI) and non-ST-elevation myocardial infarction (NSTEMI) and their characteristics, treatments with percutaneous coronary interventions (PCI), medications and in-hospital outcomes.



Data from

63,961 patients

admitted with myocardial infarction from the eight countries providing data from 2023.



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ACE inhibitors	Angiotensin-converting enzyme inhibitors
ACS	Acute coronary syndrome
ARB	Angiotensin receptor blockers
ARNI	Angiotensin receptor-neprilysin inhibitor
CABG	Coronary artery bypass graft
CKD	Chronic kidney disease
COPD	Chronic obstructive pulmonary disease
ECG	Electrocardiogram-
ESC	European Society of Cardiology
EU	European Union
EuroHeart	European Unified Registries On Heart Care Evaluation and Randomised Trials
GLP-1	Glucagon-like peptide 1
IT	Information technology
IQR	Interquartile range
LDL	Low-density lipoprotein
LVEF	Left ventricular ejection fraction
MI	Myocardial infarction
NSTEMI	Non-ST-elevation myocardial infarction
PCI	Percutaneous coronary intervention
PROMs	Patient Reported Outcome Measurements
QI	Quality indicator
RCT	Randomised controlled trial
R-RCT	Registry-based randomised controlled trial
SD	Standard deviation
SGLT-2	Sodium-glucose transport protein 2
STEMI	ST-elevation myocardial infarction
TAVI	Transcatheter aortic valve implantation

Introduction 02

WHAT IS EUROHEART?

EuroHeart is a collaboration between national registries of quality of care in countries which are members of or associated with the European Society of Cardiology. During the pilot and consolidation phases, between 2019-2024, the project has developed and published data standards for the major cardiovascular diseases and outcomes.[1-6] By the end of 2024, fourteen countries have become members of the collaboration out of which eight participated in the registration of standardised data in 2023 which are included in this annual report.

Figure 1. *The EuroHeart network 2024 including information on the countries delivering data from 2023*

The participating countries have committed to aim for continuous registration of these harmonised data in association with hospital care of common cardiovascular conditions such as acute coronary syndrome (ACS), percutaneous coronary intervention (PCI), valve disease including transcatheter valve implementation (TAVI), heart failure including cardiac resynchronization treatment, and atrial fibrillation and associated interventions. These registries allow National health care systems and National Cardiac Societies to monitor and improve the quality of care, as appropriate for the local geography and proportionate to the existing infrastructure and investment in health care. The international collaboration and standardisation also enable the comparisons of systems, standards and development of care and outcomes between the participating countries. The overall aim is thereby to foster a culture of a learning health care system based on monitoring of differences in care both at a National and International level. EuroHeart also aims to provide a framework for registry-based randomised controlled trials (R-RCT) in representative patient populations across multiple geographies. In addition, EuroHeart will provide a framework for cost-effective safety surveillance of new drugs and devices. From 1st January 2025, EuroHeart transitioned from a pilot project to an established activity of the Data Science program of the European Society of Cardiology (ESC), which marks a significant commitment to improve cardiovascular care across Europe. The ESC will continue to support and develop the EuroHeart network, while improving data quality and coverage and expanding within existing registry domains. EuroHeart will operate as a permanent platform for standardised data collection, supporting the development of national cardiovascular registries within a harmonised pan-European network. By fostering greater collaboration between countries and with other data collection initiatives of the ESC, EuroHeart will enhance the ability to deliver regular contemporary reporting on quality of care aligned with ESC guidelines, measure real-world clinical outcomes, drive quality improvement initiatives, provide robust data for guideline implementation, monitoring and development, and enable large-scale research. EuroHeart continues to be a vital tool in shaping evidence-based cardiovascular care across Europe.

OUTLINE OF THE EUROHEART ANNUAL REPORT

This EuroHeart annual report 2024 features data on 63,961 patients admitted with myocardial infarction from the eight countries providing data from 2023. The report exposes details on patients with ST-elevation (STEMI) and non-ST-elevation myocardial infarction (NSTEMI) and their characteristics, treatments with percutaneous coronary interventions (PCI), medications and in-hospital outcomes.

The aggregated information has been stratified into 86 different subsets based on diagnosis, age, sex and diabetes thereby starting to provide an atlas of the current standards of care of treatment of ACS and PCI in Europe. The transparent exposure of the similarities and differences in the recorded information in the cohorts from the different countries is aimed to foster a climate focused on quality improvement in patient care as well as coverage and completeness of registration.

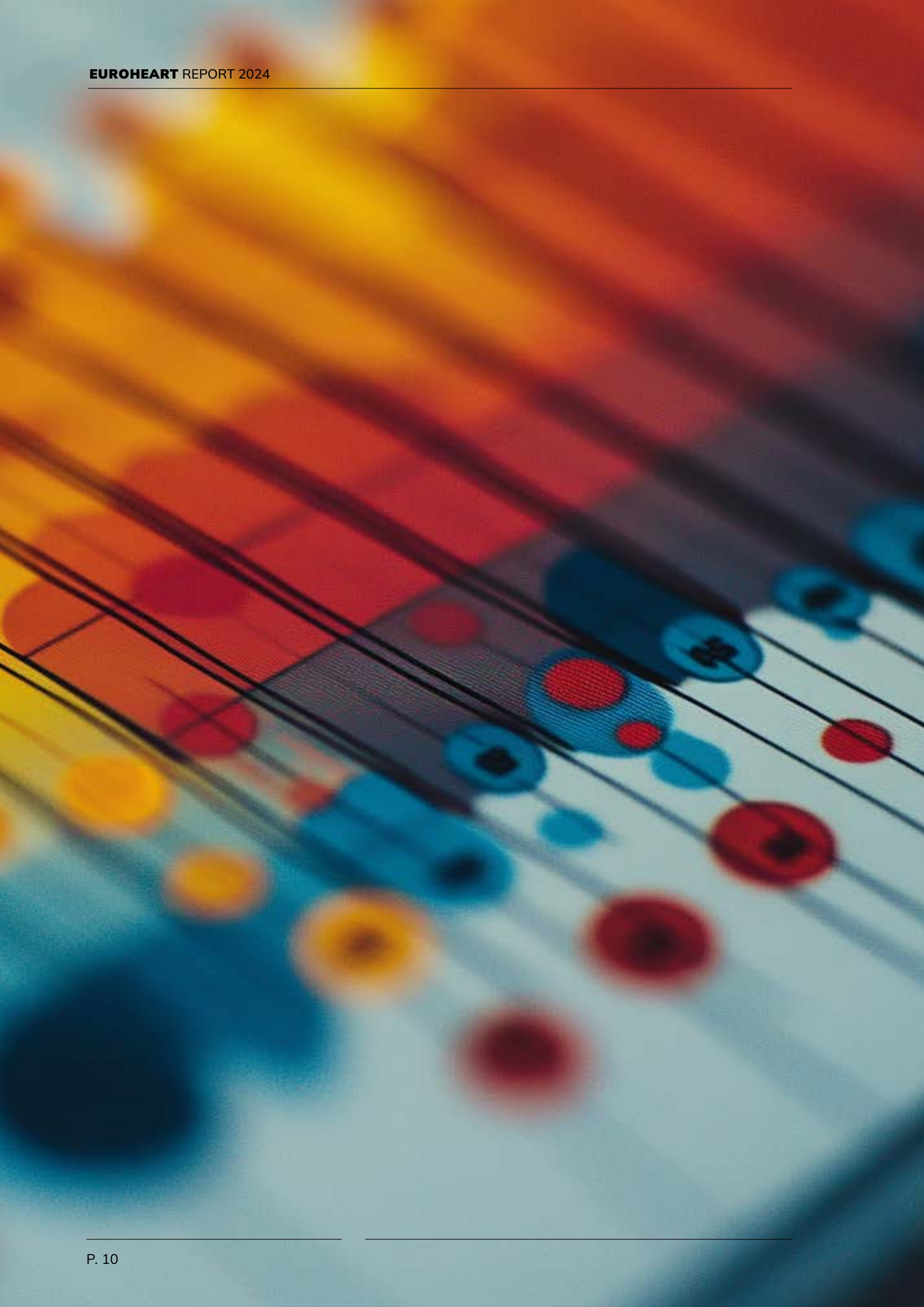
OBJECTIVES

Objectives of the current report were, in relation to country, diagnosis (STEMI, NSTEMI), sex, diabetes and nine 5-year age groups (< 50 to >85 years), to describe:

1. Patient and disease characteristics
2. In-hospital interventional treatment
3. Pharmaceutical treatments
4. In-hospital outcomes
5. Adherence to ESC quality indicators for acute myocardial infarction

KEY MESSAGES FROM THE REPORT

1. The results of the cohorts from the eight countries provide an initial view of a contemporary atlas on the standards of care for patients with myocardial infarction in Europe, offering granular data on patient and disease characteristics, interventional and pharmaceutical treatments, and in-hospital outcomes in relation to diagnosis, age, sex, and diabetes.
2. The report visualises the strengths and opportunities of international collaboration on continuous monitoring of quality of care based on mutually agreed standardised data and statistical analyses exploring both similarities and differences between country cohorts concerning guideline recommended treatments.
3. The detailed data highlight several areas with needs for improvement both concerning registration and care:
   a) Improve the utility of the reporting by transforming the annual report to an online available contemporary atlas on standards of care of patients with ACS in Europe.
   b) Improve coverage of all patients and completeness of data from several countries.
   c) Emphasise the importance of smoking cessation in the younger patients and of treatment of hypertension, myocardial and renal dysfunction in the elderly.
   d) Monitor and aim to further reduce the delay to reperfusion in STEMI in most countries.
   e) Investigate the optimal timing of interventional treatment of patients with NSTEMI preferably by performing a registry-based randomised controlled trial (R-RCT).
   f) Contribute to improve the utilisation of RAAS inhibitors and SGLT2 inhibitors by emphasising the emerging indications and the utility of echocardiograms as part of routine care in ACS.
   g) Contribute to optimise the utilisation of lipid lowering treatment by emphasising the utility of routine measurements of LDL cholesterol and the guideline recommended treatment targets.



Summary of the results 03

A. EUROHEART NETWORK

The results of the cohorts from the eight countries provide an initial view of a contemporary atlas on the standards of care for patients with myocardial infarction in Europe, offering granular data on patient and disease characteristics, interventional and pharmaceutical treatments, and in-hospital outcomes in relation to diagnosis, age, sex, and diabetes.

B. RELIABILITY OF DATA

The limitations of the provided data highlight the need to complement future EuroHeart databases with information on each stratum, including the number of individuals with unknown or missing data.

C. LIMITED COHORTS FROM SOME COUNTRIES

The uncertainties in the results from some countries highlight the importance of continuously improving the patient coverage and the completeness of data. The limited and selected cohorts from some countries make the pooled data unrepresentative of any population. Therefore, the country cohorts are presented separately, and any comparisons between countries are intended solely for hypothesis generation.

> The results of the cohorts from the eight countries provide an initial view of a contemporary atlas on the standards of care for patients with myocardial infarction in Europe.

D. RESULTS IN SUBGROUPS HIGHLIGHT THE FOLLOWING OBSERVATIONS

PATIENTS

- Higher age in women and in patients with diabetes, indicating that differences in results for these cohorts may depend on age-related factors.
- A higher proportion of current smokers among men compared to women, and among non-diabetics compared to diabetics.
- A higher proportion of current smokers in younger age groups, with fewer among elderly patients.
- A higher proportion of current smokers in Hungary and Romania and the lowest proportion in Sweden. The proportion of unknown informatin on smoking was high (43 ‘5) in Hungary.
- An increasing proportion of patients with diabetes with advancing age.
- A higher proportion of patients with diabetes in Hungary compared to other countries.
- A higher proportion of patients with hypertension in females and among diabetics.
- An increasing proportion of patients with hypertension with advancing age.
- An increasing proportion of patients with chronic kidney disease with advancing age and among diabetics.
- A low (5-12%) proportion of patients with atrial fibrillation on admission, although the proportion increases with age.

Summary of the results 03

IN-HOSPITAL INTERVENTIONAL TREATMENTS

- A very high proportion of patients with STEMI underwent coronary angiography (90-100%), with no differences between sexes or between patients with or without diabetes, and with only a slightly lower rate among the most elderly patients aged >80 years.
- A very high proportion of patients with NSTEMI underwent coronary angiography (80-90%), with no differences between sexes or between patients with or without diabetes, and with only a slightly lower rate among the most elderly patients aged >80 years.
- A very high proportion of patients with STEMI underwent primary PCI (80-95%), with no differences between sexes or between patients with or without diabetes, and with a very slight decline with increasing age.
- A variable proportion of patients with NSTEMI underwent in-hospital PCI (50-75%), with a slightly lower proportion of female and elderly patients undergoing in-hospital PCI.
- A very high proportion of radial arterial access was utilised (around 80%), with no differences between subgroups.

PHARMACEUTICAL TREATMENTS AT DISCHARGE

- A high proportion of patients were treated with aspirin (80-95%), with no differences between sexes or among patients with or without diabetes, but with a reduction in older patients (possibly due to concomitant atrial fibrillation and treatment with oral anticoagulants).
- A high proportion of patients with STEMI (85-95%) and NSTEMI (80-90%) were treated with P2Y12 inhibitors, with a slightly higher proportion of men than women receiving such treatment. No differences were observed in relation to diabetes or age.
- Among patients with STEMI, ticagrelor was the most commonly used P2Y12 inhibitor, except in Hungary, where clopidogrel predominated. Among patients with NSTEMI, ticagrelor and clopidogrel were equally common, except in Hungary, where clopidogrel predominated. Elderly patients were more often treated with clopidogrel than younger patients.
- Approximately 10-22% of patients were treated with oral anticoagulants at discharge, with use increasing with age. A higher proportion of patients in Sweden and Estonia received oral anticoagulants. Apixaban was the predominant oral anticoagulant in all countries.
- A very high proportion of patients were treated with statins (90-95%), with no differences observed in relation to age, sex, or diabetes.
- A low proportion of patients were treated with ezetimibe, with only Singapore (in STEMI) and Sweden achieving approximately 20% of treated patients
- A high proportion of patients were treated with beta blockers (around 80%), with no differences observed in relation to age, sex, or diabetes.

- A fairly high proportion of patients were treated with ACE inhibitors/ARBs (65-85%), with no differences observed in relation to age, sex, or diabetes.
- A variable proportion of patients with diabetes were treated with SGLT2 inhibitors. A lower proportion of non-diabetic patients were treated with SGLT2 inhibitors.
- GLP-1 receptor agonists were used in only a small proportion of patients with diabetes, reaching around 10% in France and Sweden for cases with STEMI, and in Estonia and Sweden for NSTEMI.

IN-HOSPITAL OUTCOMES

- The median length of stay was 4 days in most countries but longer in Romania (5-6 days) and Estonia (6-7 days).
- In-hospital mortality was between 5-10% in patients with STEMI and 1-5% in patients with NSTEMI. A higher mortality rate was observed among the elderly, women, and patients with diabetes.

ESC QUALITY INDICATORS FOR MYOCARDIAL INFARCTION

- The median duration between symptom onset and reperfusion varied, with the shortest duration observed in Sweden (around 200 minutes) and the longest in Romania (around 350 minutes).
- The median duration between hospital arrival and reperfusion in STEMI varied, with 15-20 minutes in Sweden compared to 70 minutes or more in Romania, Portugal, and Estonia.
- Reperfusion within 90 minutes of initial diagnosis in STEMI was variable: it was achieved in almost all patients in Singapore, in approximately 75-80% of patients in Hungary and Sweden, and in fewer than 50% of patients in Estonia, France, and Portugal.
- Coronary angiography within 24 hours in NSTEMI varied between countries, ranging from approximately 25% to 85%.
- There was generally high prescription (80–98%) of P2Y12 inhibitors, statins, beta blockers, and ACE inhibitors/ARBs at discharge following STEMI and NSTEMI.

> Reperfusion within 90 minutes of initial diagnosis in STEMI was variable: it was achieved in almost all patients in Singapore, in approximately 75-80% of patients in Hungary and Sweden, and in fewer than 50% of patients in Estonia, France, and Portugal.

National Leaders 04

Representatives from each country participating in EuroHeart are encouraged to be part of the National Leaders Group. The National Leaders Group is an integral part of the EuroHeart collaboration, consisting of leaders of cardiac societies and other country level representatives. As well as championing EuroHeart in their individual countries, their role is to provide input into the strategy and direction of the collaboration. The group meets regularly to discuss progress in the EuroHeart collaboration at an international level as well as at their own national level.

This year, the National Leaders were asked for their thoughts on the impact that EuroHeart has had on their quality-of-care processes and what they hoped being part of the collaboration would mean for the future. An experienced qualitative researcher met with one or two National Leaders from the majority of the participating countries and their interviews have been summarised in the following sections.

Estonia

Estonia's involvement in EuroHeart over the past three years has notably enhanced its cardiovascular care system. By collecting ACS data from its two tertiary hospitals, Estonia now covers 70% of national ACS cases. EuroHeart has sparked discussions on care quality measurement and offers real-time, accessible data for clinicians, unlike the slower national myocardial infarction registry. Standardised data collection and documentation have improved, though manual double entry remains time-consuming. Despite lacking a comprehensive national data platform, plans for automation aim to streamline processes and expand EuroHeart participation. Overall, EuroHeart has boosted clinical engagement and patient care quality in Estonia.

> EuroHeart is a very different type of quality measuring device - it's relatively real-time and accessible because we are using the IT platform.”

Dr Alar Irs
Estonia

National Leaders 04

France

France recently joined EuroHeart, which allows for international comparison of cardiovascular practices. This highlighted areas for improvement, such as France's lower outpatient PCI rate compared to the UK. France collects data for 90% of EuroHeart quality indicators with minimal adaptations. Despite challenges like double data entry, EuroHeart helps enhance practices by learning from other countries and connects with projects like the Global Registries and Surveys Programme (GRASP). Addressing double data entry is crucial for success. France sees potential in using EuroHeart for cost-effective R-RCTs and hopes to expand its PCI registry, improving cardiovascular care and enabling multicenter studies across Europe.

> It's always very interesting to compare our experience, because, for me, it's the best way to enhance our skill.”

Dr Grégoire Rangé
France

> One of the potential benefits of the EuroHeart program will be to be able to do R-RCT in multiple countries.”

Professor Eric Van Belle
France

Hungary

Hungary's cardiovascular disease registries, especially the HUMIR MI registry, have a long history, with mandatory use since 2014, covering 90% of MI cases. Prof. Jánosi and Prof. Járai lead Hungary's EuroHeart participation, with a smooth transition due to prior alignment.

EuroHeart facilitates international data comparison, revealing Hungary's strengths in drug treatment and areas needing improvement, like antiplatelet therapy reimbursement. International comparisons have also improved pre-hospital care.

Future plans include expanding the registry to other cardiovascular diseases, pending human resource and funding resolutions. EuroHeart aids Hungary in addressing regional healthcare challenges and enhancing patient care.

> We analysed the pre-hospital time... the patient delays are very long so we are trying to influence the patient that, if specific complaints occur, they should call the emergency service.”

Professor András Jánosi
Hungary

> I think the most valuable comparison is to compare regional countries with the same high-risk patterns and risk groups.”

Professor Zoltán Járai
Hungary

National Leaders 04

Iceland

Iceland joined the SCAAR SWEDEHEART PCI database in 2008, forming a foundation for quality improvement in clinical studies. EuroHeart has broadened this experience, expanding data collection into new cardiovascular areas. Dr Guðmundsdóttir oversees the PCI data collection and submission. Although direct patient care impact is yet to be seen, EuroHeart has highlighted strengths and areas for improvement in Iceland's clinical practices. Challenges include limited hospital support and the importance of accurate data entry. Prof. Ingimarsdóttir's heart failure registry, despite limited funding and IT support, has positively impacted patient care by providing real-time data and identifying contraindicated medications. Future plans include expanding registry access and data collection, overcoming resource limitations, and increasing participation in clinical trials.

We're planning to have some study days or symposia with, for instance, the nursing staff to show them the results and the data that we have been collecting this year with more complete data entry and how we can use it to improve the patient care.”

Dr Ingibjörg Jóna Guðmundsdóttir
Iceland

We've had impact on patient care. I'm actually doing the registration in real time, so I'm sending messages to the consultant saying that 'this person was discharged on this medication which is contraindicated.”

Professor Inga Jóna Ingimarsdóttir
Iceland

Romania

Romania joined EuroHeart during the pilot phase in 2022, registering over 6,000 patients from 15 interventional centres. EuroHeart has established a national epidemiological registry, aiding national treatment programs and discussions on improving care. The data influenced Romania's first national cardiovascular strategy, educational programs, and public awareness campaigns, reducing patient time to seek medical help by 20%. Romania plans to expand PCI centres and make the registry mandatory, with future coverage for atrial fibrillation, heart failure, and TAVI. The Romanian Society of Cardiology funds junior staff for data management, aiming to involve 32 centres nationwide in the next two years.

> We've had discussions with the Ministry of Health and with the ambulance system in Romania to improve the national program for interventional treatment of myocardial infarction, and these discussions were started with the data from the ACS/PCI registry."

Professor Dragos Vinereanu
Romania

National Leaders 04

Singapore

Singapore joined EuroHeart in 2021, focusing on STEMI data and recently exploring heart failure data. Established data management processes enabled a smooth transition. Interaction with other national leads provided valuable insights for improving local processes and learning about efficient data collection software systems. Future impacts include benchmarking cardiovascular outcomes against other countries and expanding data collection to cover more cardiovascular diseases. Challenges include expanding data contribution to other centres, requiring dedicated support. Overall, participation in EuroHeart is seen as a meaningful opportunity, expected to provide actionable data and enhance cardiovascular care quality for both Europe and beyond.

> The opportunity to talk to and interact with some of the other National Leads has been good… it helps us to see where we are at a global state.”

Clinical Associate Professor Jonathan Yap
Singapore

Sweden

Sweden's positive involvement with EuroHeart is, due to its long-standing SWEDEHEART registry, mainly focusing on harmonisation than new practices. Benefits include aligning variables to improve data capture, especially in pre-hospital care, despite challenges with privately-run ambulances. Key challenges are the lack of automated data collection, which strains healthcare workers and hampers real-time data gathering. Sweden is cautious about inter-country comparisons due to demographic and system differences. Future goals include participating more in R-RCTs through automation and improving data accuracy. Sweden aims to optimise data use and facilitate clinical insights by completing registrations early.

> The biggest impact so far is harmonisation, in that our ACS and PCI registers are harmonising their variables to EuroHeart.”

Dr Peter Vasko
Sweden

Country cohorts, completeness and quality of data 05

Since January 2024, in addition to the original eleven countries, France, England, and Wales have joined the EuroHeart collaboration. This annual report, with data from 2023, provides a summary of the care delivered across some of the countries within the EuroHeart network, encompassing Estonia, Iceland (only PCI data), France, Hungary, Portugal, Romania, Singapore, and Sweden, for individuals suffering from myocardial infarction. The EuroHeart annual report highlights various aspects of patient characteristics and care across these countries during the period from January to December 2023.

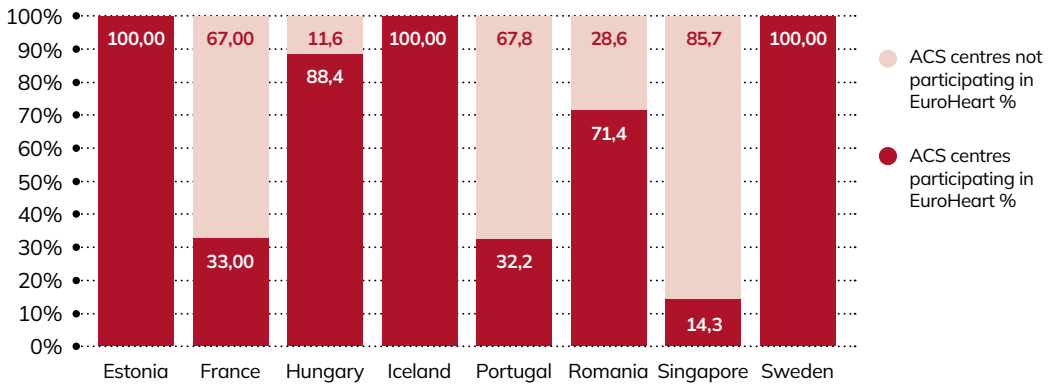
EuroHeart has requested that countries submit de-identified aggregated data based on the EuroHeart standards for acute coronary syndrome and percutaneous coronary intervention.[2] These data have been categorised a priori for de-identification purposes by diagnosis (STEMI/NSTEMI), sex, five-year age groups (<50, 50–54, 55–59, 60–64, 65–69, 70–74, 75–79, 80–84, ≥85 years), and diabetes for analysis and reporting. In addition to baseline characteristics and hospital care, the report includes performance metrics based on ESC quality indicators for acute myocardial infarction.[7]

Submissions for 2023 have been completed with full coverage in some countries, while in others, they represent a proportion of hospitalisations for myocardial infarction (Figure 2). Information about coverage is provided in at the patient, ward/department, hospital, and country levels.

The process of implementing the EuroHeart data standards in each country requires a considerable amount of effort. While some EuroHeart countries have fully adopted the data standards , others are still in the process of transitioning their case record forms to align with the EuroHeart variables.[2] Consequently, certain variables were not adopted in time for inclusion in the 2023 annual report. Additionally, some data items may not be collected by a country due to their local setup. Where countries are unable to provide specific data items, it has been indicated that the data are unavailable in the report.

Following the submission of de-identified aggregated data from each country, the EuroHeart Data Science Group conducted internal checks prior to analysis. Once analysed, the data were returned to each country's data submission lead and National Leaders for review. This iterative process of reviewing, checking, and revising the analyses continued until agreement was reached between the National Leaders and EuroHeart.

Figure 2. National coverage of ACS dataset



Overall numbers and admissions for myocardial infarction

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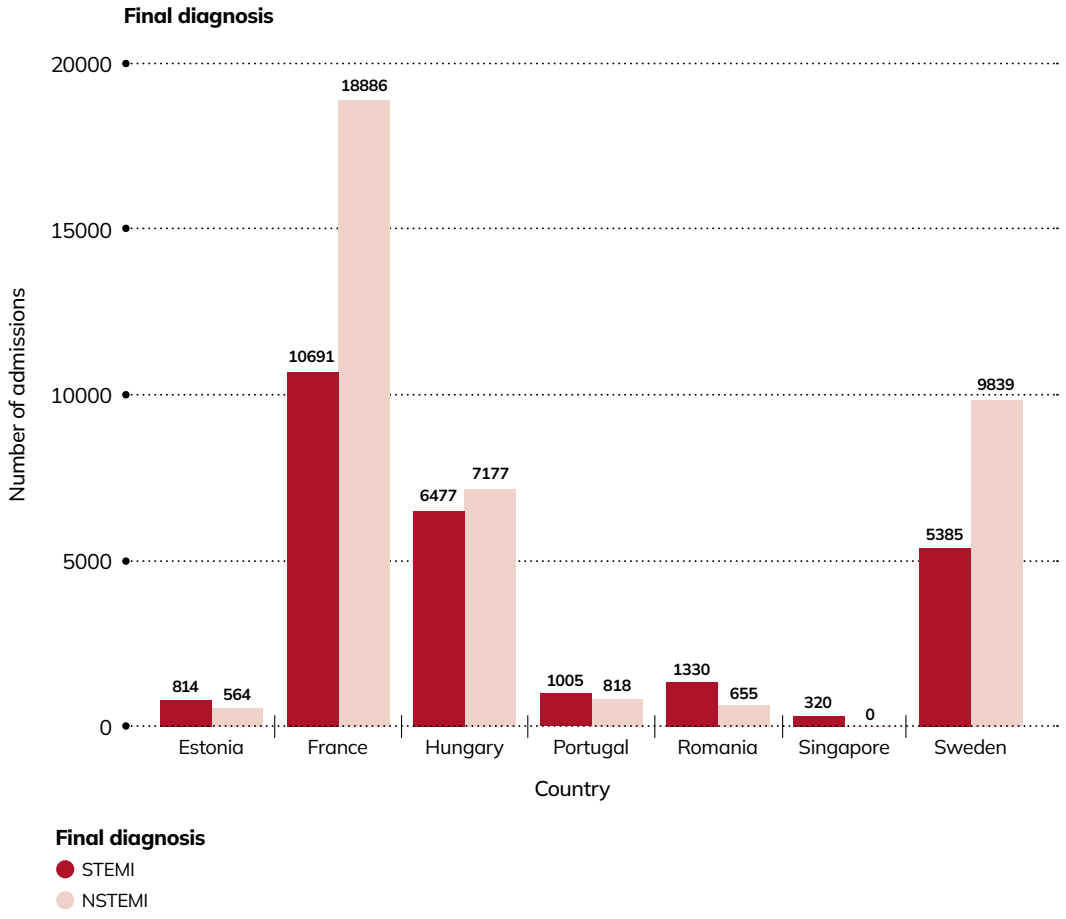
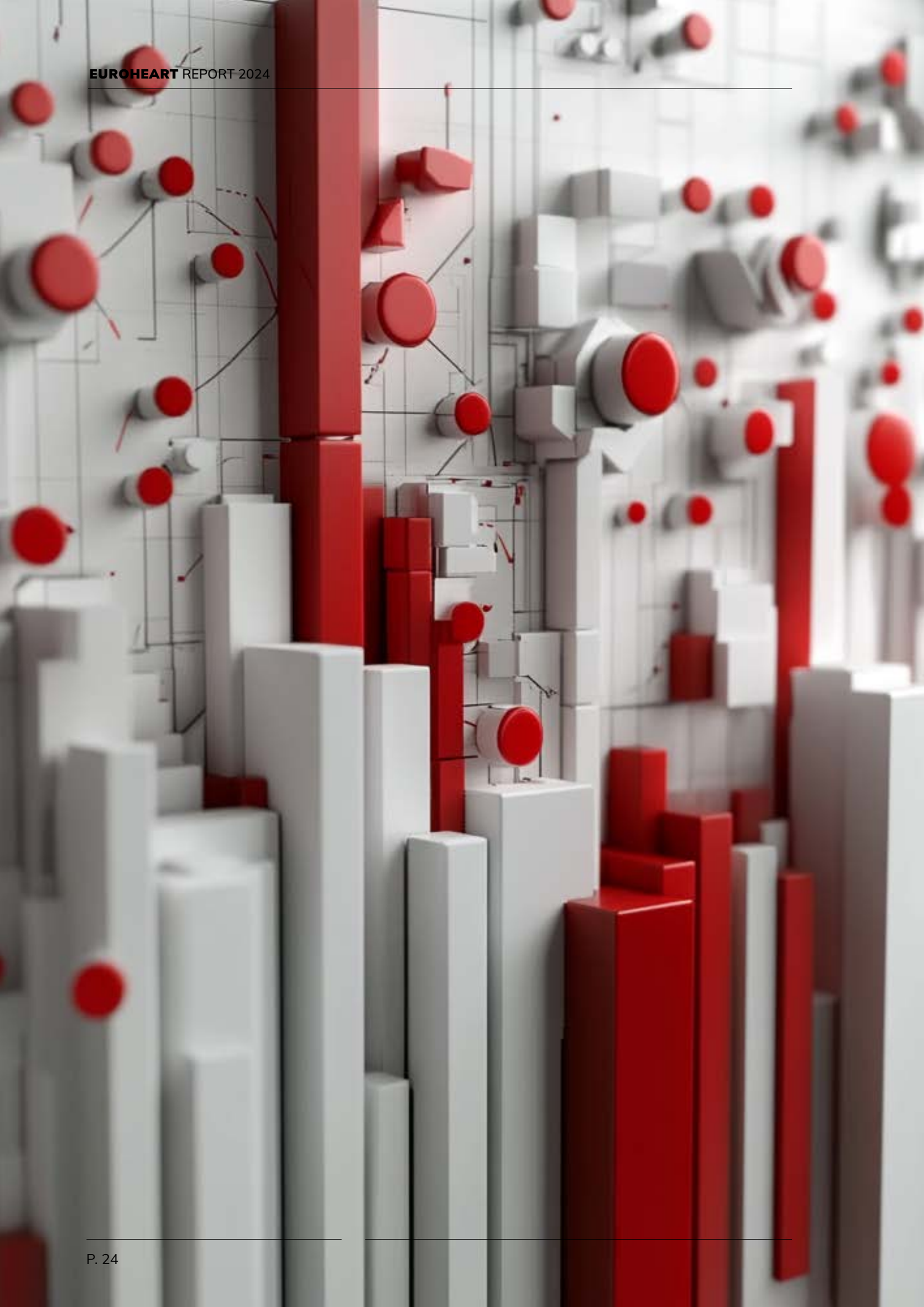
In total, the EuroHeart countries reported 63,961 admissions for myocardial infarction (Figure 3). Approximately 60% of the reported cases were NSTEMI, while the remaining patients had STEMI. However, this distribution may not accurately reflect the true proportions, as some countries did not collect or report data for all myocardial infarction cases in their region.

Figure 3. Number of admission with STEMI or NSTEMI by country.



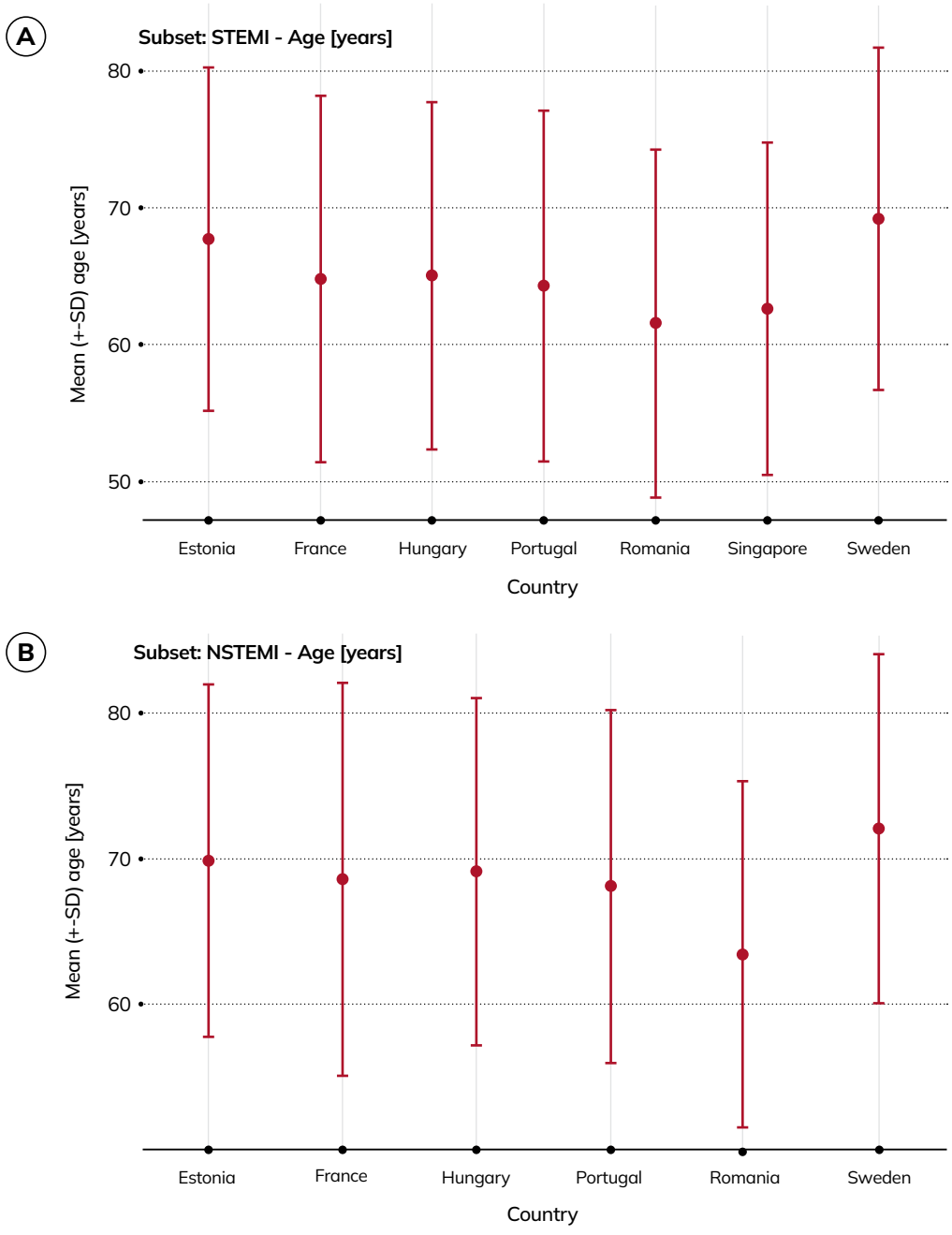


Baseline characteristics and comorbidities

07

Baseline characteristics and comorbidities of the included patients are presented separately by country and for those with STEMI and NSTEMI, and are further stratified by sex, age, and diabetes status.

Figure 4. Age. Patients with (A) STEMI tend to be younger than those with (B) NSTEMI.



Baseline characteristics and comorbidities

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Figure 5. Age. Female and diabetic patients are generally older than male and non-diabetic patients, regardless of whether they have (A) STEMI or (B) NSTEMI.

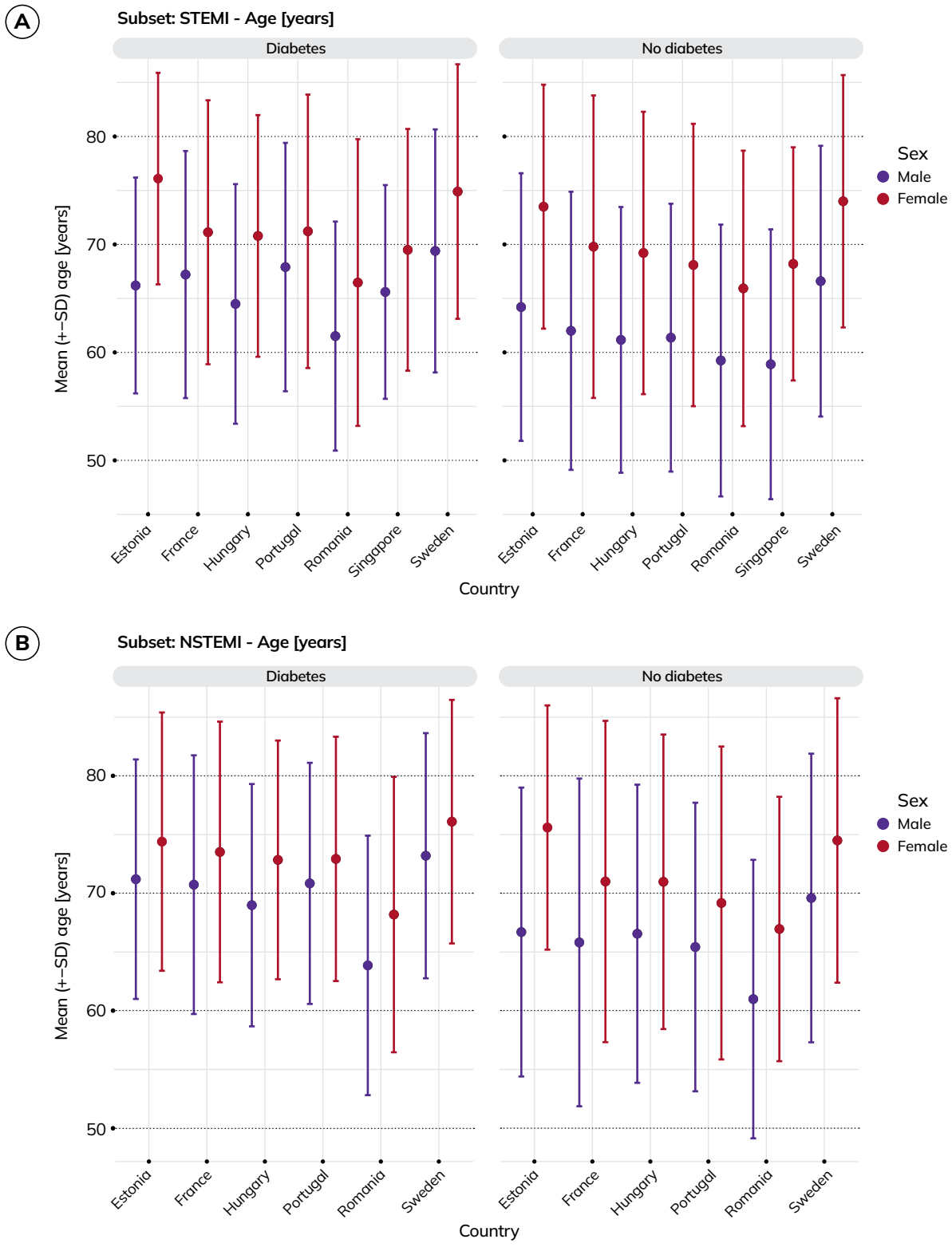
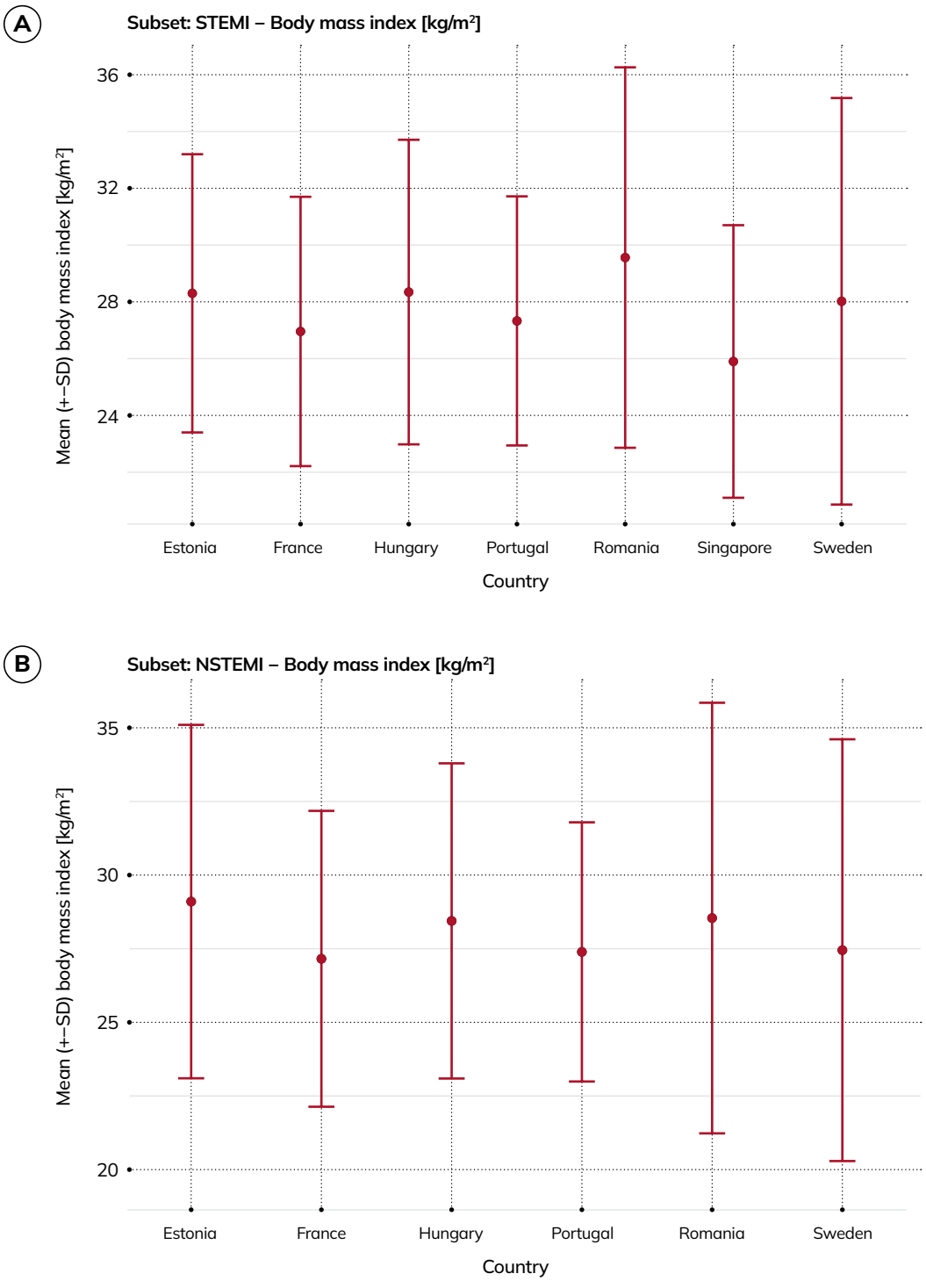


Figure 6. Body mass index. The mean BMI in patients with myocardial infarction was 27.5 kg/m². Overall, BMI levels were similar among patients with (A) STEMI and (B) NSTEMI. Diabetic patients generally had a higher BMI than non-diabetic patients, at 29.0 versus 27.0 kg/m².



Baseline characteristics and comorbidities

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Figure 7. Smoking. A higher proportion of (A, B) STEMI patients were current smokers compared to (C, D) NSTEMI patients. When stratifying by age and sex, younger and male patients were more often current smokers.

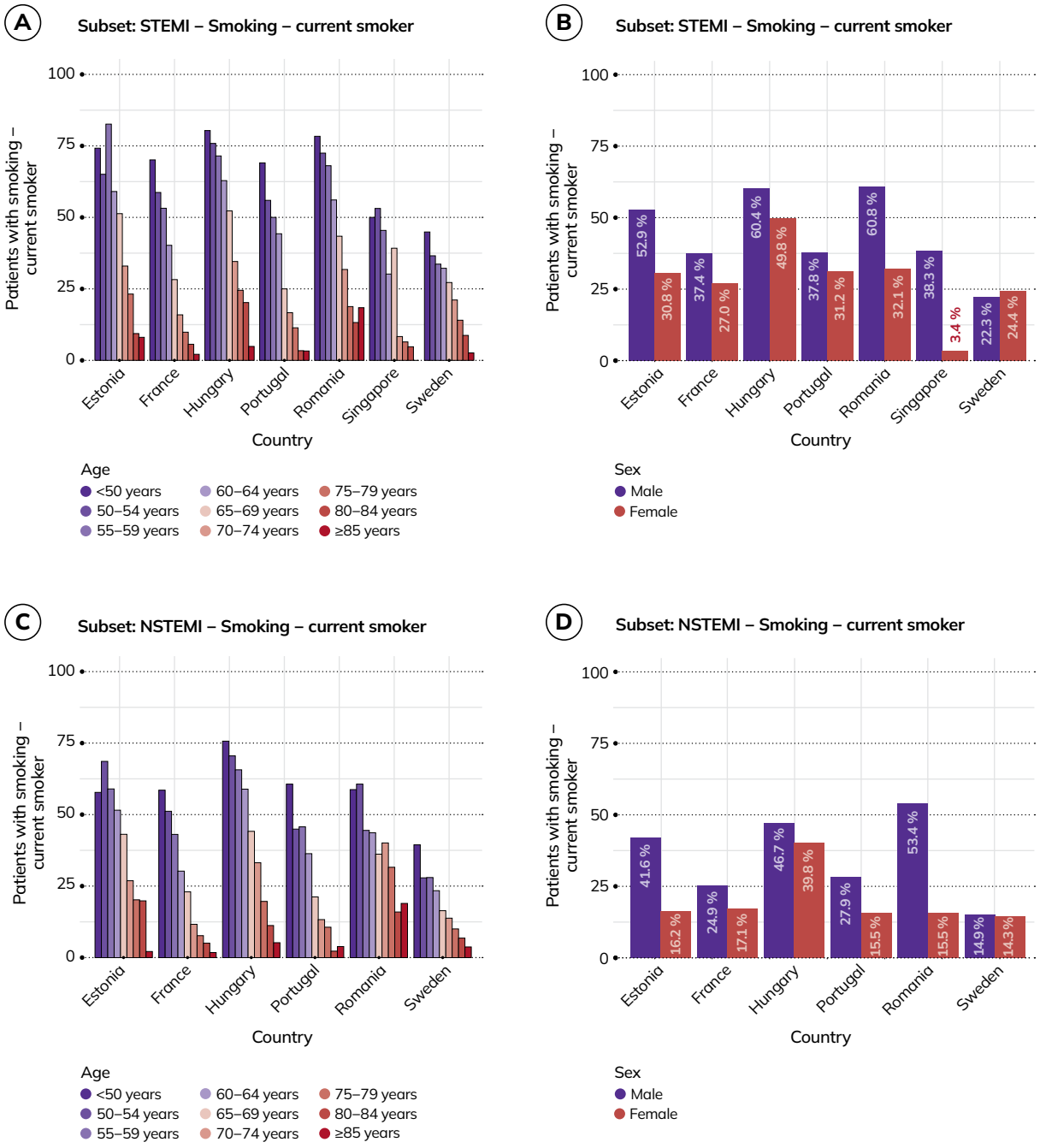
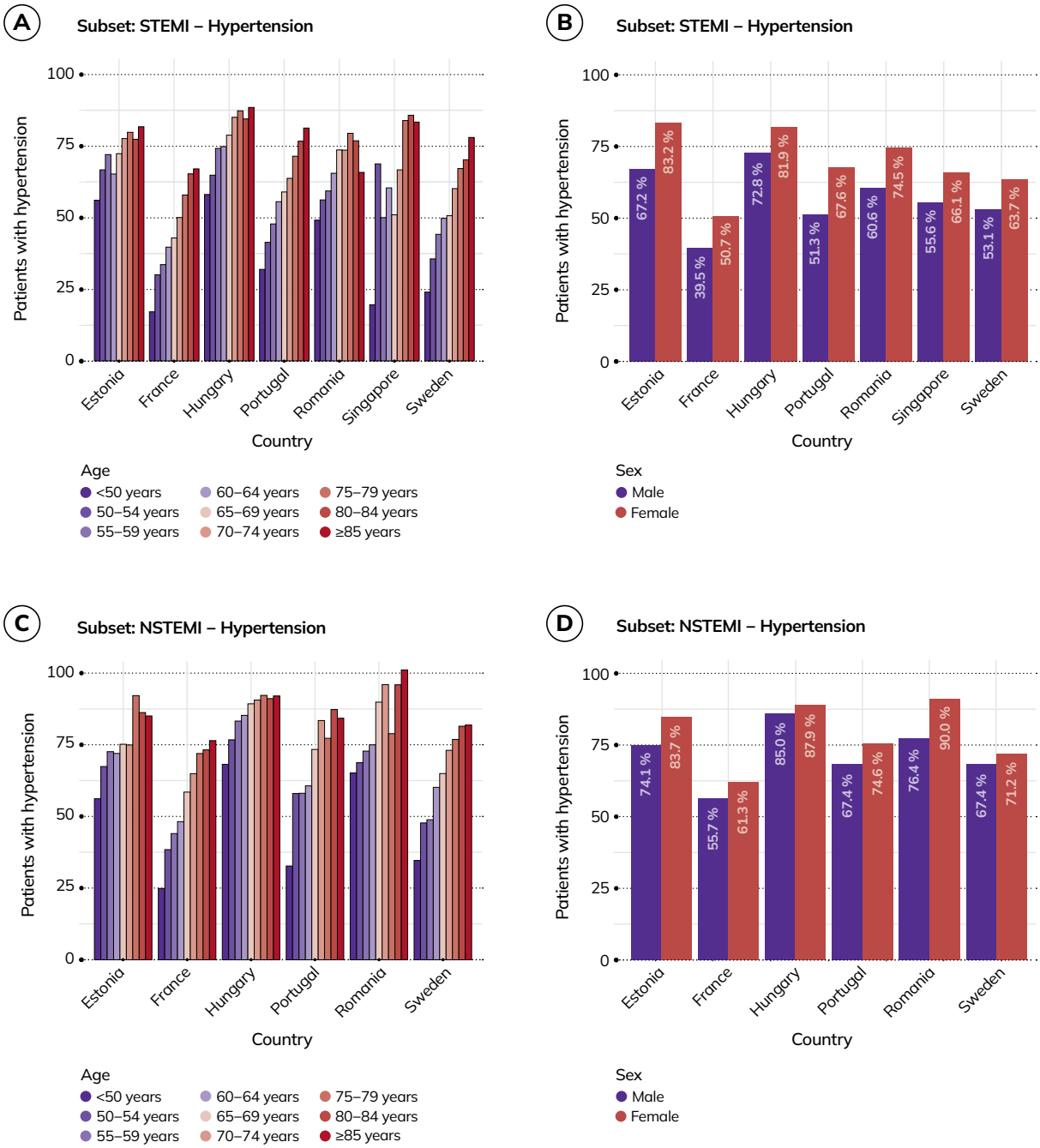


Figure 8. Hypertension. A slightly lower proportion of (A, B) STEMI patients had a history of hypertension compared to (C, D) NSTEMI patients. When stratifying by age and sex, older and female patients more often had a history of hypertension. Diabetic patients as compared to non-diabetic patients more often had hypertension, at 83.6% versus 54.9%.



Baseline characteristics and comorbidities

07

Figure 9. Diabetes. A lower proportion of (A, B) STEMI patients had diabetes compared to (C, D) NSTEMI patients. When stratifying by age and sex, older and female patients more often had a history of diabetes. The most common type of diabetes was type 2 diabetes, affecting 29.0%, followed by type 1 diabetes, affecting 1.4%.

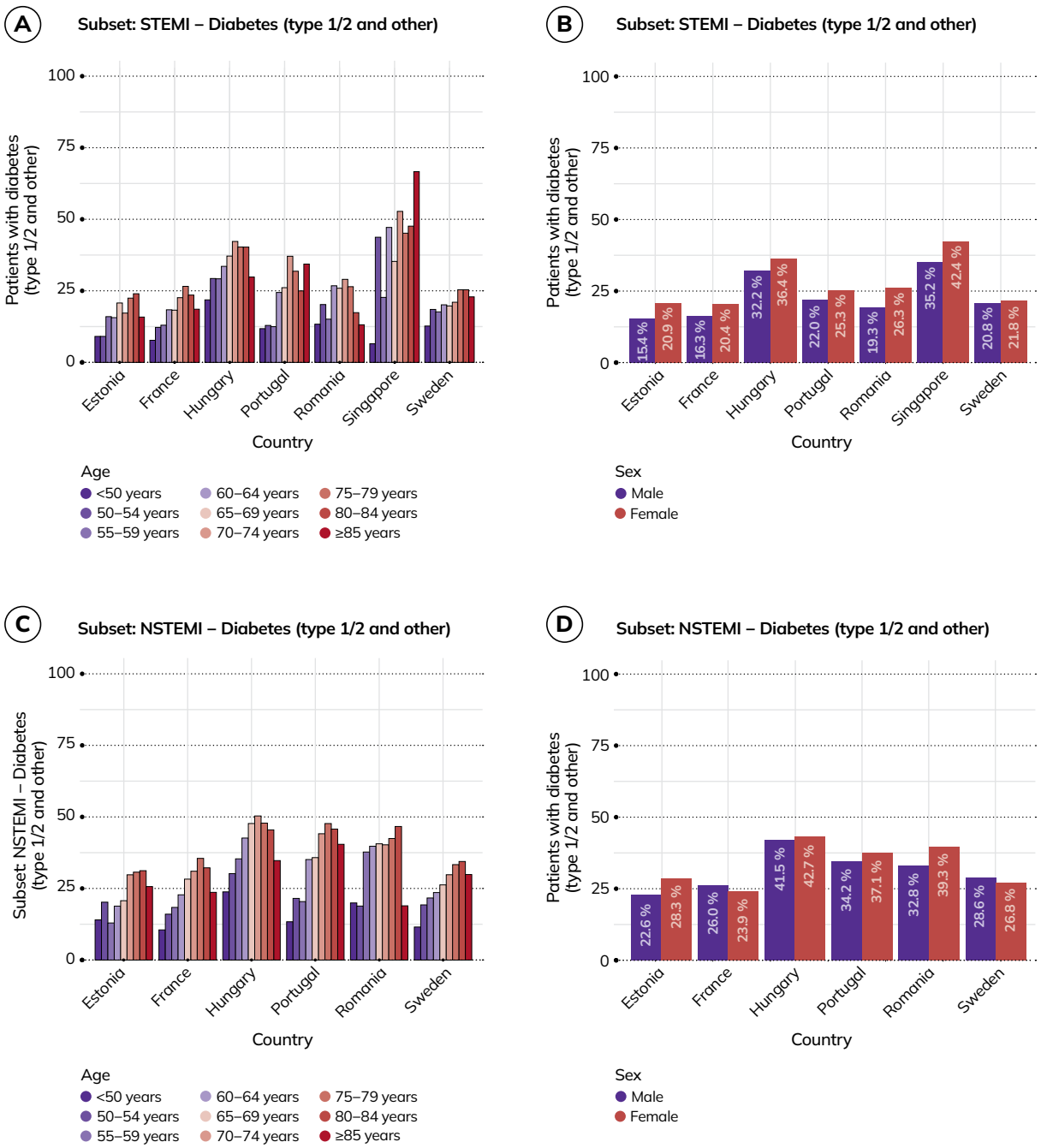
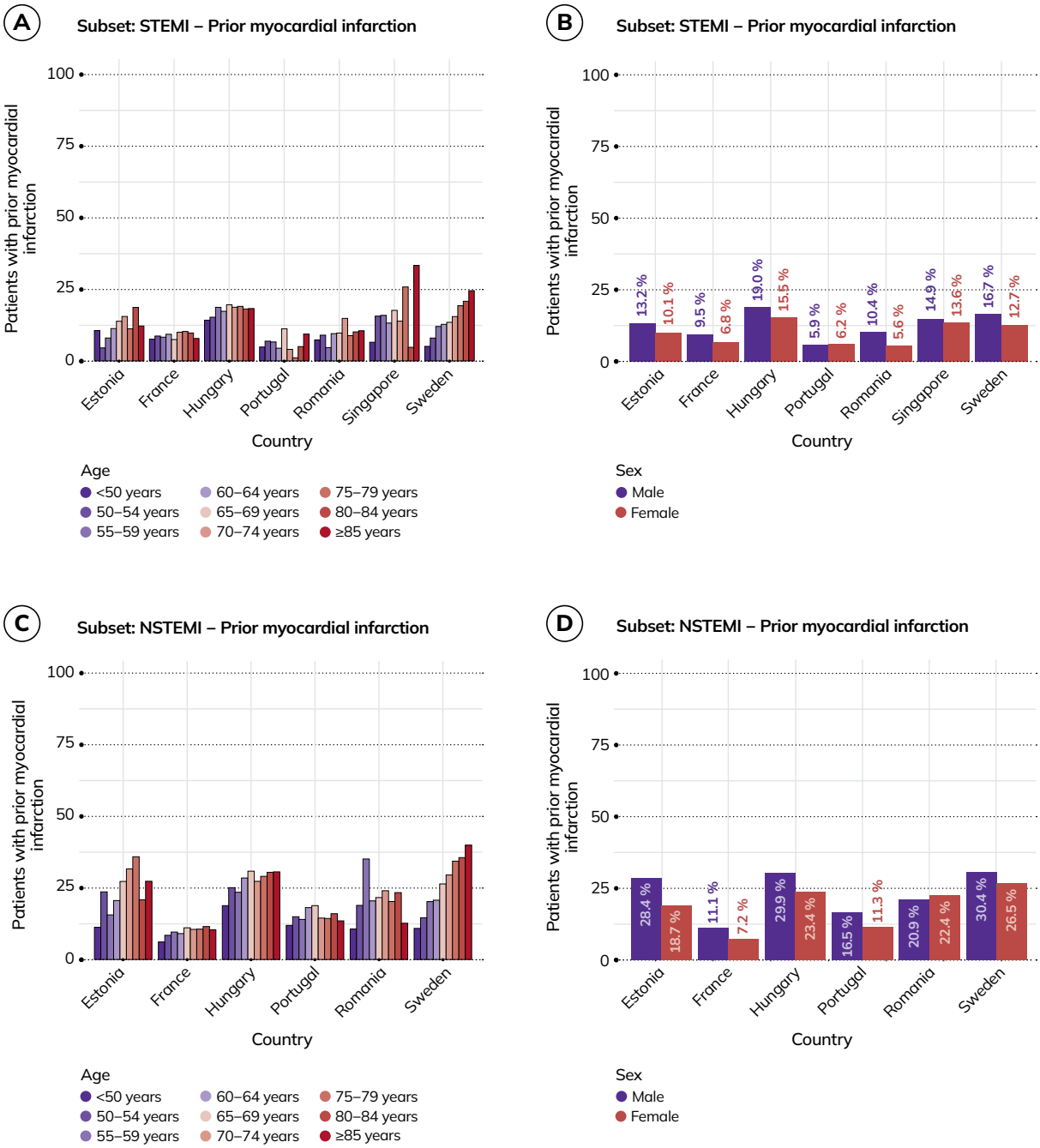


Figure 10. Prior myocardial infarction. A smaller proportion of (A, B) STEMI patients had a history of prior myocardial infarction compared to (C, D) NSTEMI patients. When stratifying by age and sex, older and male patients more often had a history of myocardial infarction.



Baseline characteristics and comorbidities

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Figure 11. Prior PCI. A smaller proportion of (A, B) STEMI patients had a history of prior PCI compared to (C, D) NSTEMI patients. When stratifying by age and sex, older and male patients more often had a history of prior PCI.

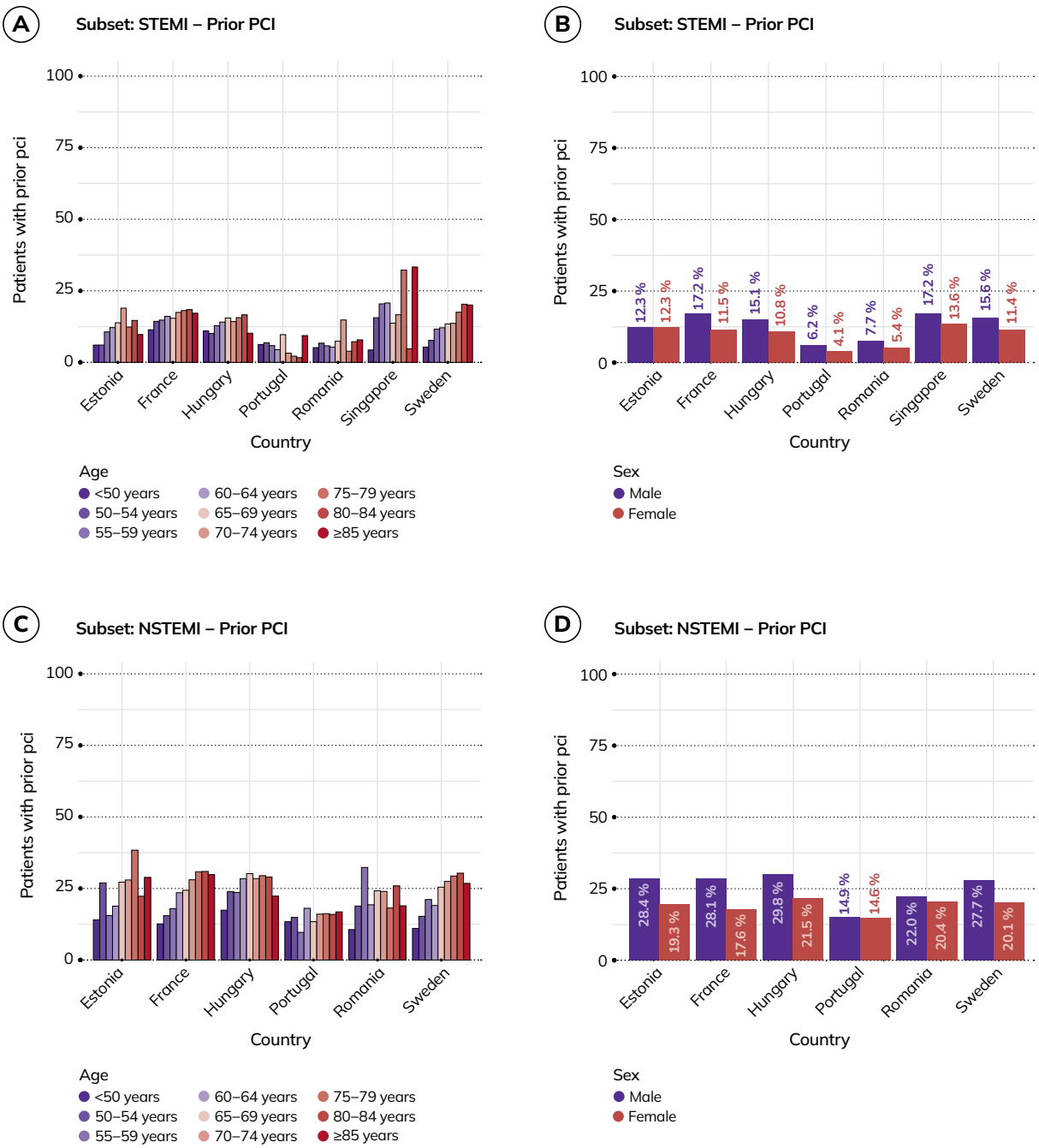
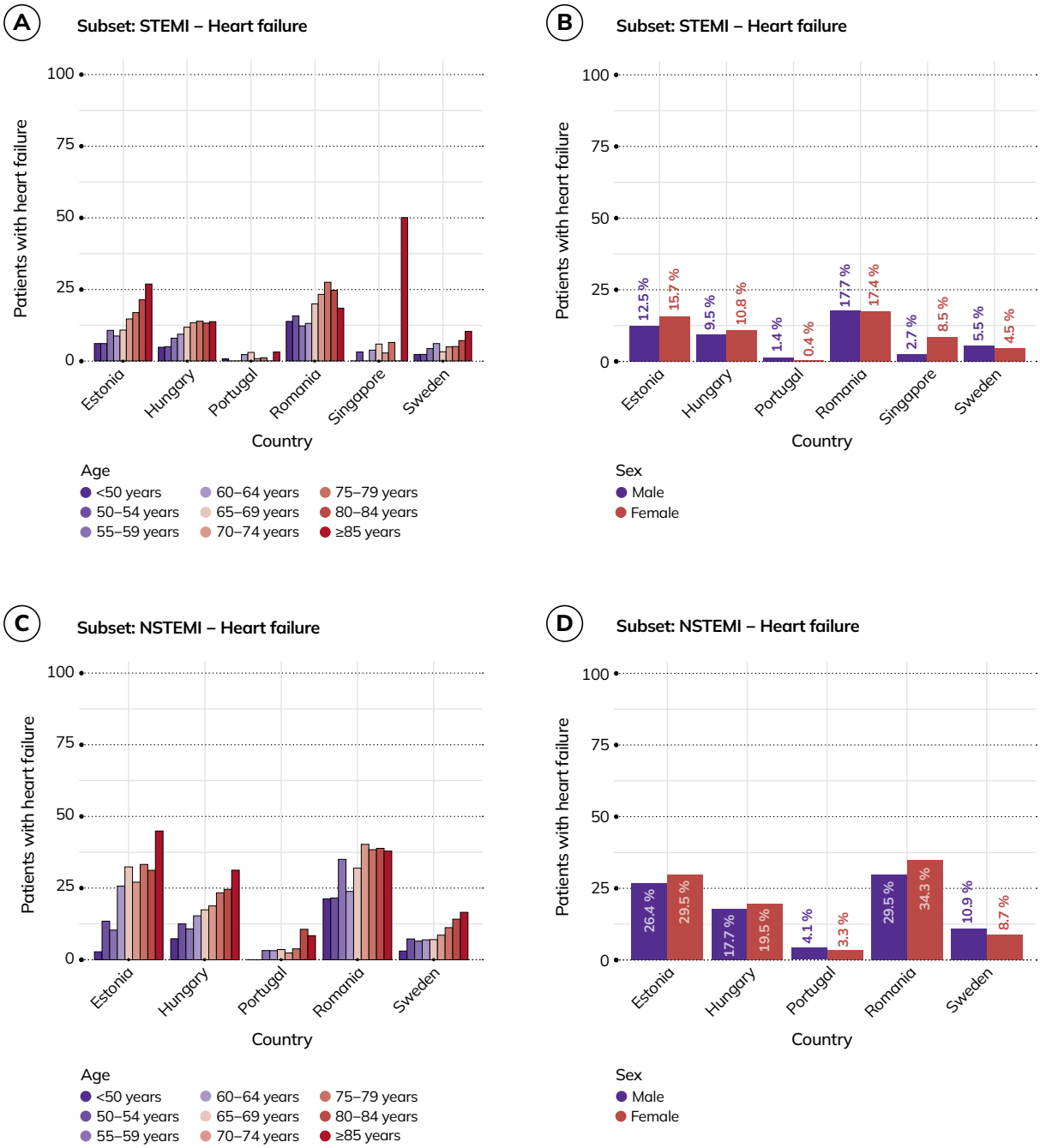


Figure 12. Heart failure. A smaller proportion of (A, B) STEMI patients had a history of heart failure compared to (C, D) NSTEMI patients. When stratifying by age, older patients more often had a history of heart failure. Diabetic patients as compared to non-diabetic patients more often had a history of heart failure, at 17.6% versus 9.2%. Data on heart failure were unavailable for France, and only incomplete data were available for Portugal.



Baseline characteristics and comorbidities

07

Figure 13. Chronic kidney disease. A smaller proportion of (A, B) STEMI patients had chronic kidney disease compared to (C, D) NSTEMI patients. When stratifying by age, older patients more often had chronic kidney disease. Nearly three times as many diabetic patients as compared to non-diabetic patients had chronic kidney disease, at 14.4% versus 5.7%. Data on chronic kidney disease were unavailable for Sweden.

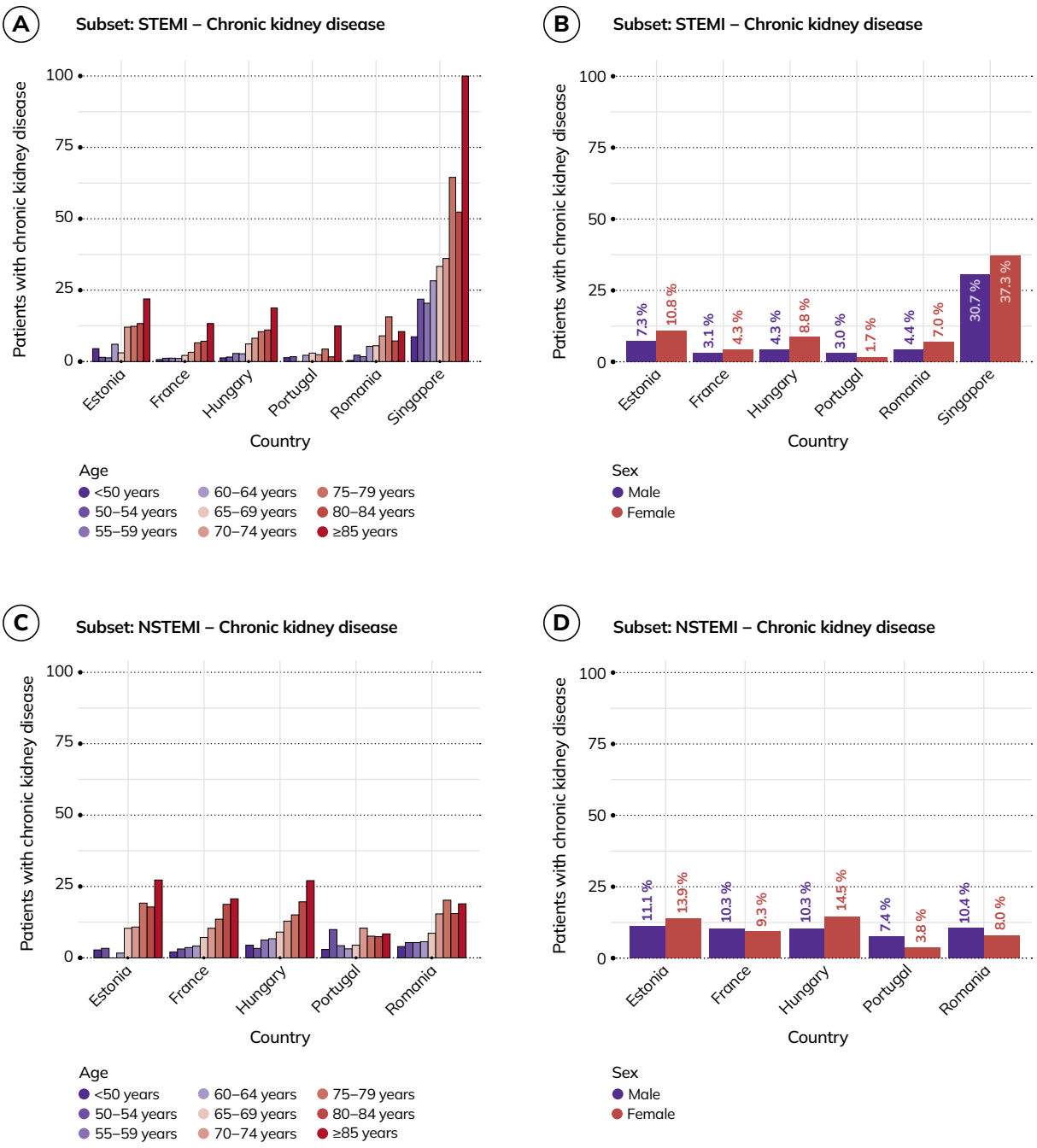
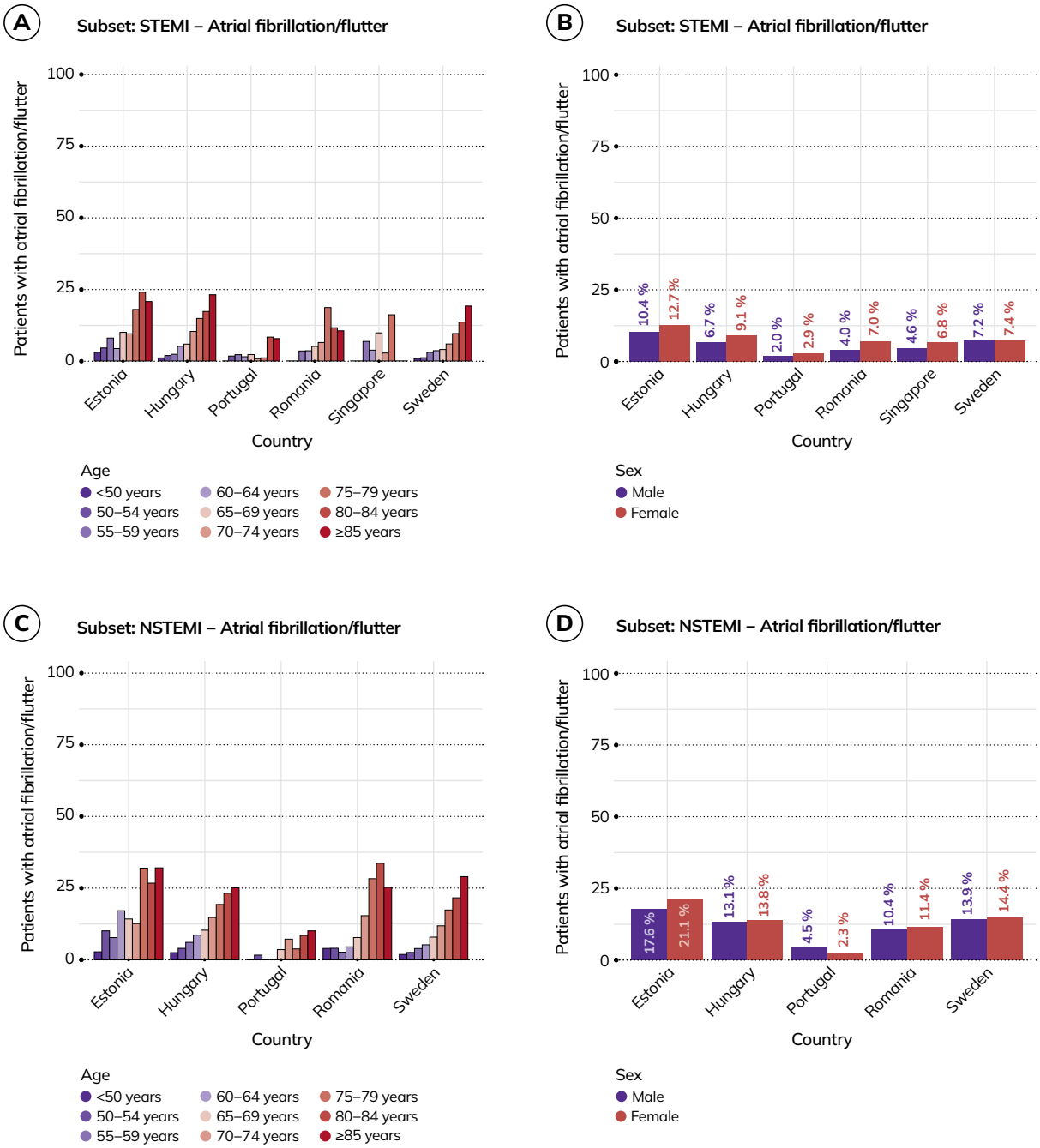


Figure 14. Atrial fibrillation. A smaller proportion of (A, B) STEMI patients had a history of atrial fibrillation/flutter compared to (C, D) NSTEMI patients. When stratifying by age, older patients more often had a history of atrial fibrillation/flutter. Diabetic patients as compared to non-diabetic patients more often had a history of atrial fibrillation/flutter, at 13.5% versus 9.2%. Data on atrial fibrillation/flutter were unavailable for France.



In-hospital care and discharge medication

08

Details about in-hospital care and medication at discharge of the included patients are presented separately by country and for those with STEMI and NSTEMI, and are further stratified by sex, age, and diabetes status.

Figure 15. Creatinine. First recorded level of creatinine (µmol/L) during the hospital stay. Patients with diabetes had higher mean level of creatinine compared to patients without diabetes. Data on creatinine were unavailable for France.

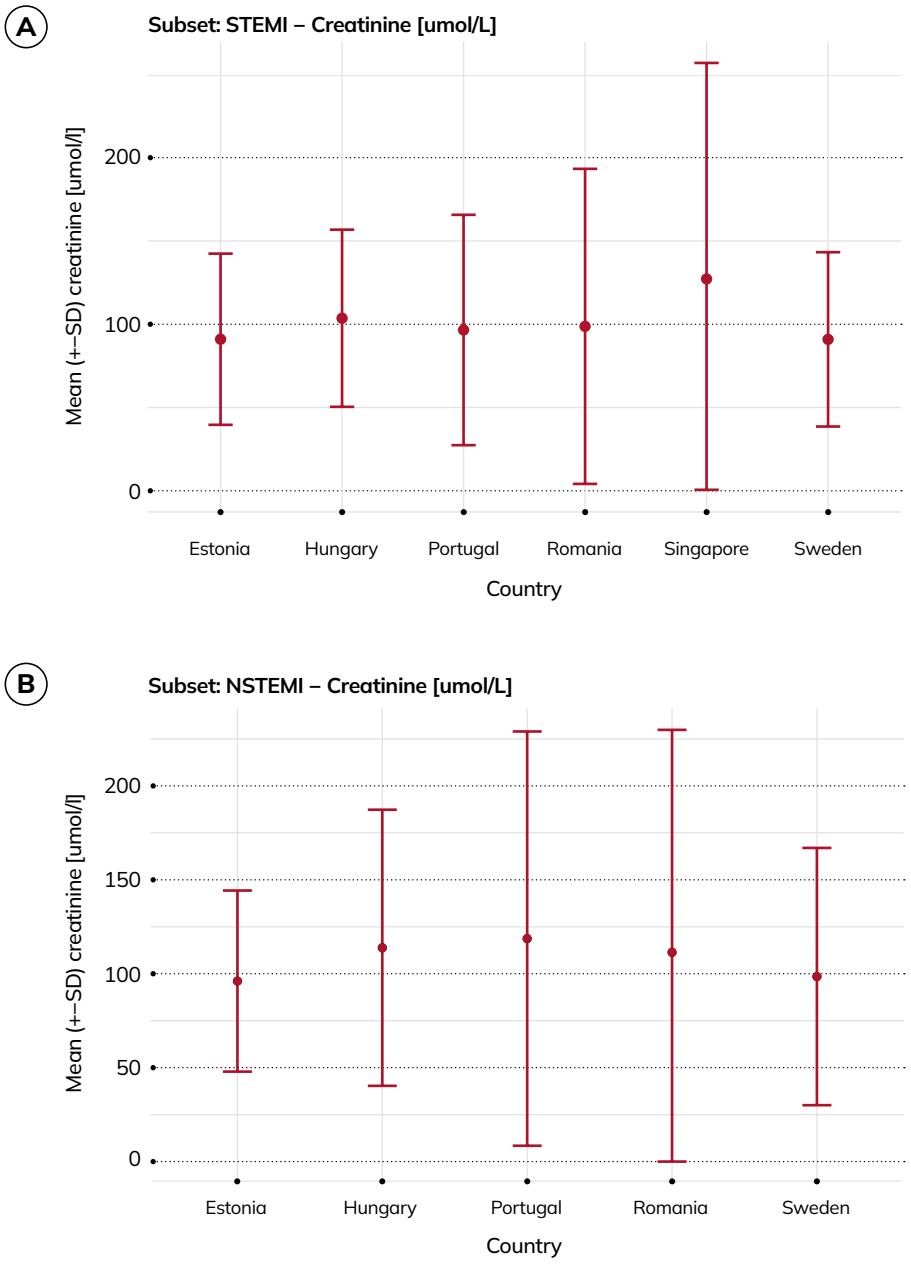
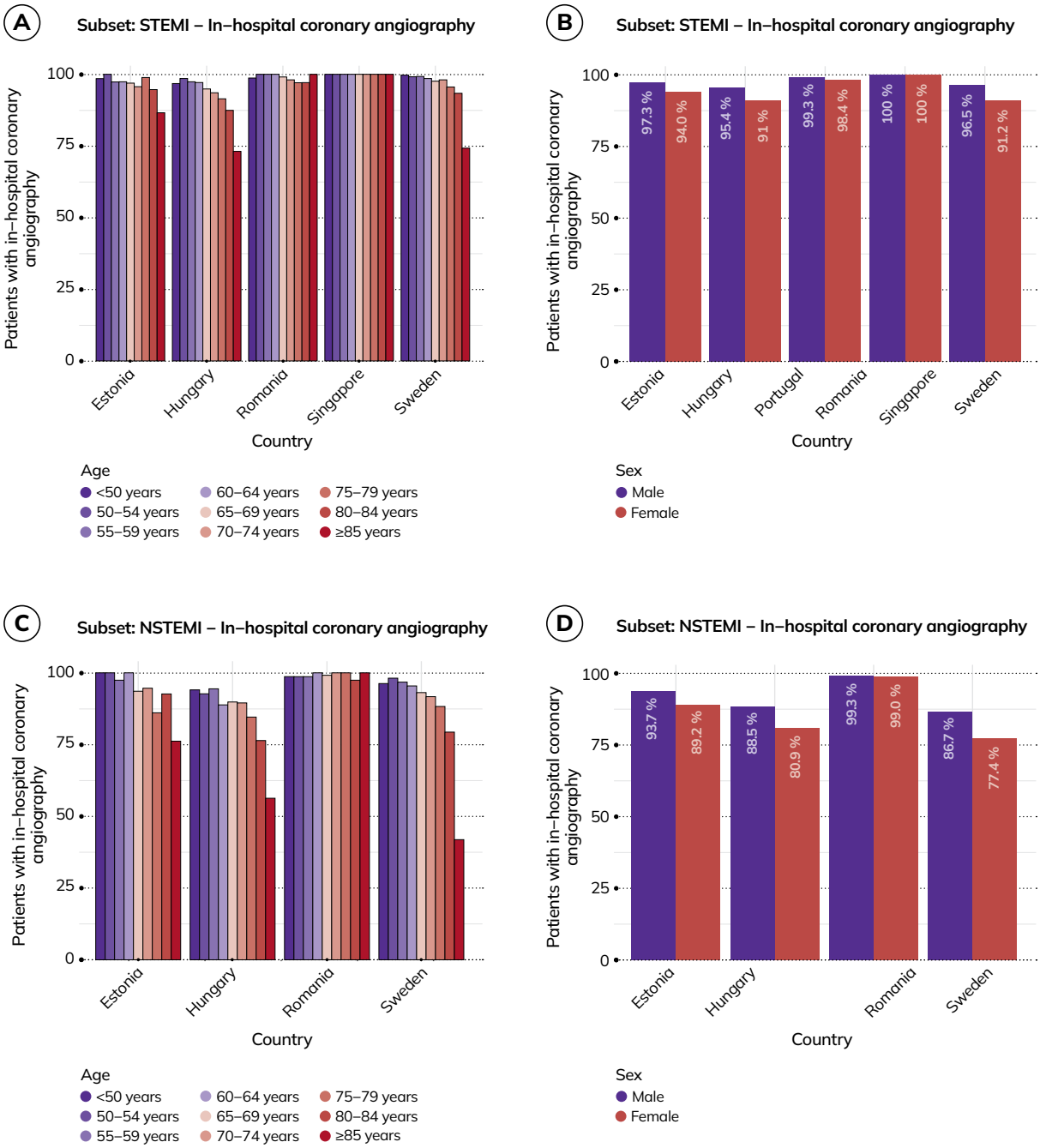


Figure 16. Coronary angiography. Most patients with (A, B) STEMI or (C, D) NSTEMI underwent in-hospital coronary angiography. Stratification by age and sex revealed that elderly patients, and to some extent females, were less likely to undergo in-hospital coronary angiography. Data on coronary angiography were unavailable for France and Portugal.



In-hospital care and discharge medication

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Figure 17. PCI. Most patients with (A, B) STEMI or (C, D) NSTEMI underwent in-hospital PCI. Stratification by age and sex revealed that elderly patients, and to some extent females, were less likely to undergo in-hospital PCI. Data on PCI were unavailable for Portugal.

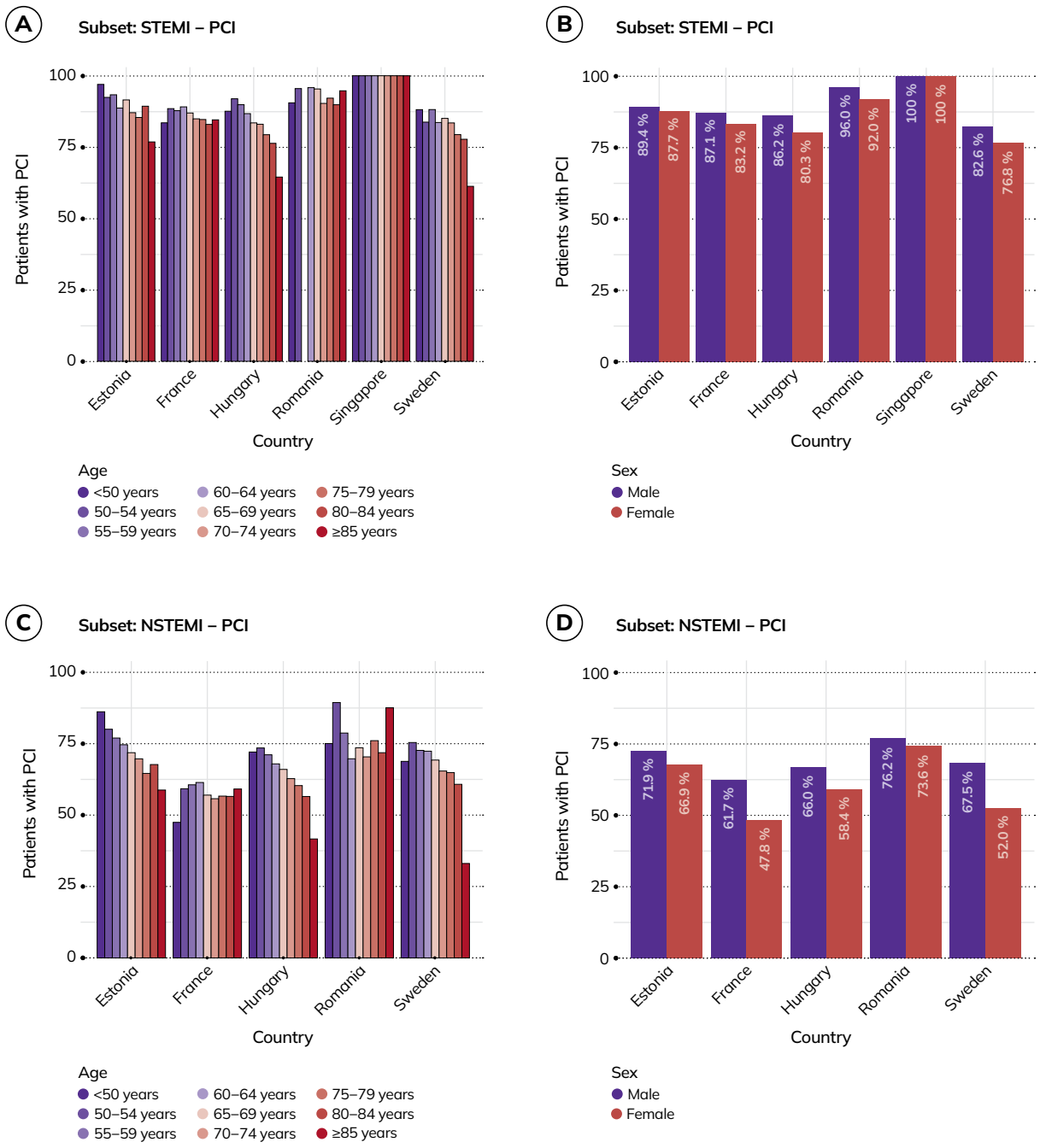
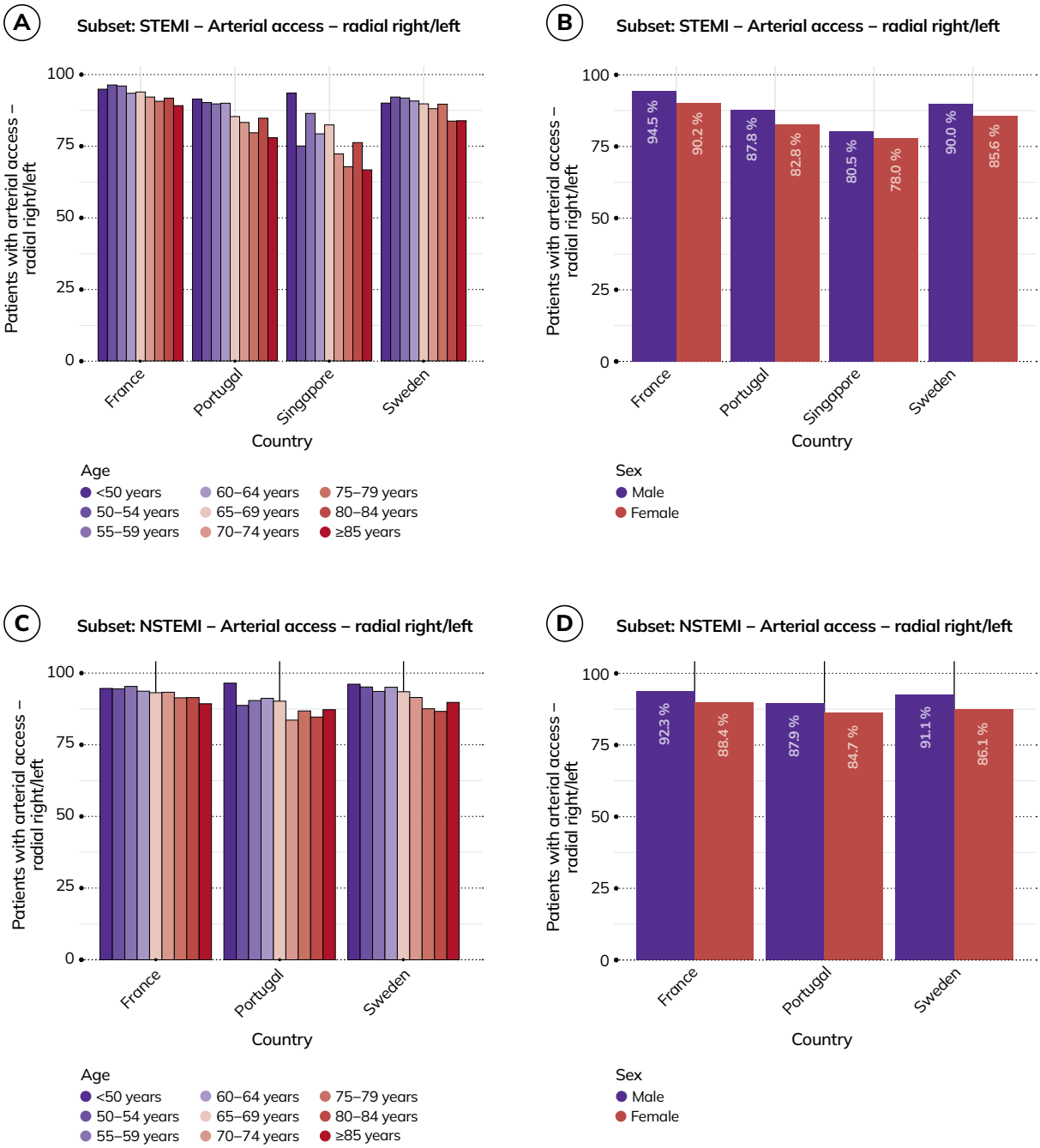


Figure 18. Arterial access during PCI. Radial access was commonly used among patients with (A, B) STEMI and (C, D) NSTEMI who underwent in-hospital PCI. When stratifying by age and sex, radial access was more commonly employed for younger patients and males. Data on arterial access were unavailable for Estonia, Hungary, and Romania.



In-hospital care and discharge medication

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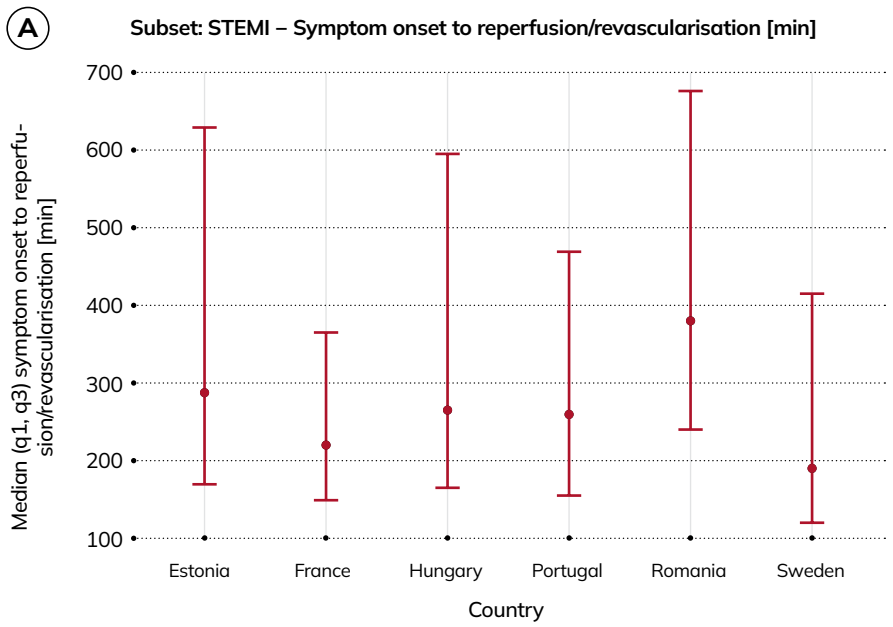
Figure 19. Symptom onset to reperfusion/revascularisation. Time (minutes) from symptom onset to reperfusion/revascularisation (median with interquartile range) illustrates variations in duration between the different EuroHeart countries for patients with (A) STEMI and (B) NSTEMI. Data on symptom onset to reperfusion/revascularisation were unavailable for Singapore, and unavailable for patients with NSTEMI for France.



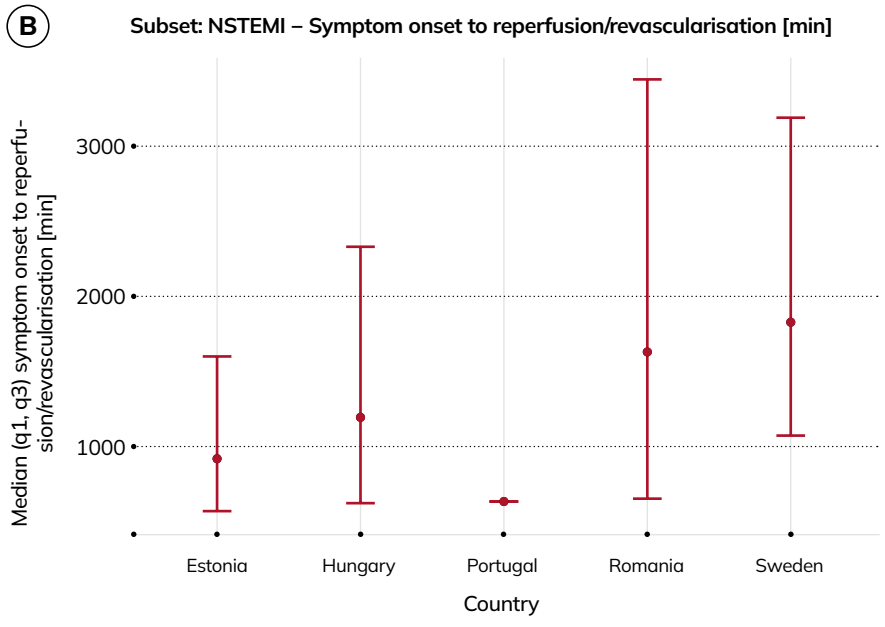
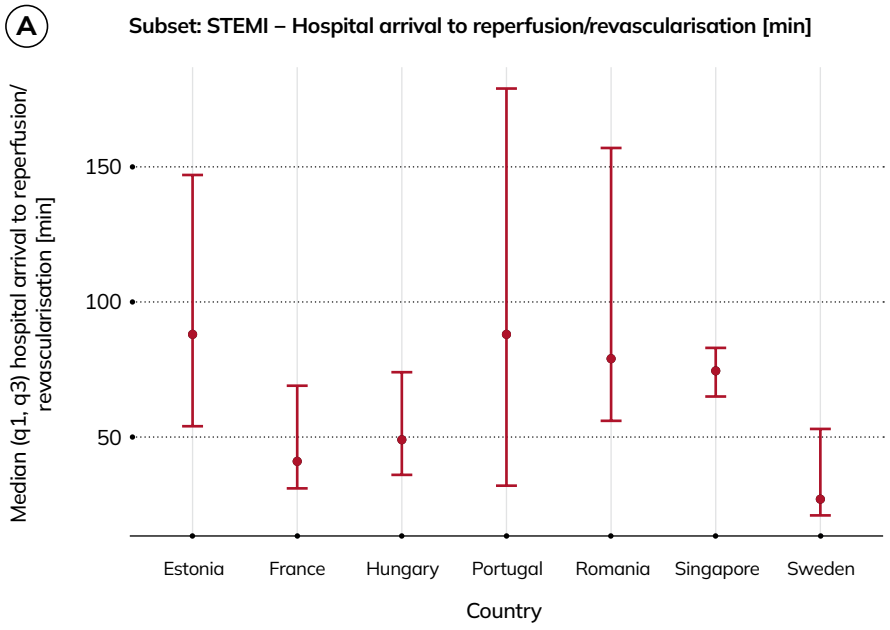
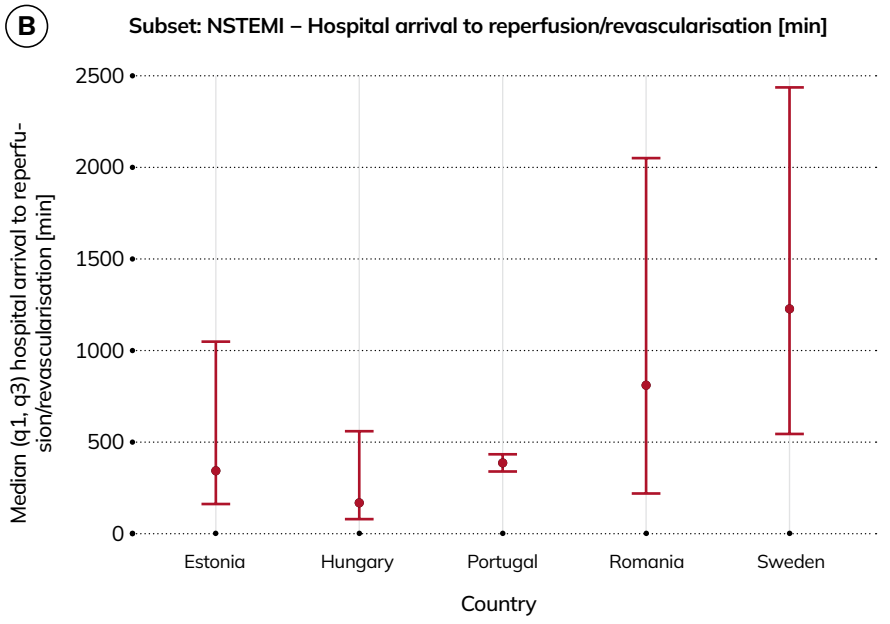


Figure 20. Hospital arrival to reperfusion/revascularisation. Time (minutes) from hospital arrival to reperfusion/revascularisation (median with interquartile range) illustrates variations in duration between the different EuroHeart countries for patients with (A) STEMI and (B) NSTEMI. Data on symptom hospital arrival to reperfusion/revascularisation were unavailable for patients with NSTEMI for France.





In-hospital care and discharge medication

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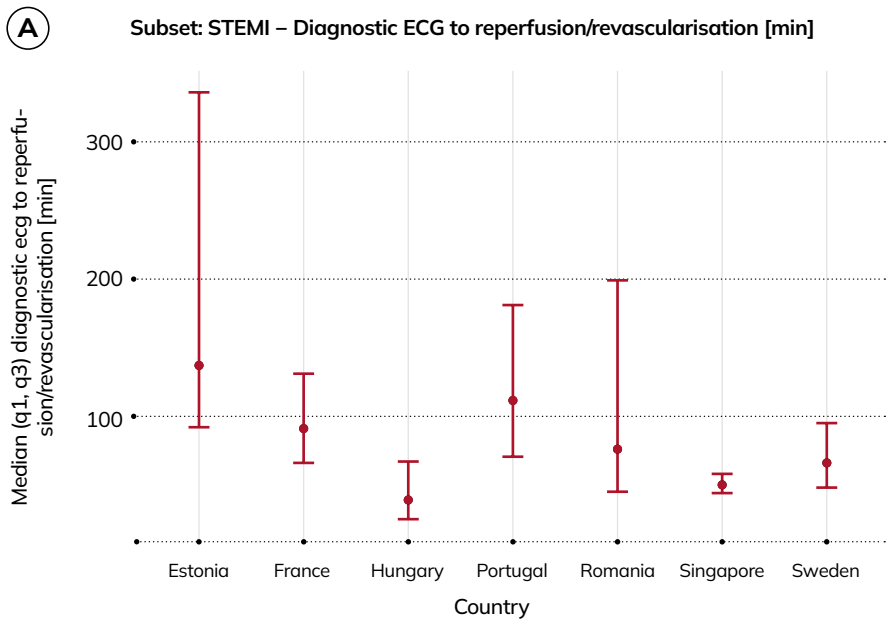
Figure 21. Diagnostic ECG to reperfusion/revascularisation. Time (minutes) from diagnostic ECG (median with interquartile range) illustrates variations in duration between the different EuroHeart countries for patients with (A) STEMI and (B) NSTEMI. Data on diagnostic ECG to reperfusion/revascularisation were unavailable for patients with NSTEMI for France and Portugal.



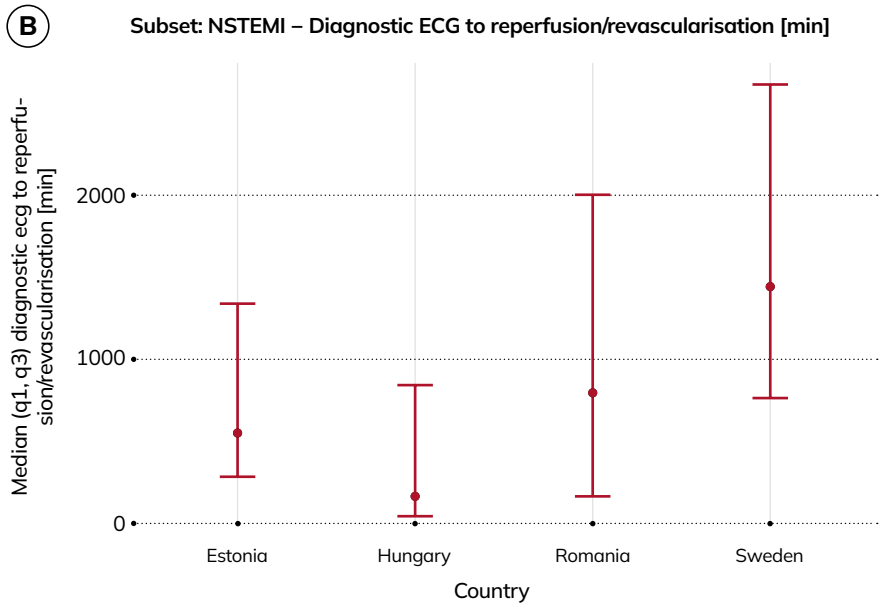
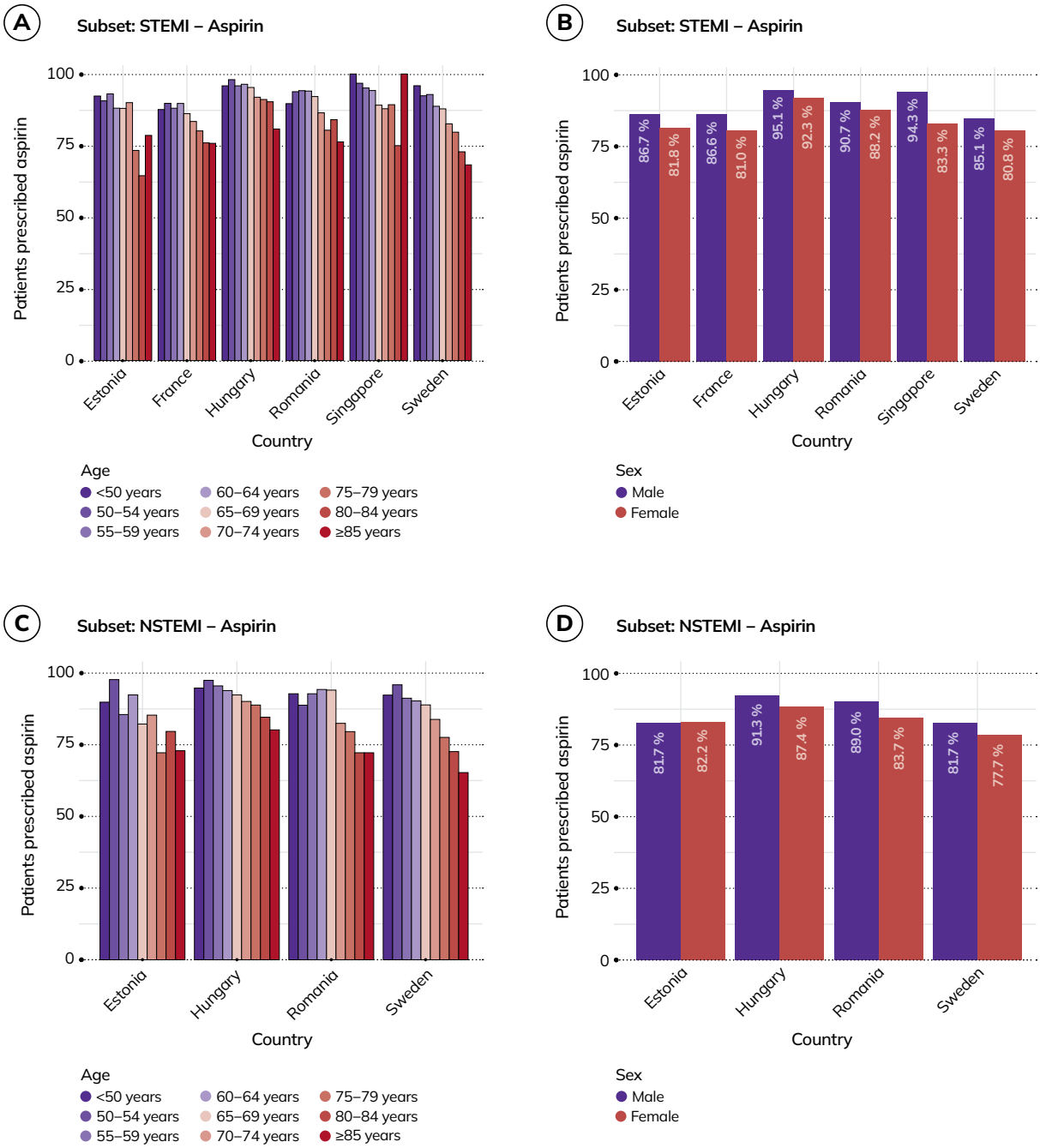


Figure 22. Discharge medication – Aspirin. Most patients with (A, B) STEMI and (C, D) NSTEMI received aspirin at discharge. When stratifying by age and sex, older patients and females were less likely to receive aspirin at discharge. Data on aspirin were unavailable for Portugal, and unavailable for patients with NSTEMI for France.



In-hospital care and discharge medication

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Figure 23. Discharge medication – $P2Y_{12}$ inhibitors. Most patients with (A, B) STEMI and (C, D) NSTEMI received a P2Y12 inhibitor at discharge. When stratifying by age and sex, older patients and females were less likely to receive a P2Y12 inhibitor. Data on P2Y12 inhibitors were unavailable for Portugal, and unavailable for patients with NSTEMI for France.

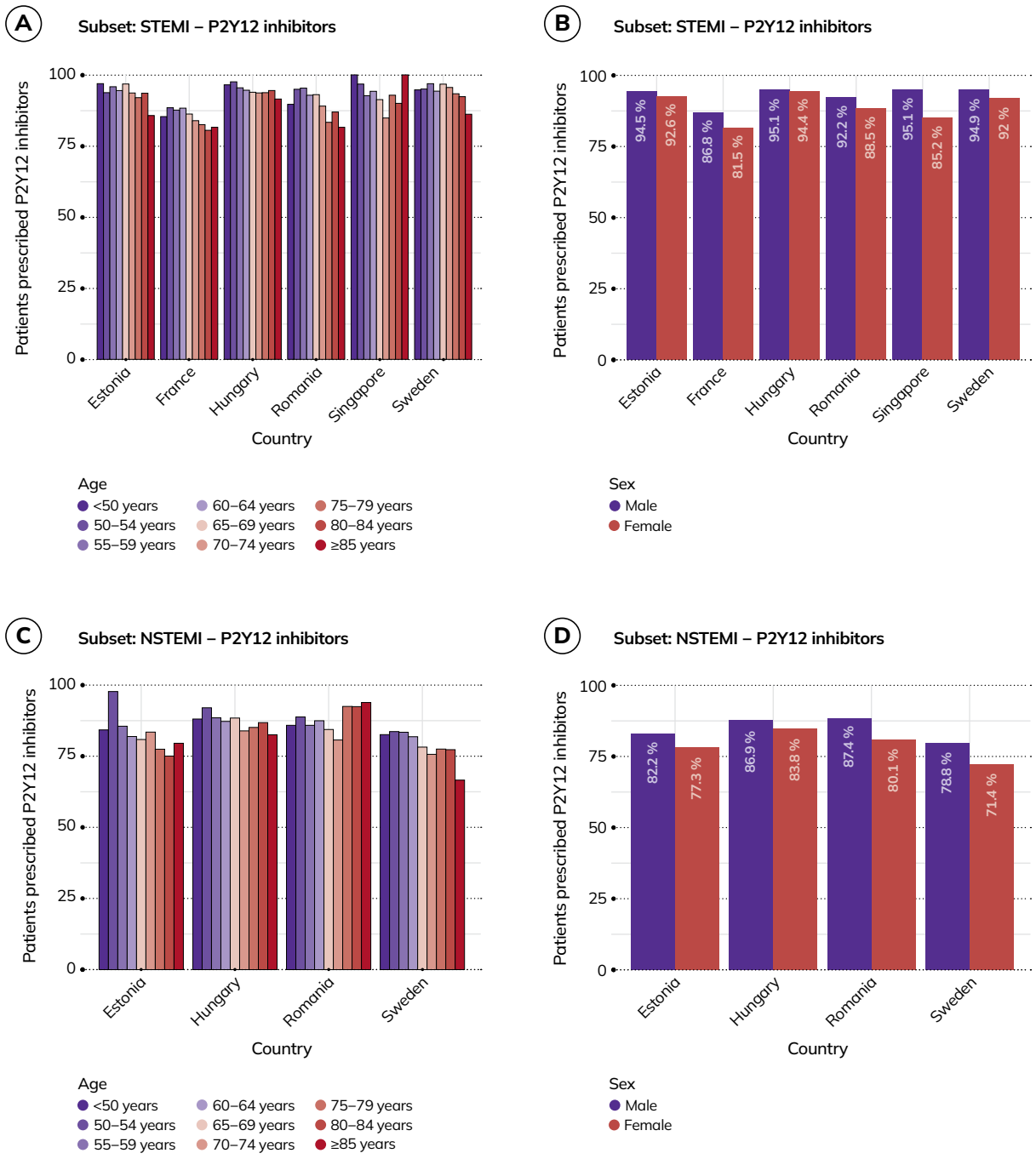
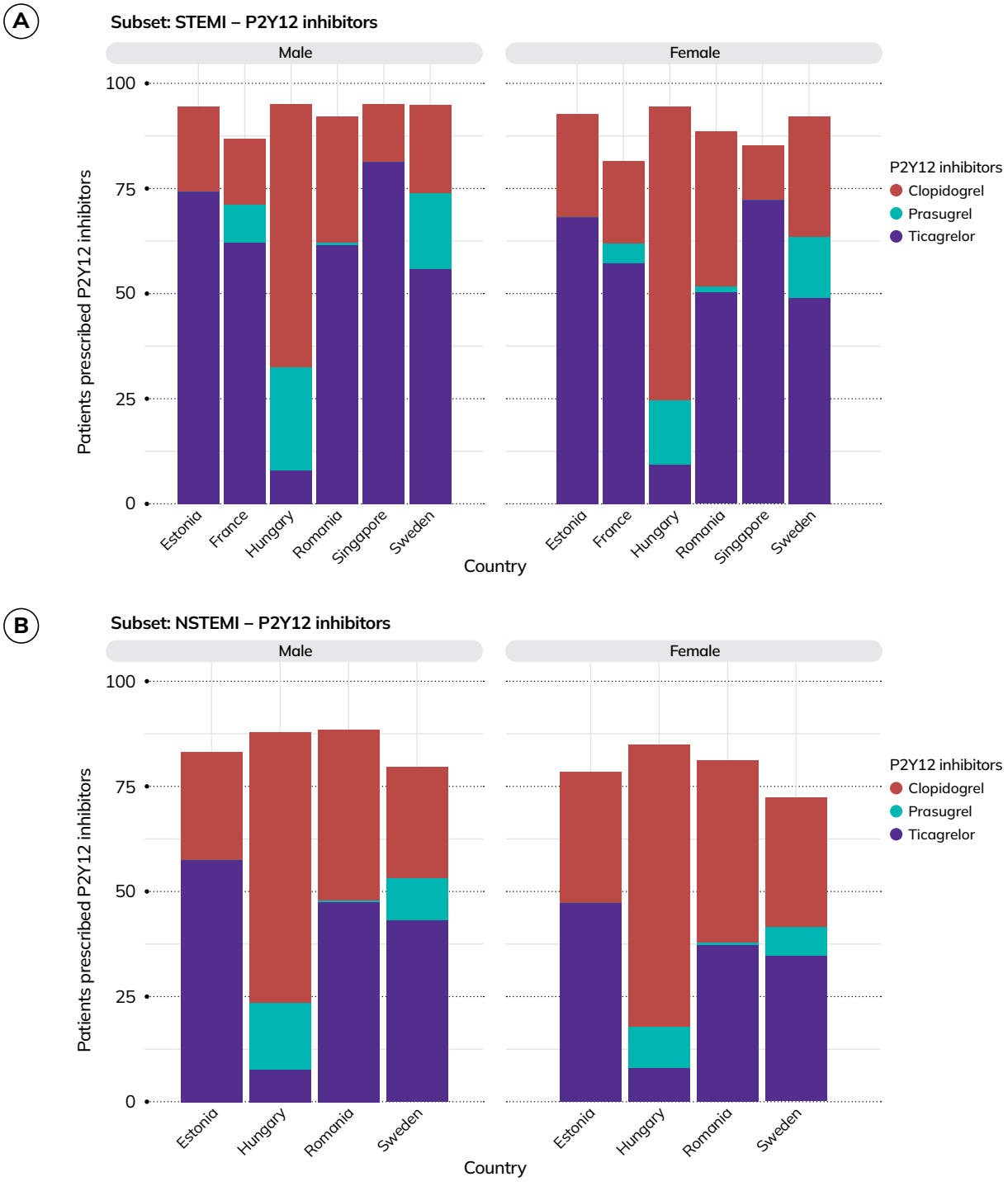


Figure 24. Discharge medication – Type of $P2Y_{12}$ inhibitor. Ticagrelor (36.8%) was the most commonly used $P2Y_{12}$ inhibitor among EuroHeart countries, particularly in patients with STEMI, followed by clopidogrel (30.4%) and prasugrel (9.1%). Data on $P2Y_{12}$ inhibitors were unavailable for Portugal, and unavailable for patients with NSTEMI for France.



In-hospital care and discharge medication

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Figure 25. Discharge medication – Oral anticoagulants. An oral anticoagulant was prescribed to a proportion of patients with (A, B) STEMI and (C, D) NSTEMI. Stratification by age and sex showed that older patients and females were less likely to receive this medication. The indication for treatment with oral anticoagulation was not available. Data on oral anticoagulants were unavailable for Portugal, and unavailable for patients with NSTEMI for France.

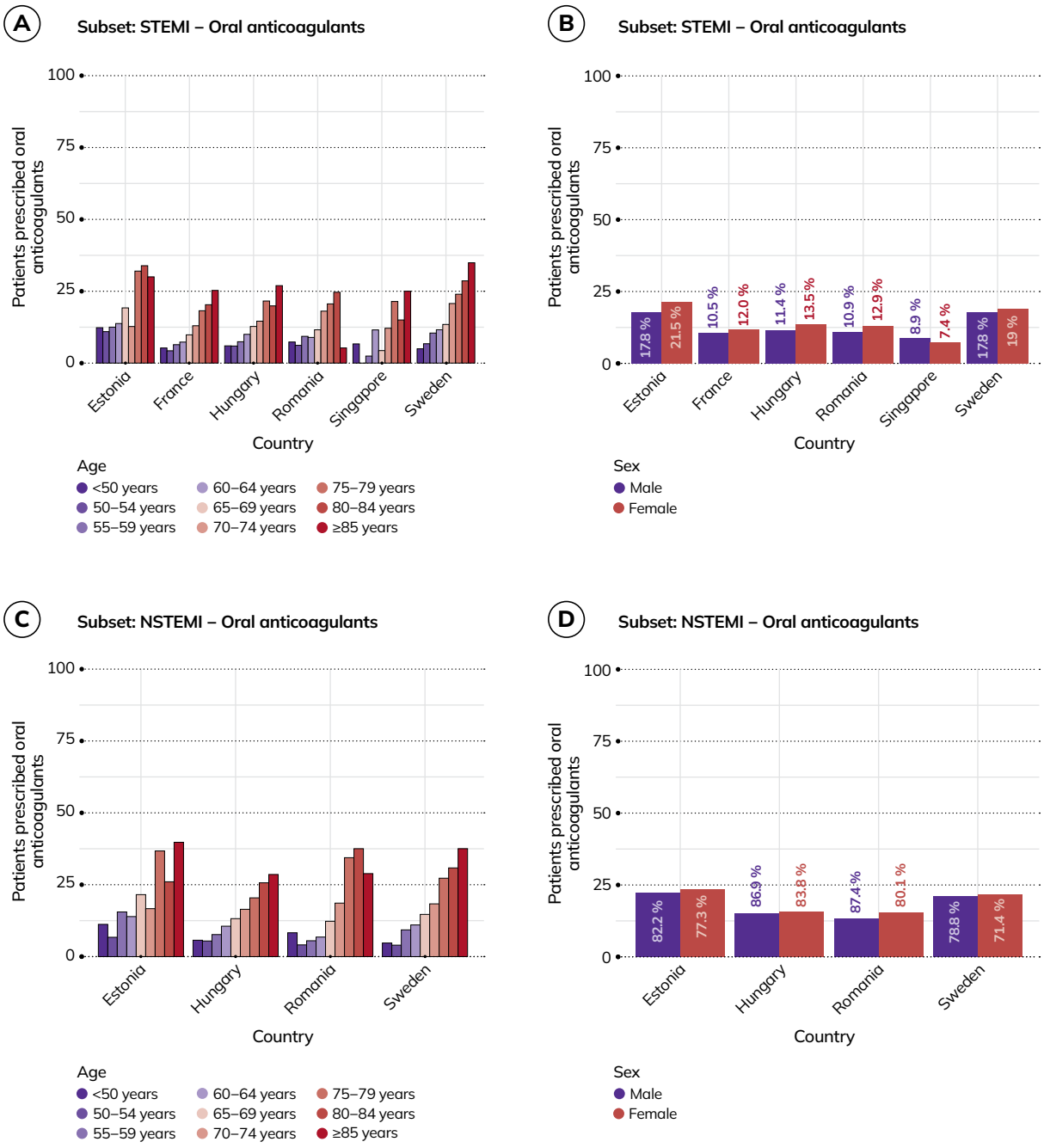
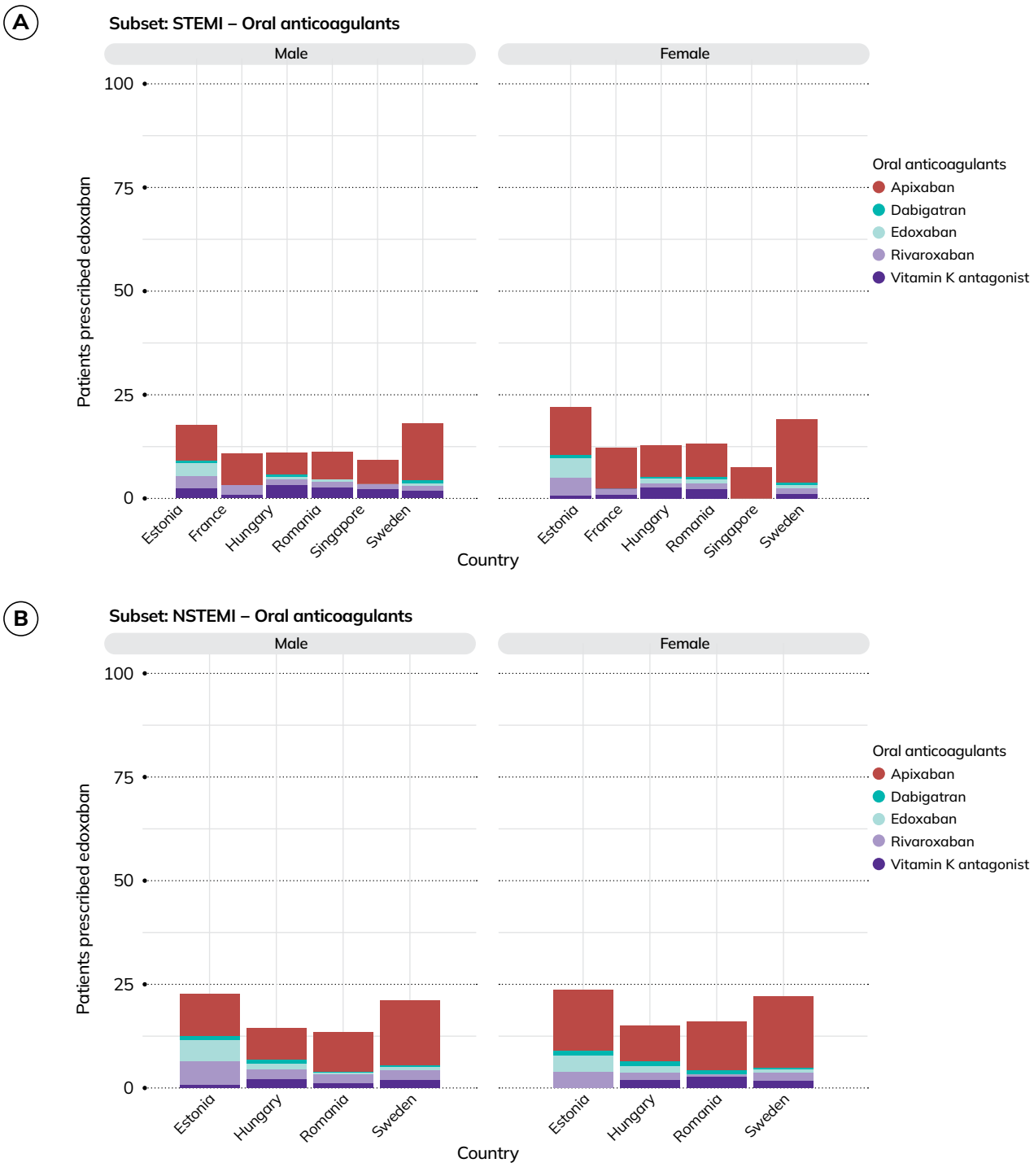


Figure 26. Discharge medication – Type of oral anticoagulants. Apixaban (8.7%) was the most commonly used oral anticoagulant, followed by rivaroxaban (1.8%), warfarin (1.4%), edoxaban (0.9%), and dabigatran (0.5%). The indication for treatment with oral anticoagulation was not available. Data on oral anticoagulants were unavailable for Portugal, and unavailable for patients with NSTEMI for France.



In-hospital care and discharge medication

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Figure 27. Discharge medication – Statins. Statins were prescribed to 86.6% of patients with (A, B) STEMI and (C, D) NSTEMI. When stratifying by age, older patients were to some extent less likely to receive statins at discharge. Data on statins were unavailable for Portugal, and unavailable for patients with NSTEMI for France.

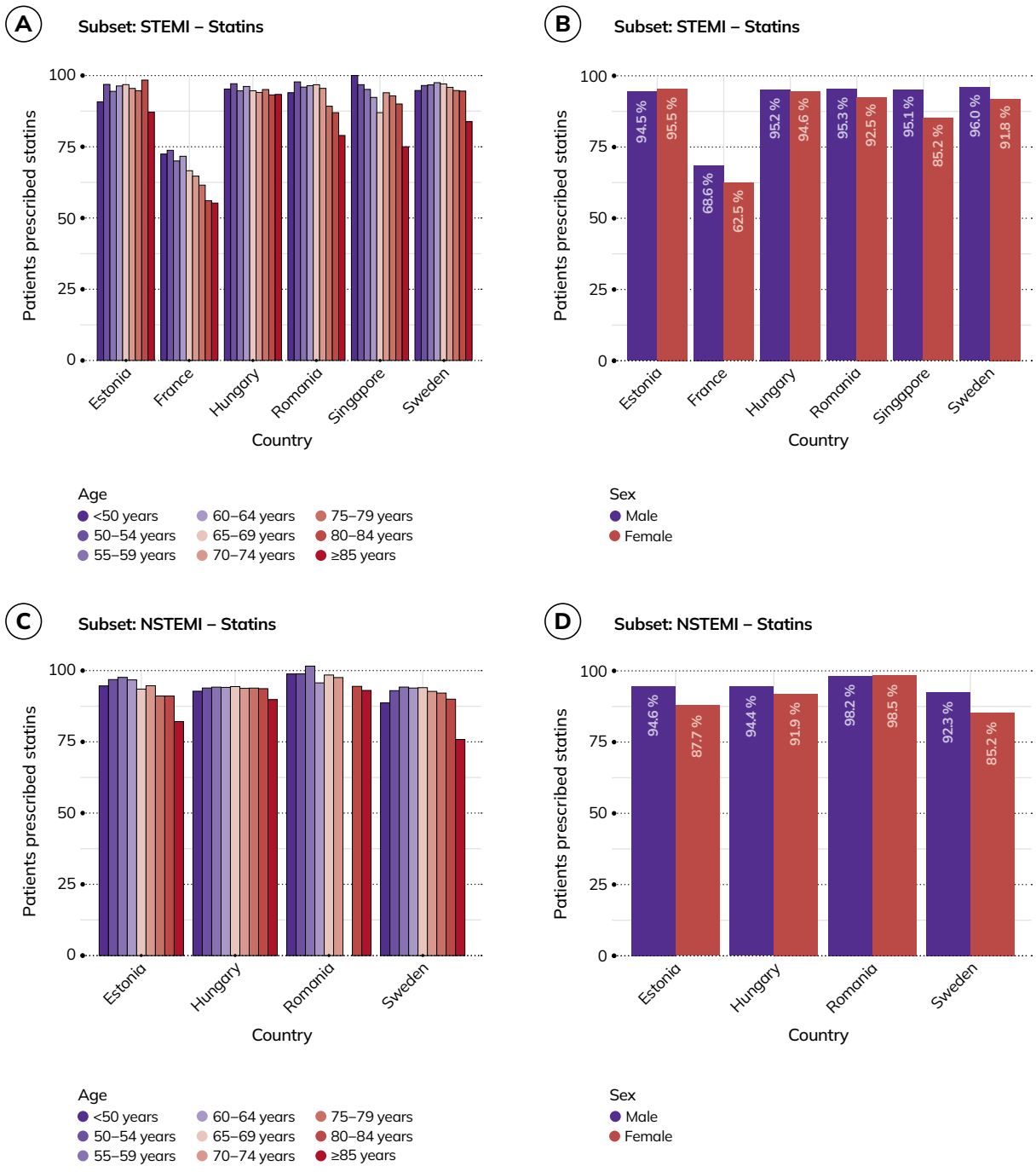
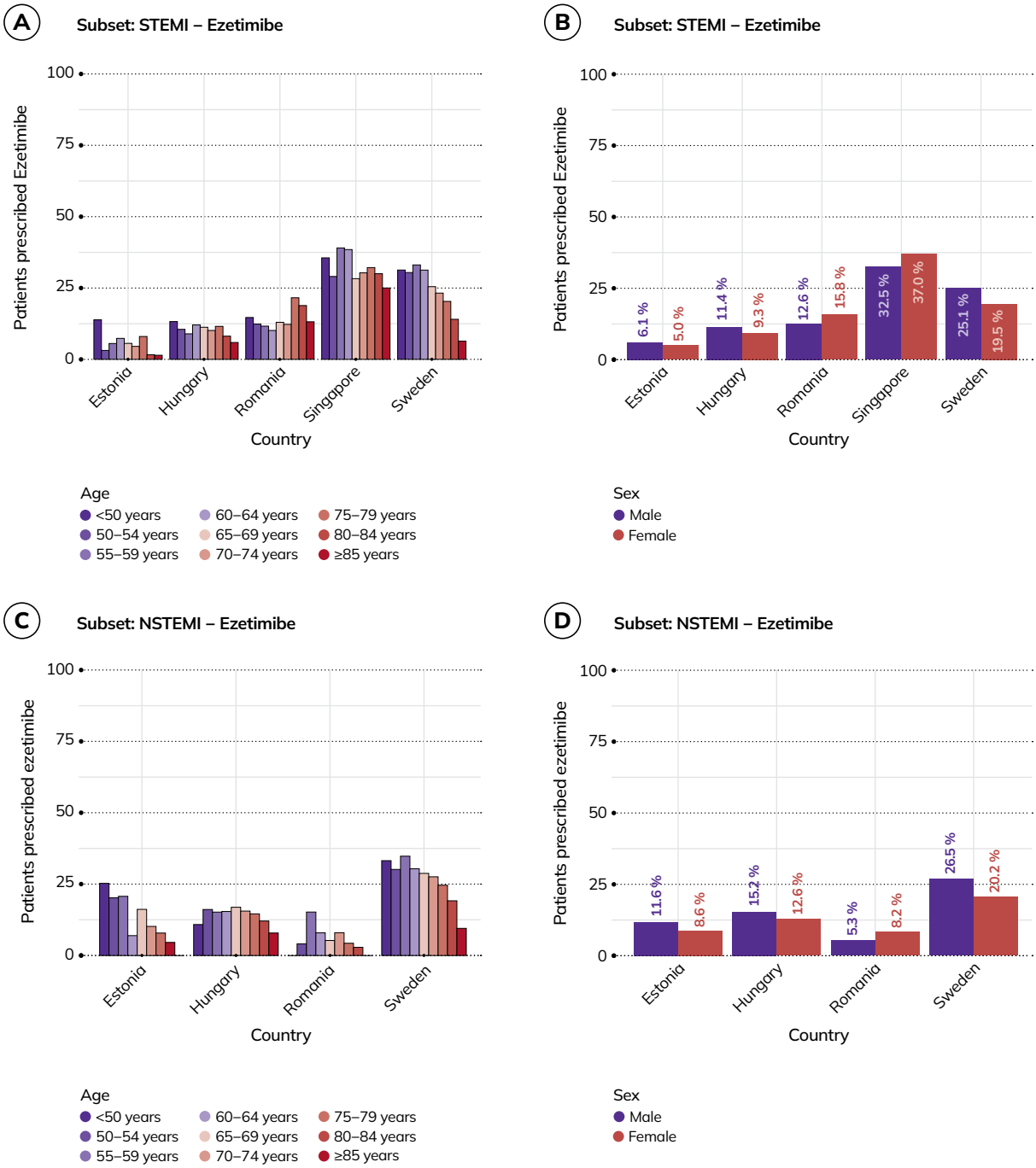


Figure 28. Discharge medication – Ezetimibe. Ezetimibe was prescribed to 18.0% of the patients with (A, B) STEMI and (C, D) NSTEMI. When stratifying by age and sex, older patients and females were less likely to receive ezetimibe at discharge. Data on ezetimibe were unavailable for France and Portugal.



In-hospital care and discharge medication

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Figure 29. Discharge medication – Beta blockers. Beta blockers were prescribed to 77.9% of patients with (A, B) STEMI and (C, D) NSTEMI. Data on beta blockers were unavailable for Portugal, and unavailable for patients with NSTEMI for France.

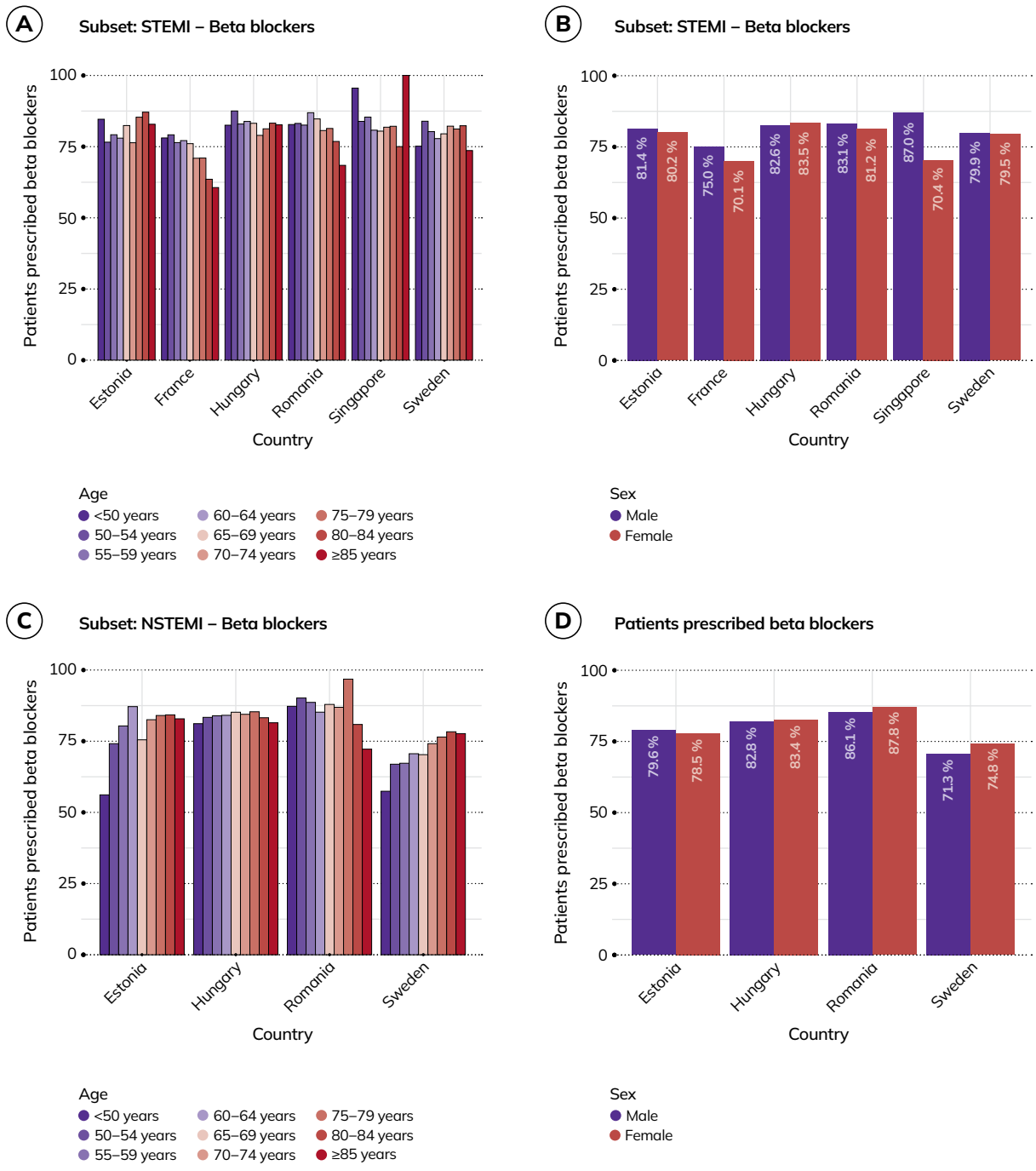
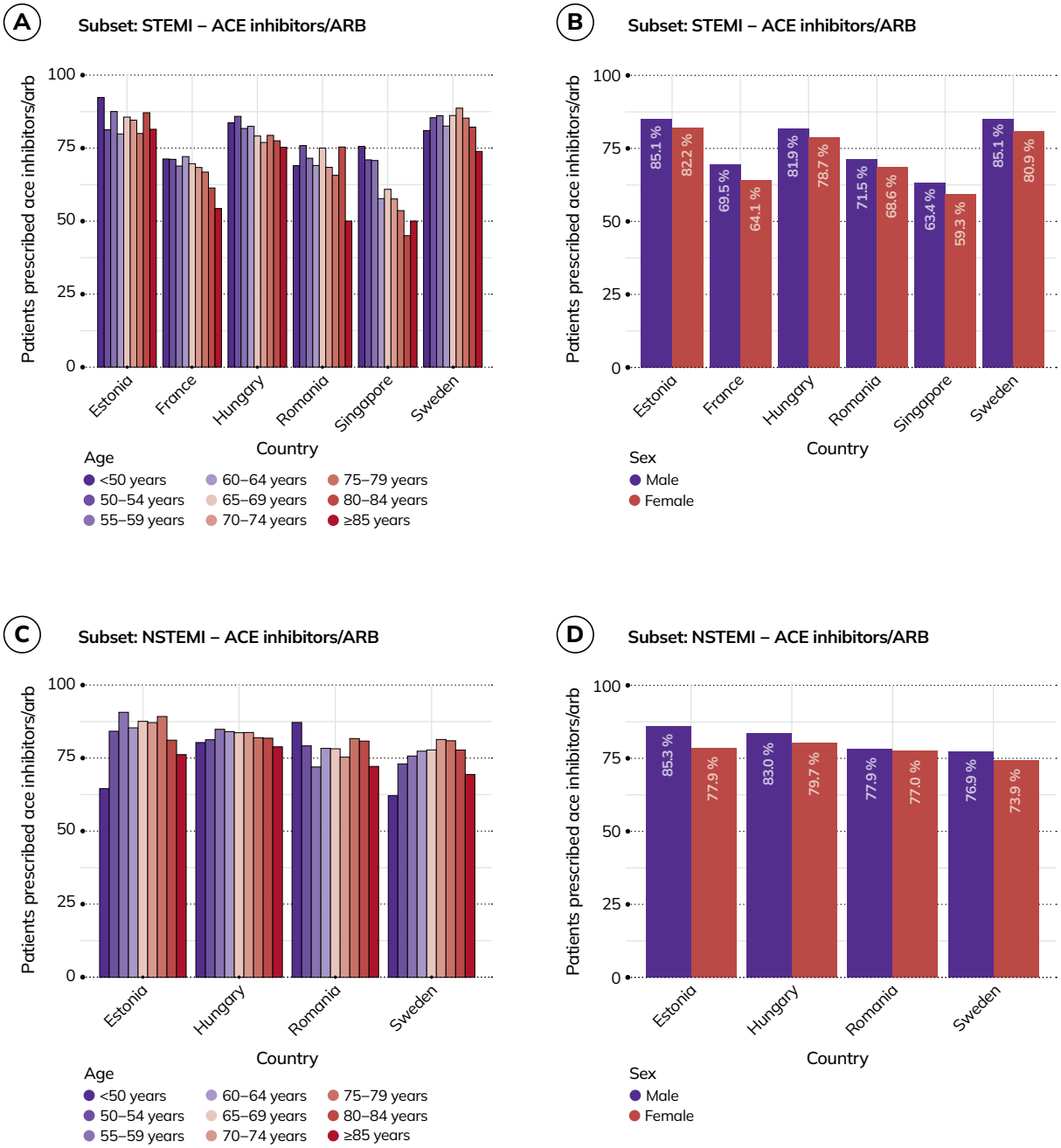


Figure 30. Discharge medication – ACE inhibitors/ARB. ACE inhibitors/ARBs were prescribed to 76.7% patients with (A, B) STEMI and (C, D) NSTEMI. When stratifying by age and sex, older patients and females were less likely to receive ACE inhibitors/ARBs at discharge. Diabetic patients as compared to non-diabetic patients more often received an ACE inhibitor/ARB at discharge, at 79.1% versus 75.7%. Data on ACE inhibitors/ARB were unavailable for Portugal, and unavailable for patients with NSTEMI for France.



In-hospital care and discharge medication

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Figure 31. Discharge medication – Metformin among diabetic patients. Among diabetic, approximately half (56.4%) of the patients with (A, B) STEMI and (C, D) NSTEMI received metformin at discharge. When stratifying by age and sex, older patients and females were less likely to receive metformin. Data on metformin were unavailable for France and Portugal.

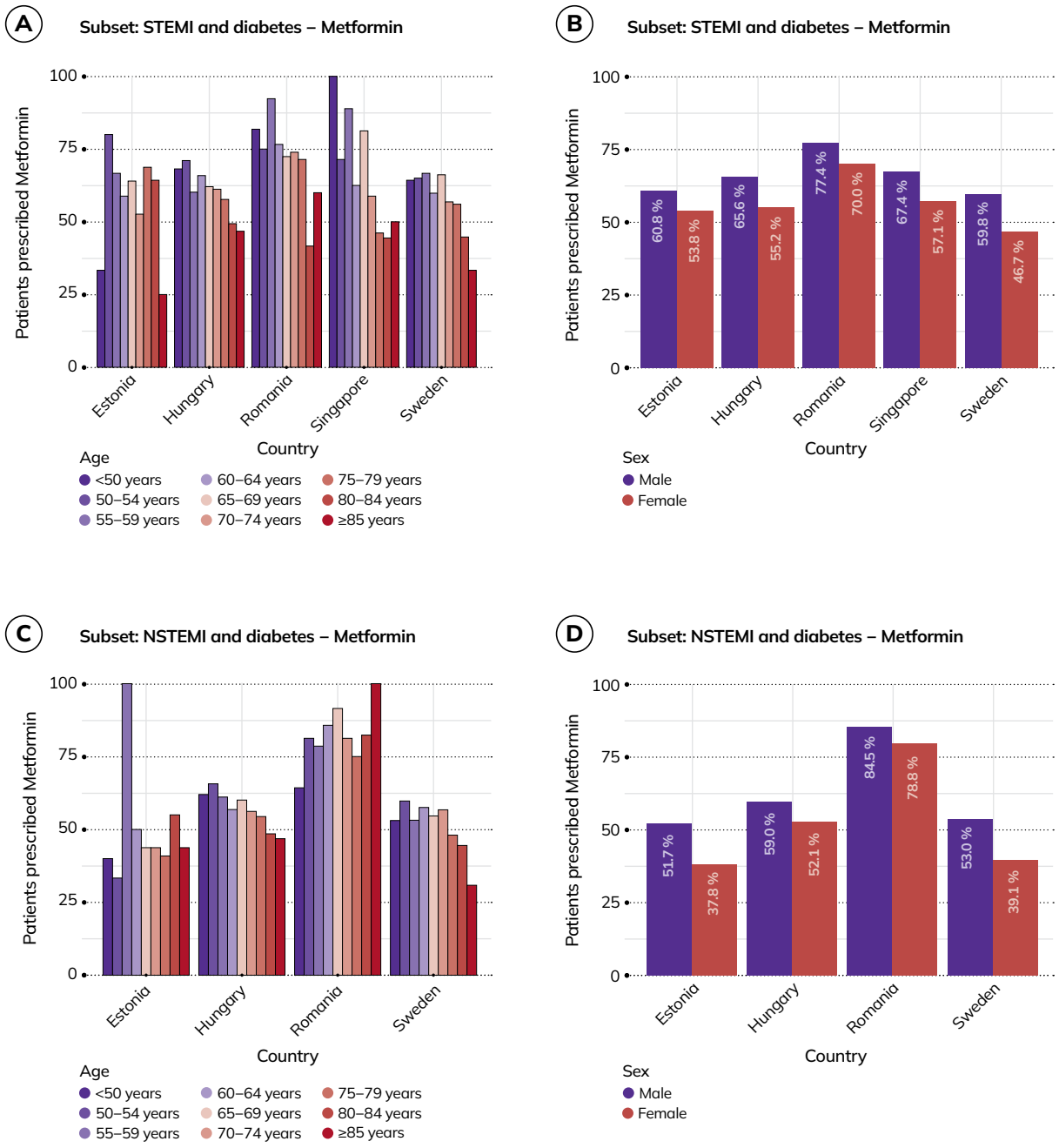
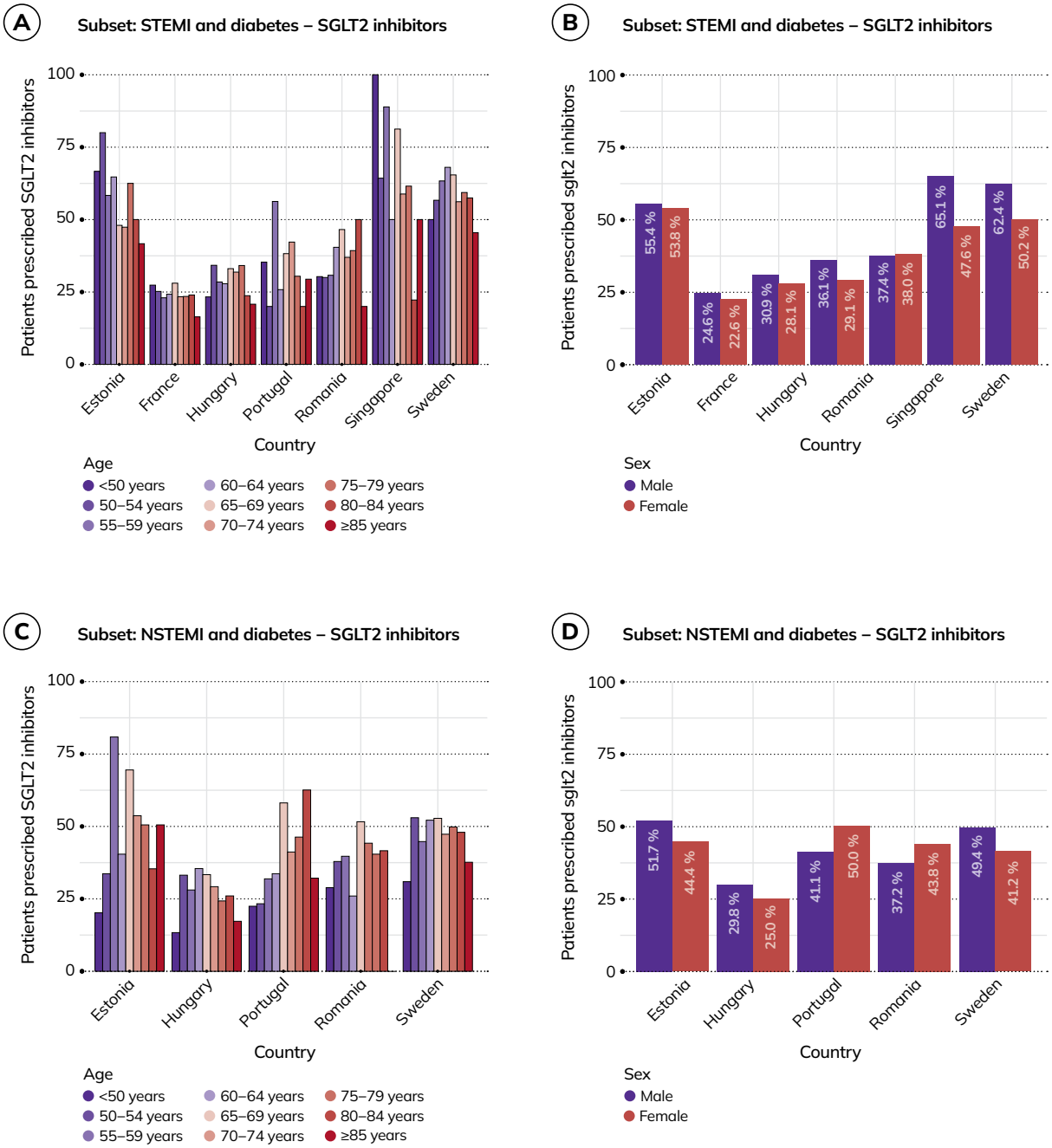


Figure 32. Discharge medication – SGLT2 inhibitors among diabetic patients. Among diabetic patients, approximately one-third (29.3%) with (A, B) STEMI and (C, D) NSTEMI received an SGLT2 inhibitor at discharge. Data on SGLT2 inhibitors were unavailable for patients with NSTEMI for France.



In-hospital care and discharge medication

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Figure 33. Discharge medication – SGLT2 inhibitors among diabetic/non-diabetic patients. Among diabetic patients, approximately one-third (29.3%) with (A, B) STEMI and (C, D) NSTEMI received an SGLT2 inhibitor at discharge. Among non-diabetic patients, this number was lower (6.0%). However, there were variations between countries in the prescription of SGLT2 inhibitors at discharge among patients with and without diabetes. Data on SGLT2 inhibitors were unavailable for patients with NSTEMI for France.

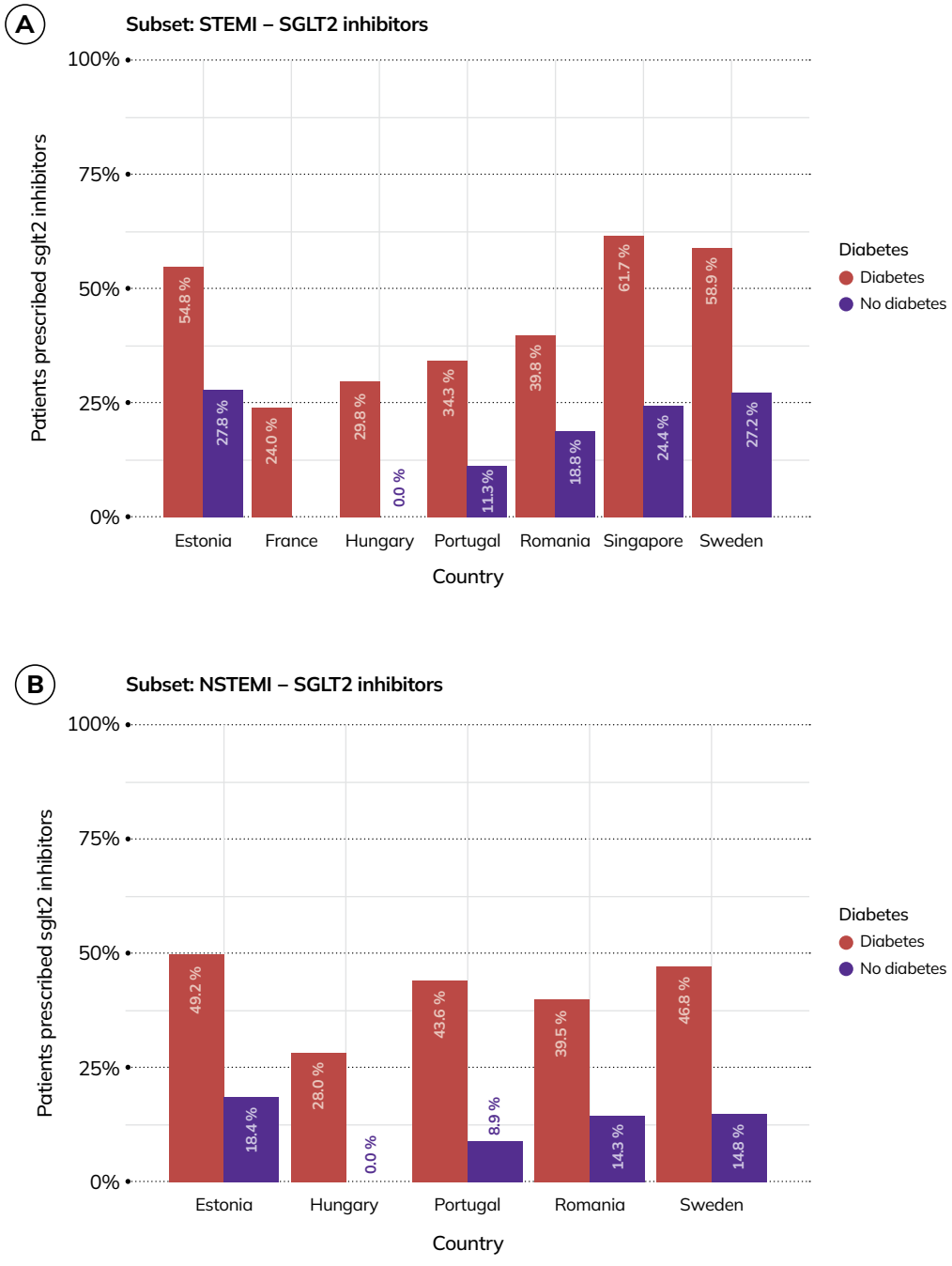
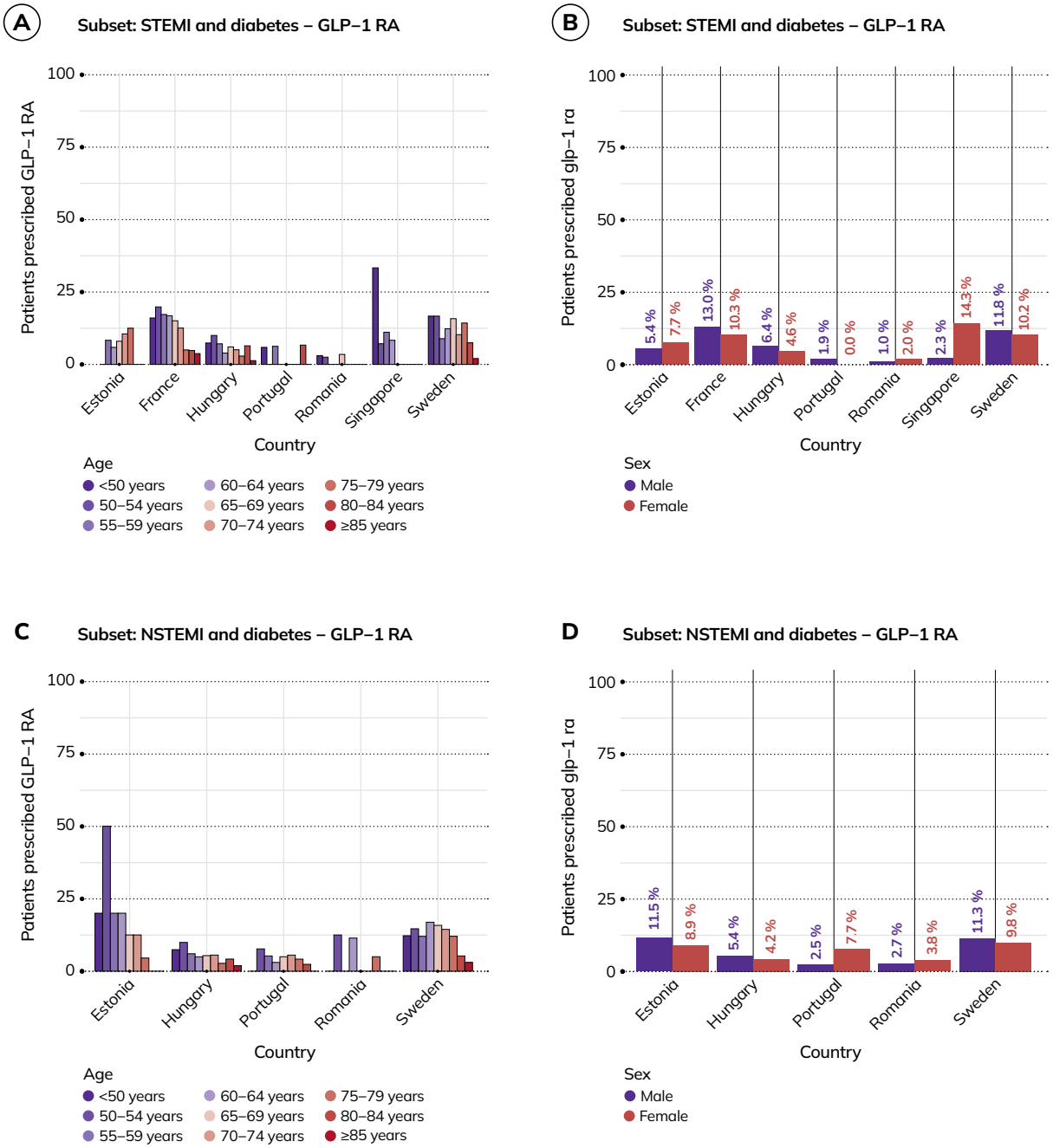


Figure 34. Discharge medication – GLP-1 receptor agonists among diabetic patients. Among diabetic patients, less than one in ten (7.7%) with (A, B) STEMI and (C, D) NSTEMI received a GLP-1 receptor agonist at discharge. When stratifying by age, older patients were less likely to receive a GLP-1 receptor agonist at discharge. Data on GLP-1 receptor agonists were unavailable for patients with NSTEMI for France.

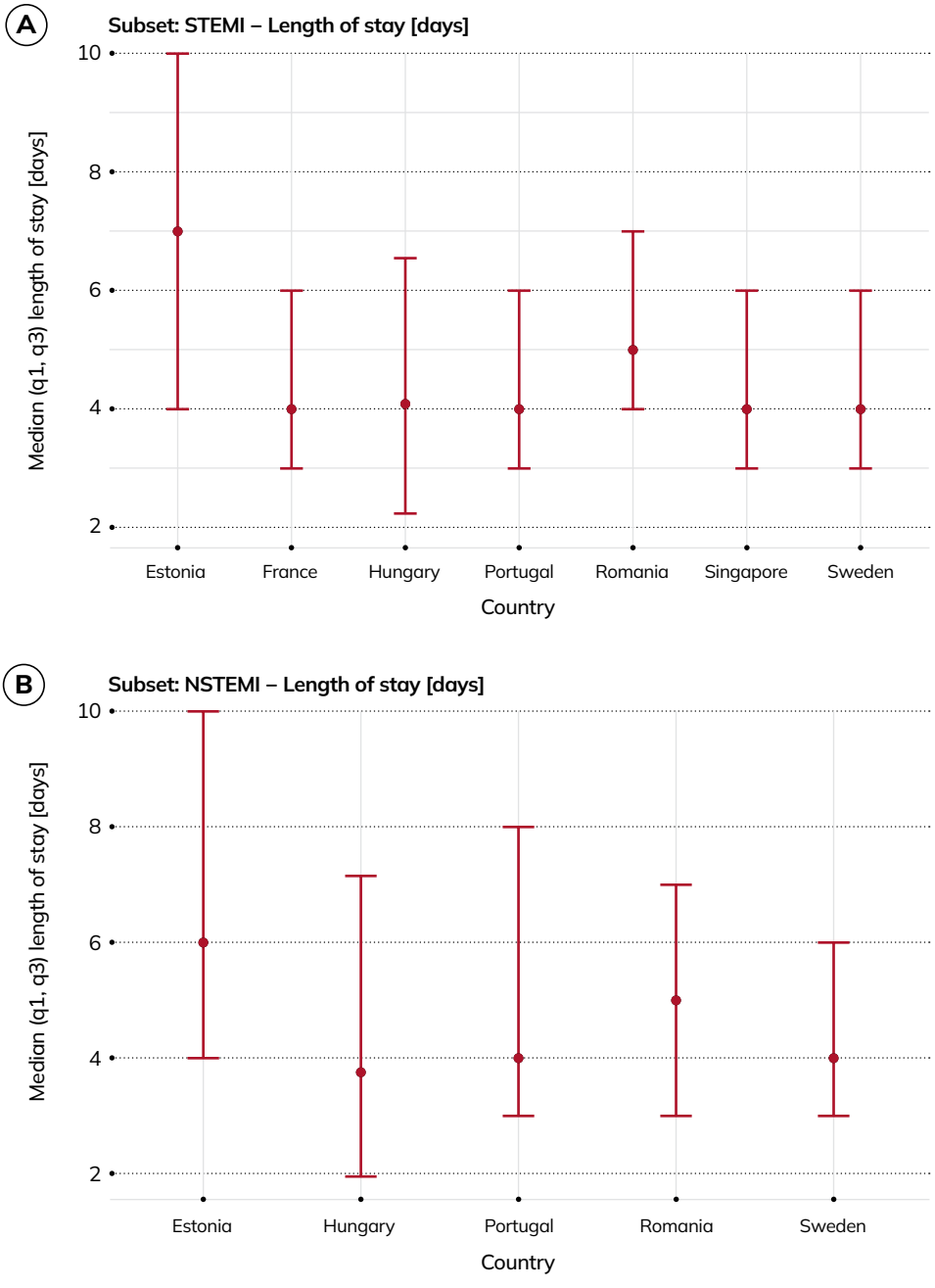


Length of stay and in-hospital mortality

09

Details about length of stay and in-hospital mortality among the included patients are presented separately by country and for those with STEMI and NSTEMI, and are further stratified by sex, age, and diabetes status.

Figure 35. Length of hospital stay. The median length of hospital stay (days) for patient with STEMI and NSTEMI are presented. Data on length of stay were unavailable for patients with NSTEMI in France.



Length of stay and in-hospital mortality

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Figure 36. In-hospital death. A higher proportion of (A, B) STEMI patients died during their in-hospital stay compared to (C, D) NSTEMI patients. When stratified by age and sex, older patients and females were more likely to die. Data on mortality stratified by age and sex were unavailable for patients with STEMI in Romania.

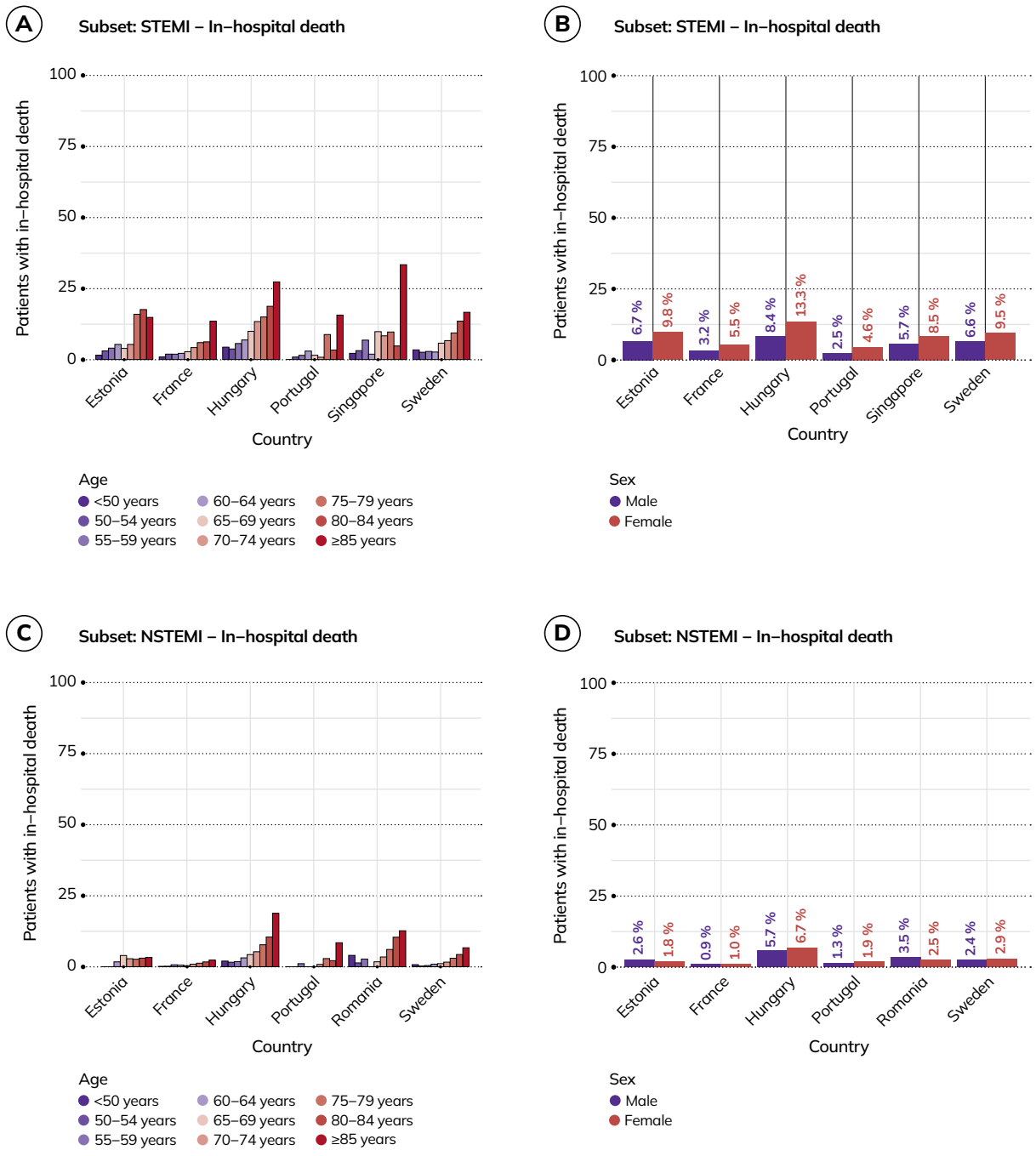
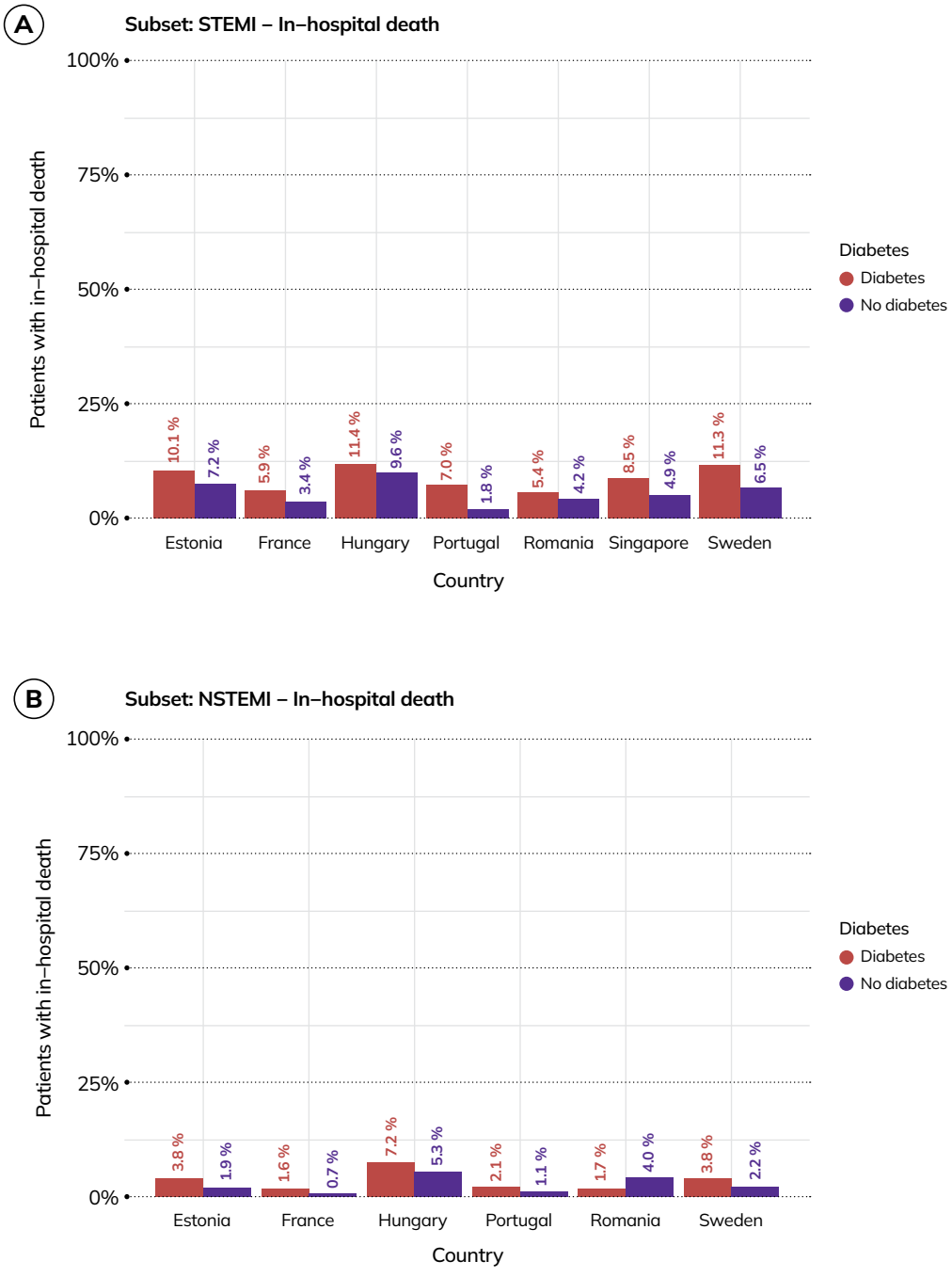


Figure 37. In-hospital death and diabetes. A higher proportion of (A, B) STEMI patients died during their in-hospital stay compared to (C, D) NSTEMI patients. When stratified by diabetes, those with diabetes were more likely to die.



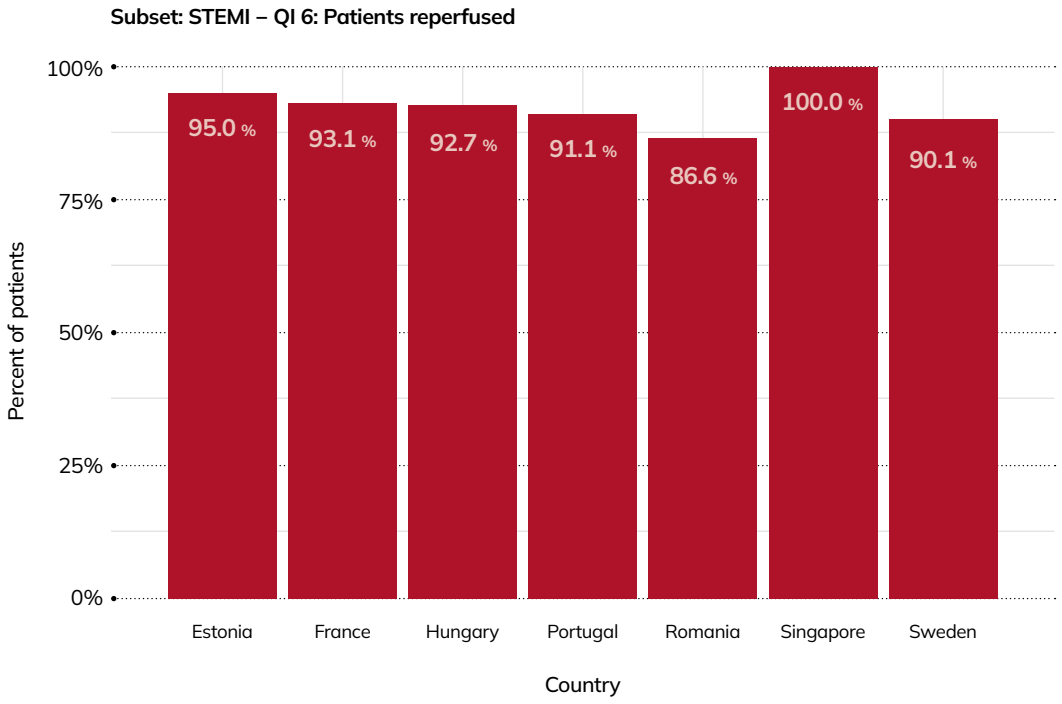
Quality indicators 10

Performance metrics based on ESC quality indicators for acute myocardial infarction are presented separately by country and for patients with STEMI and NSTEMI. [REF] Some quality indicators could not be calculated due to the limitations of the available data in each EuroHeart country. Therefore, the quality indicators that could be calculated are presented in the table below.

Table 1. Quality indicators reported in the EuroHeart Annual Report for 2023.

Quality indicator	Numerator	Denominator
QI 6: Patients with STEMI reperfused among those eligible (onset of symptoms to diagnosis <12 hours)	Number of eligible patients with STEMI <12 hours undergoing reperfusion	Number of patients with STEMI eligible for reperfusion and without contraindications
QI 7: Patients with STEMI who receive timely reperfusion with PCI (wire crossing) within 90 minutes from initial diagnosis	Number of patients with STEMI undergoing timely reperfusion with primary PCI or fibrinolysis	All patients with STEMI eligible for reperfusion
QI 8: Patients with NSTEMI who receive invasive coronary angiography within 24 hours of their diagnosis	Number of NSTEMI patients who receive invasive coronary angiography within 24 hours of their diagnosis	All NSTEMI patients without contraindications
QI 9: Use of radial access in case of invasive strategy for patients with STEMI and NSTEMI	Number of patients who receive invasive coronary angiography via radial access	Number of patients who receive invasive coronary angiography without overriding procedural considerations against the use of radial access
QI 11: Patients with STEMI or NSTEMI who have an assessment of their left ventricular ejection fraction (LVEF) before discharge	Number of patients who have their LVEF measured before hospital discharge	Number of patients with a diagnosis of myocardial infarction.
QI 12: Patients with STEMI or NSTEMI who have their LDL cholesterol measured during hospitalisation	Number of patients who have their LDL cholesterol measured during hospitalisation	Total number of patients with a diagnosis of myocardial infarction.
QI 14: Patients with STEMI or NSTEMI discharged on dual antiplatelet therapy	Number of patients prescribed dual antiplatelet therapy at the time of hospital discharge	Patients alive at the time of hospital discharge who have an indication for dual antiplatelet therapy with no contraindications
QI 15: Patients with STEMI or NSTEMI discharged on statins	Number of patients who receive statin therapy at the time of hospital discharge	Number of patients alive at the time of hospital discharge
QI 16: Patients with LVEF <40% who are discharged on ACE inhibitor/ARB	Number of patients with a LVEF <40% prescribed ACE inhibitor/ARB at the time of hospital discharge	Number of patients with LVEF <40% and alive at the time of hospital discharge who are eligible for ACE inhibitor/ARB
QI 17: Patients with LVEF <40% who are discharged on beta blockers	Number of patients with LVEF <40% prescribed beta blocker at the time of hospital discharge	Number of patients with LVEF <40%, and alive at the time of hospital discharge who are eligible for beta blocker

Figure 38. Quality indicator 6 – Patients with STEMI reperfused among those eligible. The majority of eligible patients with STEMI were reperfused during their hospital stay.



Quality indicators 10

Figure 39. Quality indicator 7 – Patients with STEMI who receive timely reperfusion with PCI (wire crossing) within 90 minutes from initial diagnosis. A large variation in timely reperfusion within 90 minutes among patients with STEMI was observed between the different EuroHeart countries. Data on quality indicator 7 were unavailable for Portugal.

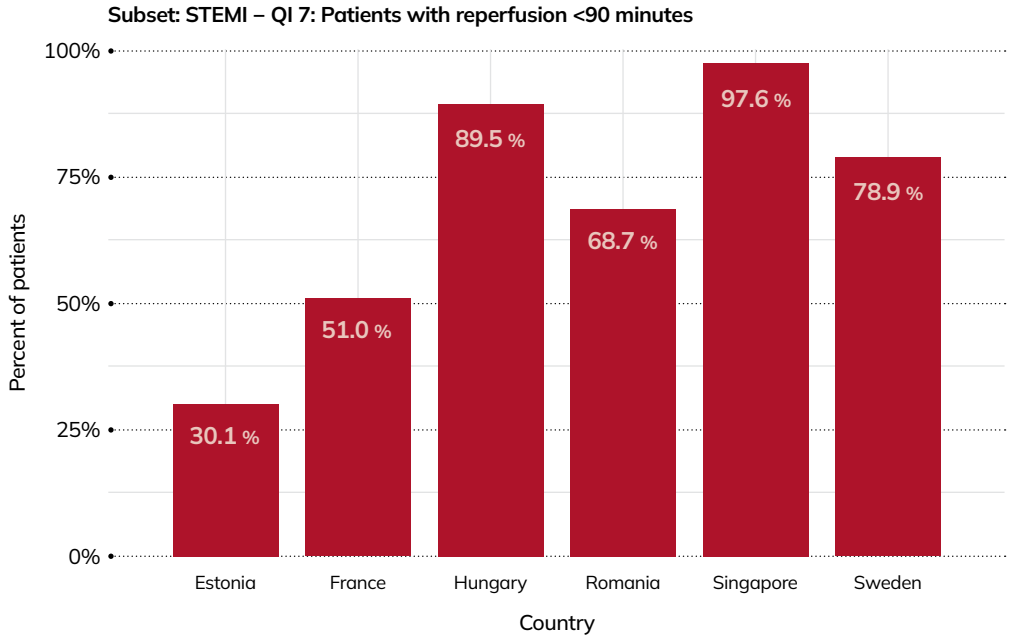


Figure 40. Quality indicator 8 – Patients with NSTEMI who receive invasive coronary angiography within 24 hours of their diagnosis. A large variation in early invasive strategy among patients with NSTEMI was observed between the different EuroHeart countries. Data on quality indicator 8 were unavailable for France and Portugal.

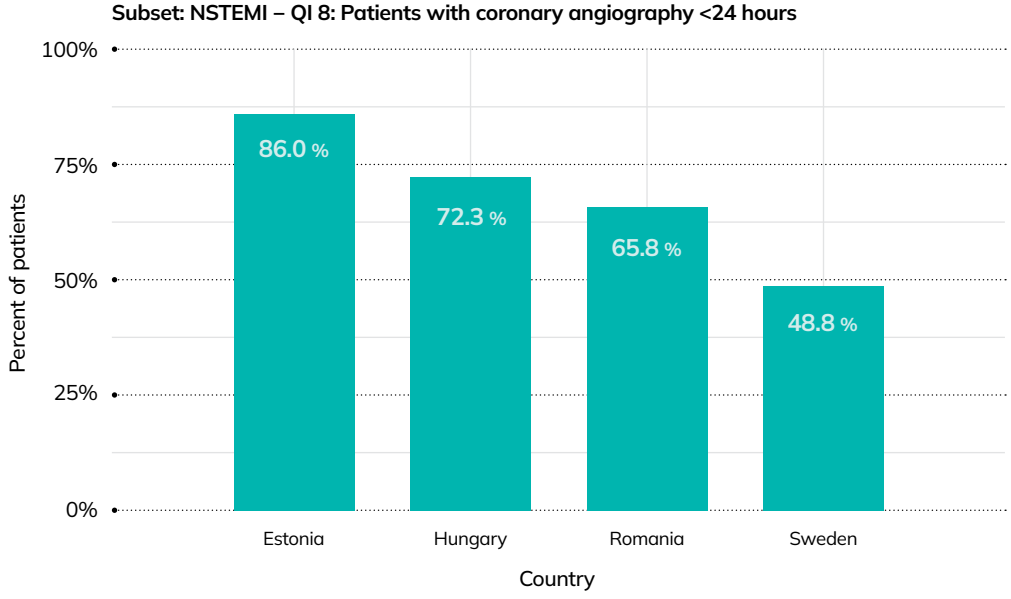
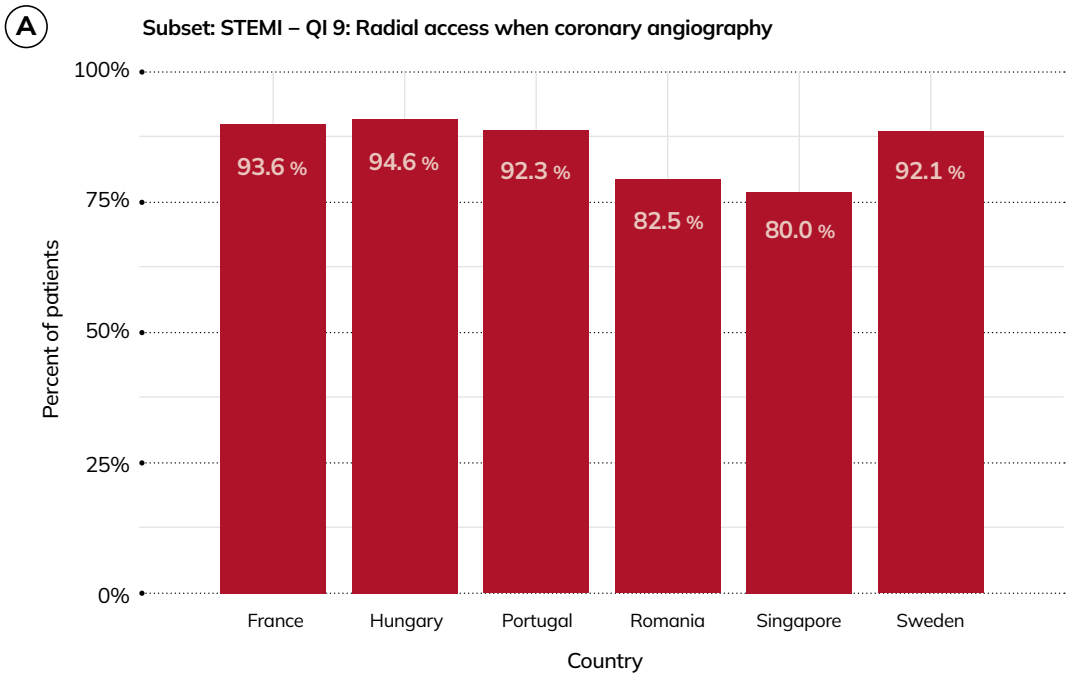
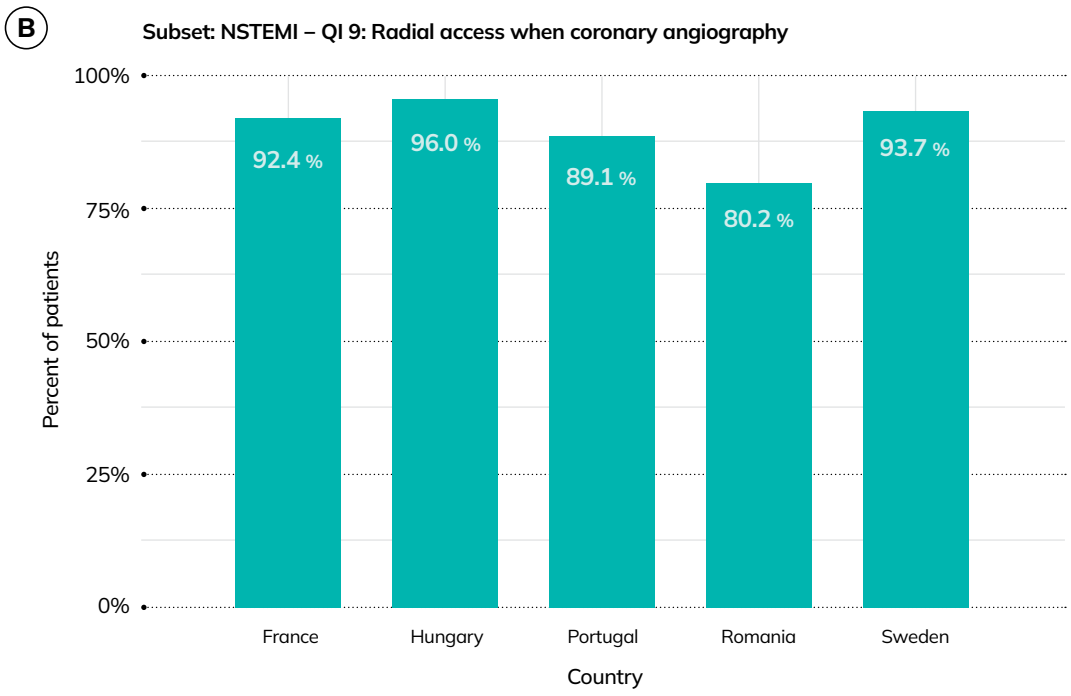


Figure 41. Quality indicator 9 – Use of radial access in case of invasive strategy for patients with STEMI and NSTEMI. Radial access was often used in invasive strategies in most EuroHeart countries. Data on quality indicator 9 were unavailable for Estonia.





Quality indicators 10

Figure 42. Quality indicator 11 – Patients with STEMI or NSTEMI who have an assessment of their left ventricular ejection fraction (LVEF) before discharge. Many patients across the EuroHeart countries had an assessment of their LVEF before discharge. Data on quality indicator 11 were unavailable for Portugal, and unavailable for patients with NSTEMI for France.

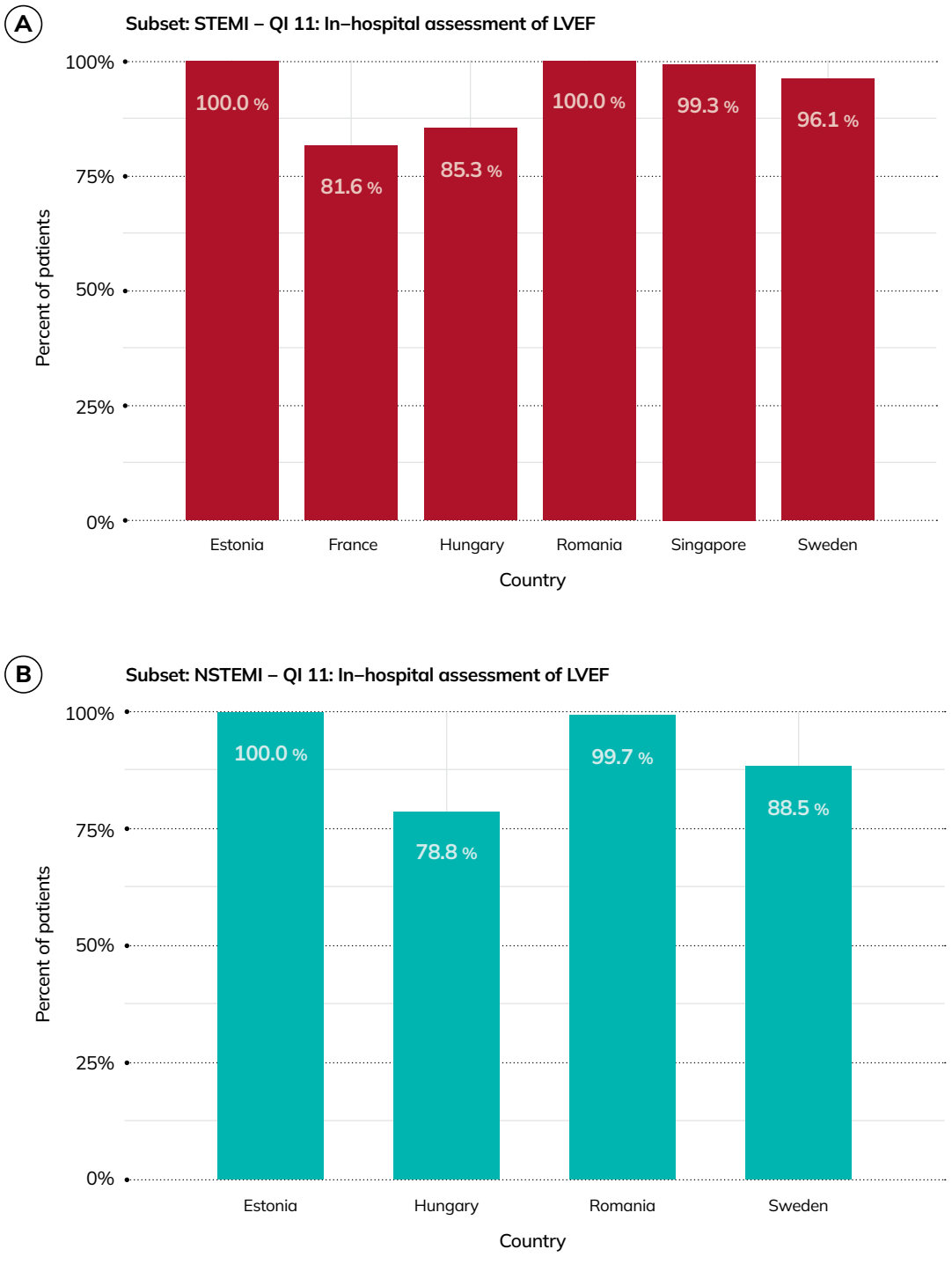
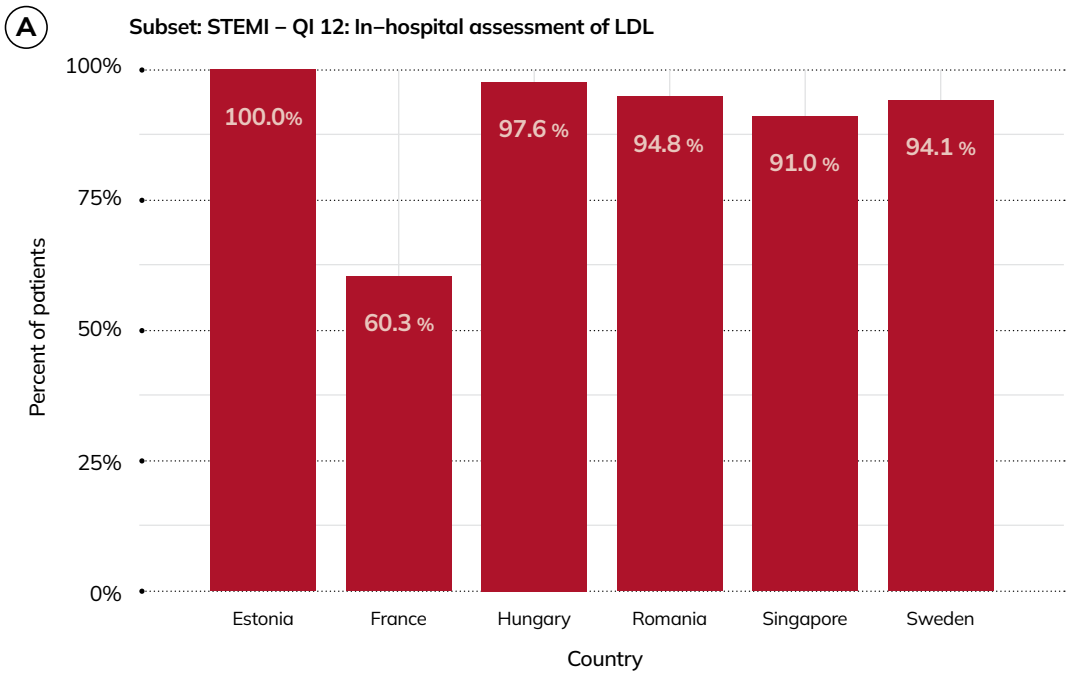
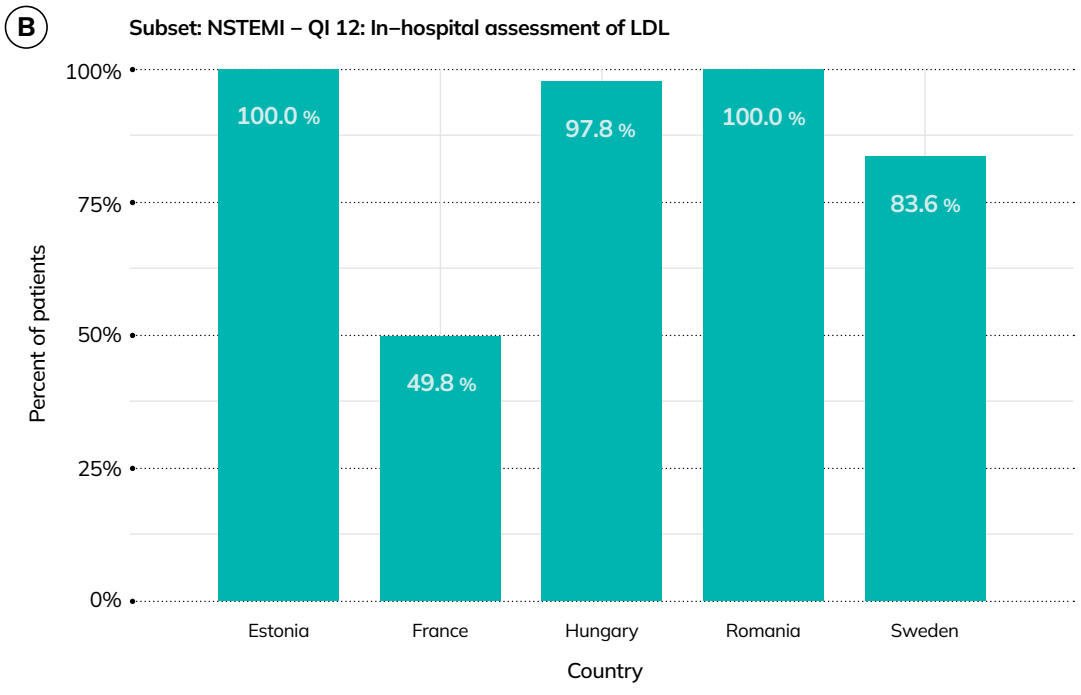


Figure 43. Quality indicator 12 – Patients with STEMI or NSTEMI who have their LDL cholesterol measured during hospitalisation. Many patients across the EuroHeart countries had their LDL cholesterol measured during hospitalisation. Data on quality indicator 12 were unavailable for Portugal.





Quality indicators

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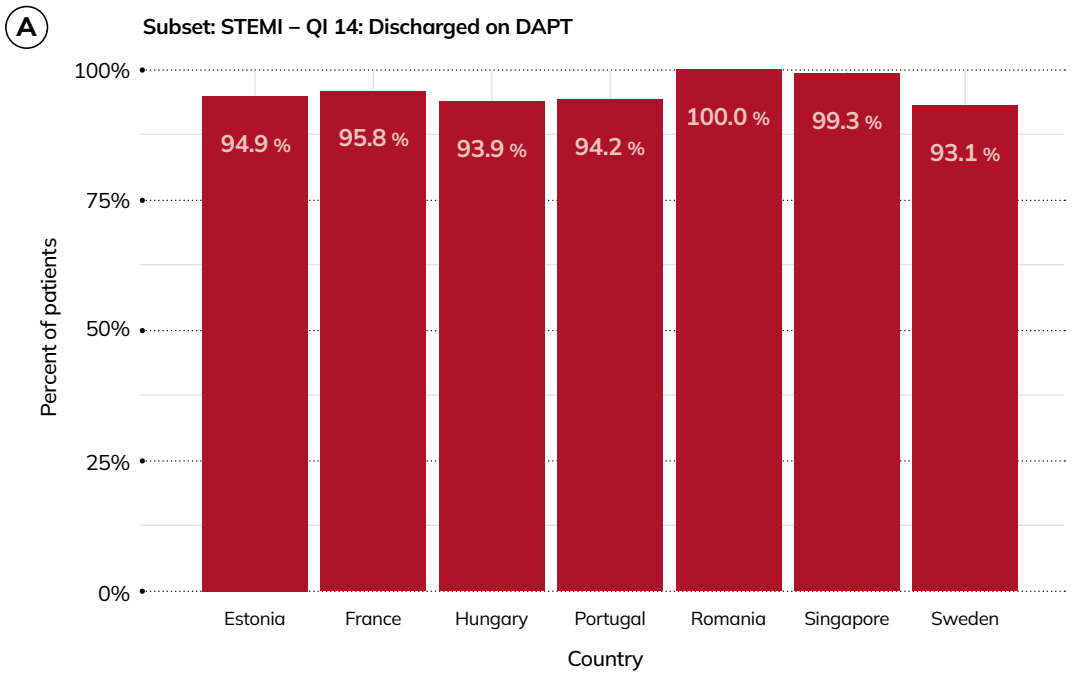
Figure 44. Quality indicator 14 – Patients with STEMI or NSTEMI discharged on dual antiplatelet therapy. The majority of patients with STEMI or NSTEMI were discharged on dual antiplatelet therapy (DAPT).



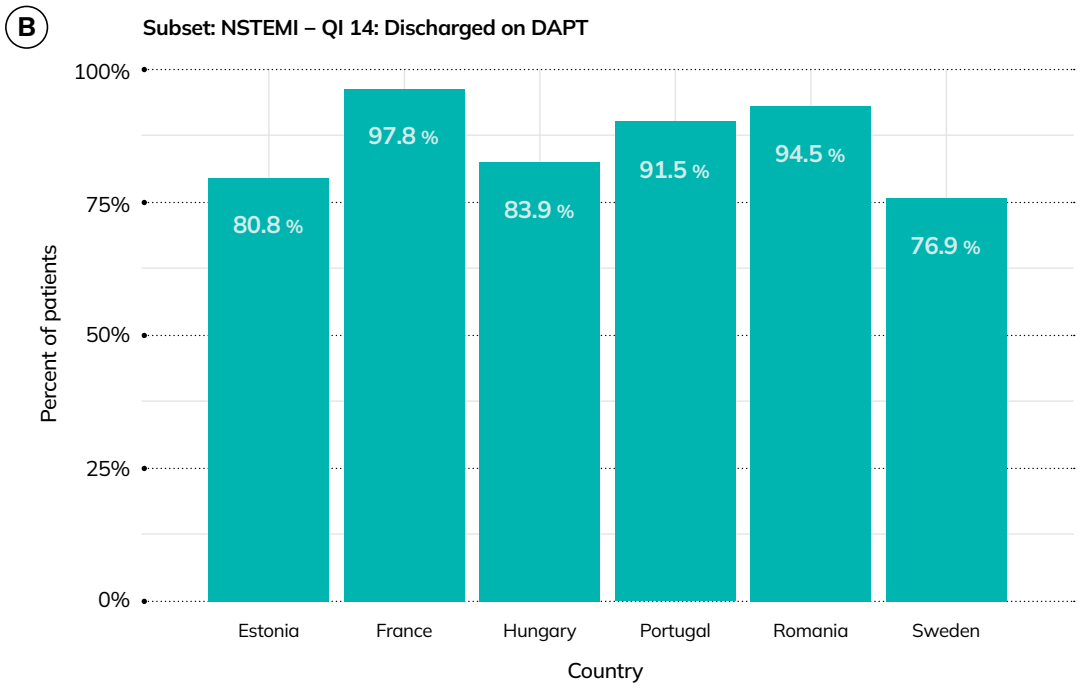
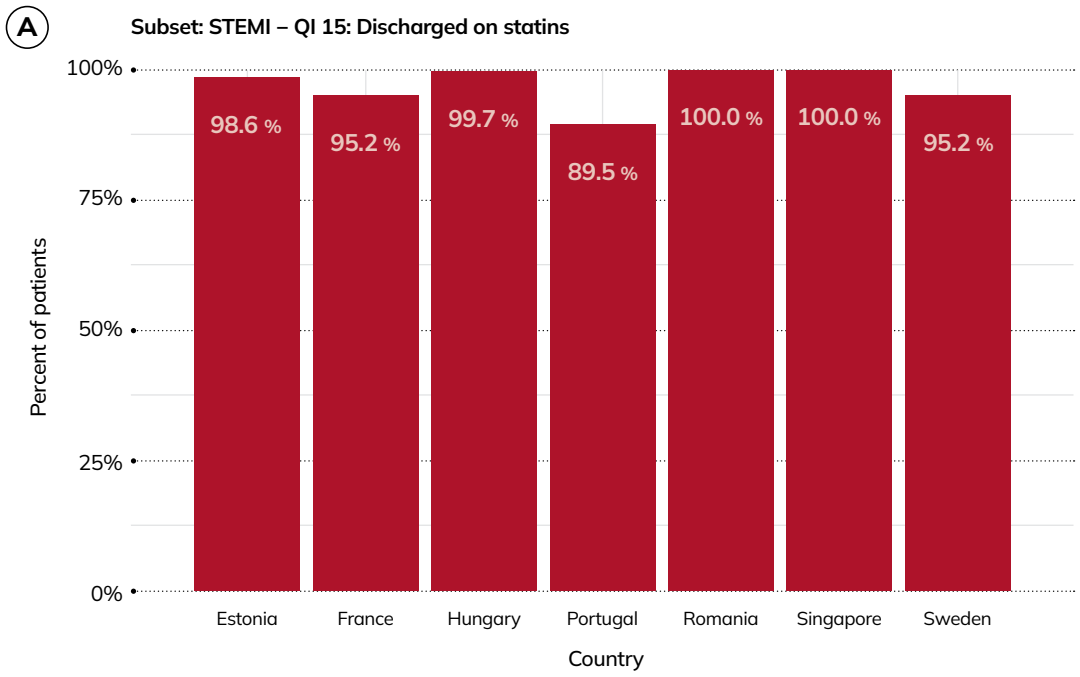
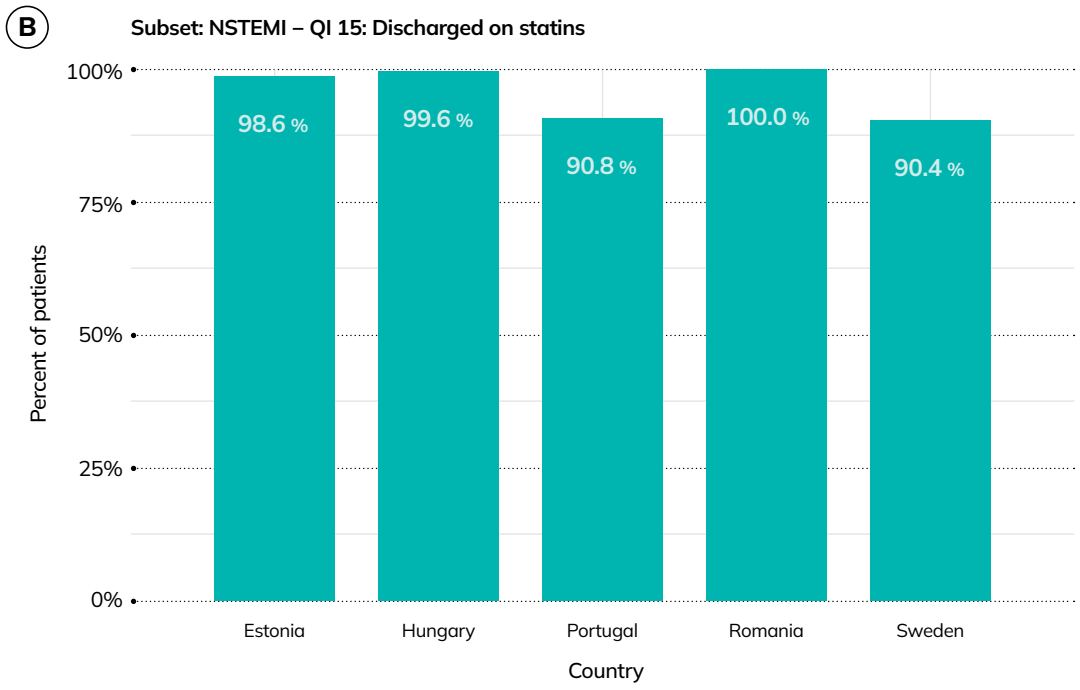


Figure 45. Quality indicator 15 – Patients with STEMI or NSTEMI discharged on statins. The majority of patients with STEMI or NSTEMI were discharged on statins. Data on quality indicator 15 for patients with NSTEMI were unavailable for France.





Quality indicators

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Figure 46. Quality indicator 16 – Patients with LVEF <40% who are discharged on ACE inhibitor/ARB. Many patients with STEMI or NSTEMI and LVEF <40% were discharge on an ACE inhibitor or ARB. Data on quality indicator 16 for patients with NSTEMI were unavailable for France.

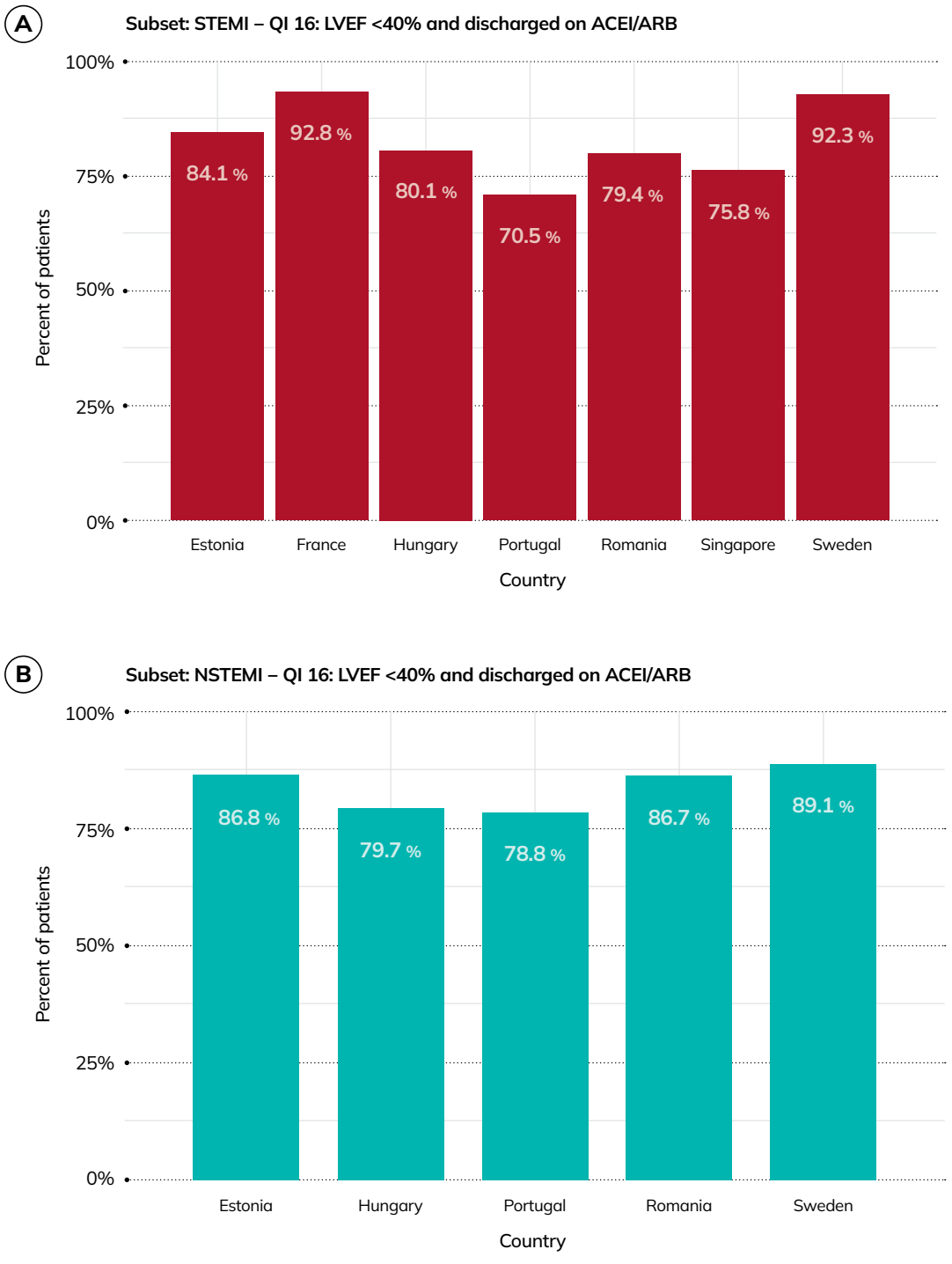
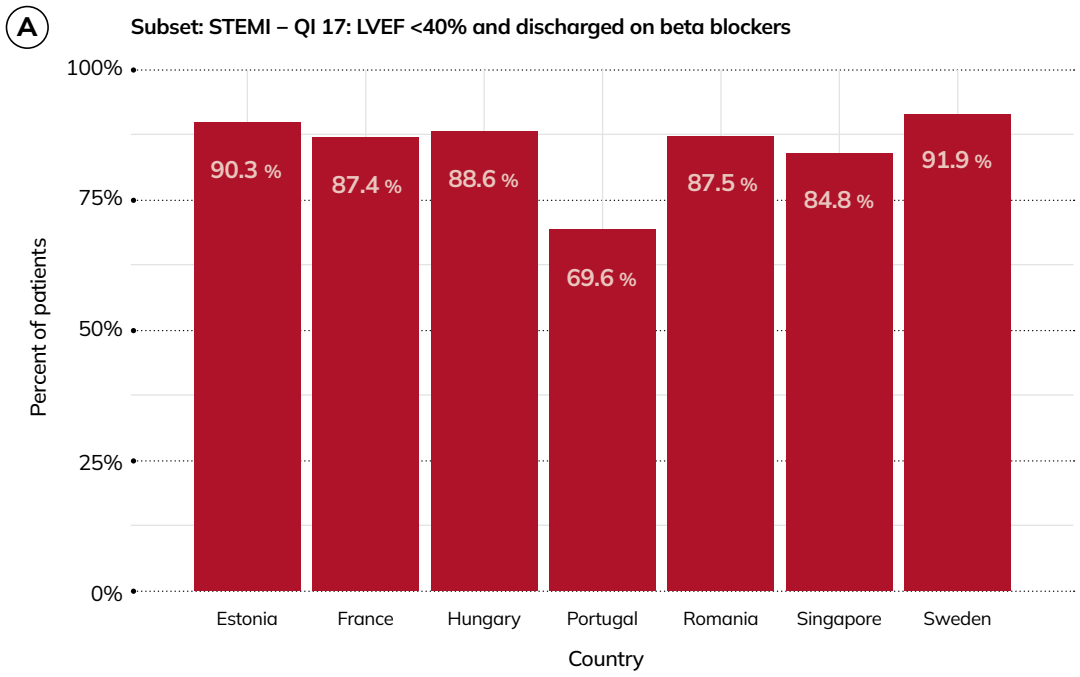
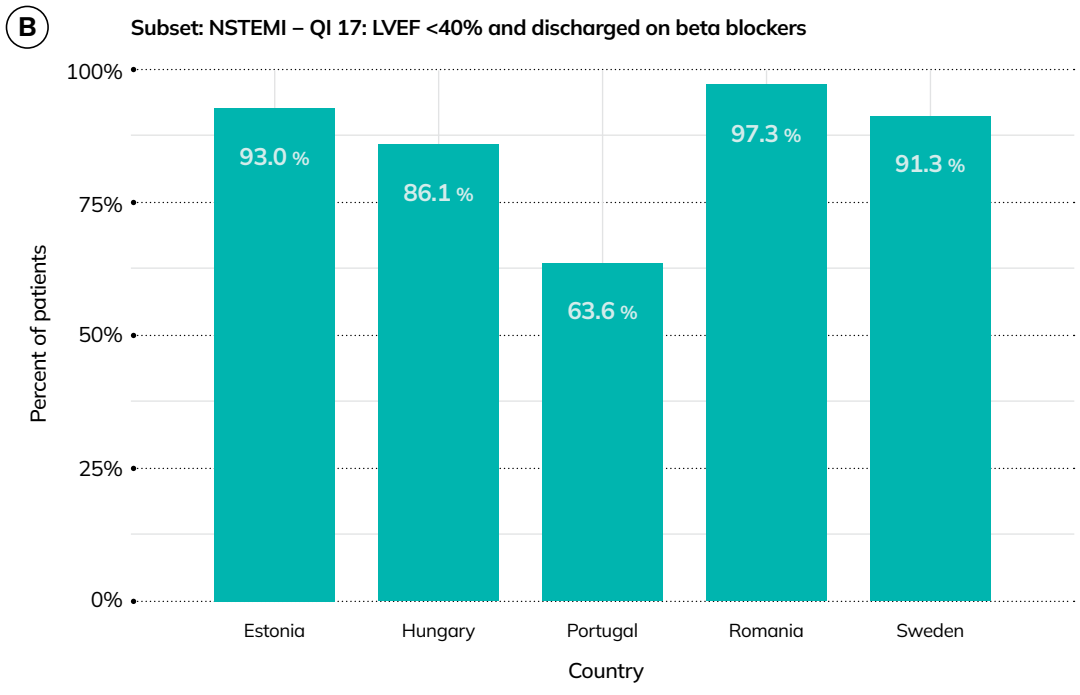


Figure 47. Quality indicator 17 – Patients with LVEF <40% who are discharged on beta blockers. Many patients with STEMI or NSTEMI and LVEF <40% were discharge on a beta blocker. Data on quality indicator 17 for patients with NSTEMI were unavailable for France.





Acknowledgements 11

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EuroHeart leadership and operations team 2024

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The Scientific Leaders of the EuroHeart Executive Committee at the ESC congress 2024.

(L-R Prof Chris Gale, Prof Aldo Maggioni, Prof Barbara Casadei, Prof Lars Wallentin, Prof Stefan James)

Appendix 13

Appendix Table 1. National coverage of ACS dataset

	Level			
Country	**Patient**	**Ward/department**	**Hospital**	**Region**
Estonia	All consecutive patients admitted to the only two tertiary care hospitals are included.	Occasional patients having a myocardial infarction in different wards of the hospital and treated outside the regular cardiology flow will not be recorded in the registry.	There are two tertiary care hospitals that cover over 50% of the myocardial infarction cases. There are 3 main secondary care hospitals with daytime PCI capability which are not yet part of EuroHeart in Estonia.	The hospitals reporting to EuroHeart cover the whole country. According to the mandatory Estonian myocardial infarction registry the quality differences in the indicators reported in EuroHeart would not be large, but some variation exists.
France	Only ACS patients undergoing coronary angiogram/PCI from participant centres are included. Data were systematically collected via reporting software (CardioReport, Hemolia, AtoutCoeur) with calibrated interfaces for automatic, mandatory data collection.	Patients admitted for ACS but who do not undergo coronary angiography or PCI are not included. The entry door of the registry is the cath lab.	66 participant centres in 2023. 33% (66/200) of French centres. Collection of clinical, procedural and in-hospital data are 100% in all participating centres.	All French regions have at least one participating centre. In 10 regions all centres are (or will be) participating. With 33% of French centres and a national coverage the data is representative of France.
Hungary	Registration is mandatory and Hungary compare the registered and reimbursed cases continuously. There are no exclusions.	No patients are excluded based on the type of wards they are admitted to.	76 hospitals participate (85% of all hospitals). 90.4% of the patients with myocardial infarction are registered.	Data are collected from all regions and is representative of the patient population.
Iceland	Participated in the Swedish Coronary Angiography and Angioplasty Registry (SCAAR) since 2008. Since January 2024, Iceland has worked on enhancing continuous data collection in hospital wards.	It is possible that some patients who are very frail or have multiple comorbidities might go elsewhere but a high volume of patients are admitted to the cardiology department.	Landspitali is the only cardiology department in the country and all ACS patients tend to be moved there by ambulance or air ambulance.	There is very good collaboration with doctors elsewhere in the country and patients are sent to Landspitali from all regions.
Portugal	Patients need to consent to their data being collected. Currently, Portugal is working on problems with the numbers consecutive patients included and data completeness, from baseline to outcome. Almost all of the patients included are from public hospitals.	Some hospitals do not have cardiology wards, and some ACS patients are admitted in internal medicine wards. In both cases, patients are not included in the ACS registry.	19 out of 59 hospitals that manage ACS patients participate in EuroHeart reporting on approximately 50% of their patients.	Data are being collected from all regions, and Portugal are confident that the data is representative of the country's population, despite the lack of completeness in the recruitment and data filling.
Romania	Patients are not collected continuously due to the lack of registrars and the fact that the registry is not mandatory by law.	No patients are excluded based on the type of wards they are admitted to.	15 hospitals participate from 21 that are part of STEMI network. There are 39 PCI centres in Romania.	Data are representative of the country; all regions are covered.

	Level			
Country	**Patient**	**Ward/department**	**Hospital**	**Region**
Singapore	Singapore captures all PCI patients admitted for cath/PCI procedures. VVIP patients are excluded due to hospital policies. No barriers to continuous data collection as this is for an audit database.	No patients are excluded based on the ward/department they are admitted to.	One hospital submits data to EuroHeart. This represents approximately 30% of total hospitals in the country. No variation in volume/quality.	Data are representative of the population from the country.
Sweden	Registration is mandatory only for patients with myocardial infarction. No patients are actively excluded.	For patients <80 years, the national coverage is >90%. Sweden has recently started a project to find out why those 10% are not registered. Being admitted to a non-cardiology ward may, at larger hospitals, be a problem.	100% of the hospitals.	All hospitals participate.

Appendix Table 2. Health care systems

Country	Health care system
Estonia	Acute and invasive cardiac care is 100% public.
France	40% are private centres and 60% are public centres.
Hungary	All hospitals caring ACS patients are public.
Iceland	Public state funded system. However, outpatient care is partially in private cardiology clinics.
Portugal	More than 85% of ACS patients are deemed to be admitted to public hospitals. In the Portuguese healthcare system, 92-93% of PCIs are performed in public hospitals, while 7-8% are carried out in private hospitals. This distribution reflects the predominant role of the public sector in providing these procedures.
Romania	The majority of Romanian health care is public (79.3%). There are no major demographic differences between public and private hospitals. Private hospital use is more common in the bigger cities.
Singapore	For tertiary care, 80% public, 20% private.
Sweden	All hospitals except one are public. There are no major differences in demographics.

EuroHeart publications 14

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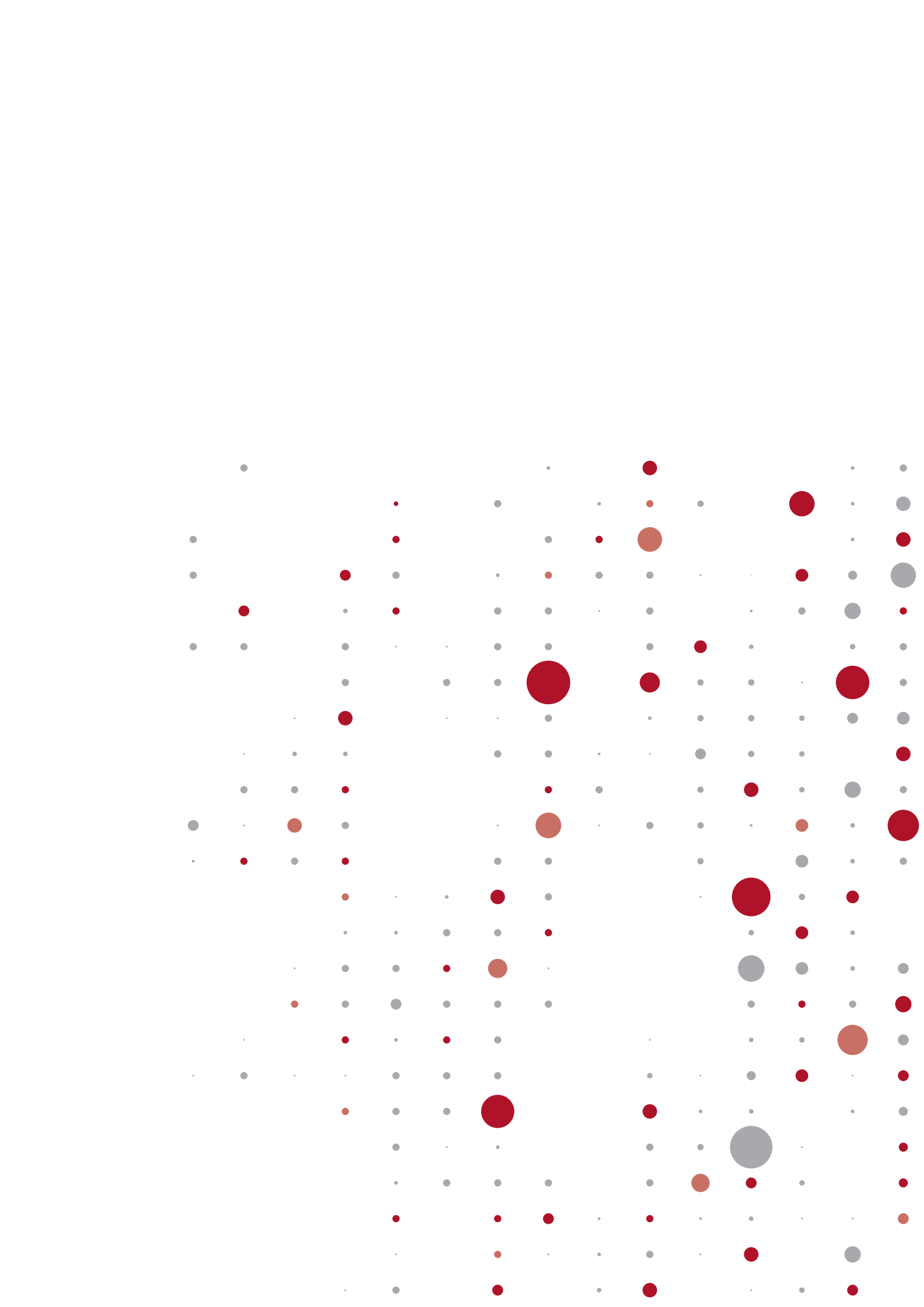

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