Euro Heart Survey 2009 Snapshot: regional variations in presentation and management of patients with AMI in 47 countries

European Heart Journal: Acute Cardiovascular Care
2(4) 359–370

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DOI: 10.1177/2048872613497341

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Etienne Puymirat¹, Alex Battler², John Birkhead³, Hector Bueno⁴, Peter Clemmensen⁵, Yves Cottin⁶, Keith AA Fox⁷, Bulent Gorenek⁸, Christian Hamm⁹, Kurt Huber¹⁰, Maddalena Lettino¹¹, Bertil Lindahl¹², Christian Müller¹³, Alexander Parkhomenko¹⁴, Susanna Price¹⁵, Tom Quinn¹⁶, Francois Schiele¹⁷, Maarten Simoons¹⁸, Gabriel Tatu-Chitoiu¹⁹, Marco Tubaro²⁰, Christiaan Vrints²¹, Doron Zahger²², Uwe Zeymer²³ and Nicolas Danchin¹; on behalf of the EHS 2009 snapshot participants

Abstract

Aims: Detailed data on patients admitted for acute myocardial infarction (AMI) on a European-wide basis are lacking. The Euro Heart Survey 2009 Snapshot was designed to assess characteristics, management, and hospital outcomes of AMI patients throughout European Society of Cardiology (ESC) member countries in a contemporary 'real-world' setting, using a methodology designed to improve the representativeness of the survey.

Methods: Member countries of the ESC were invited to participate in a 1-week survey of all patients admitted for documented AMI in December 2009. Data on baseline characteristics, type of AMI, management, and complications were recorded using a dedicated electronic form. In addition, we used data collected during the same time period in national registries in Sweden, England, and Wales. Data were centralized at the European Heart House.

Results: Overall, 4236 patients (mean age 66±13 years; 31% women) were included in the study in 47 countries. Sixty per cent of patients had ST-segment elevation myocardial infarction, with 50% having primary percutaneous coronary intervention and 21% fibrinolysis. Aspirin and thienopyridines were used in >90%. Unfractionated and low-molecular-weight heparins were the most commonly used anticoagulants. Statins, beta-blockers, and angiotensin-converting enzyme

¹Hôpital Européen Georges Pompidou, Assistance Publique Hôpitaux de Paris, INSERM U-970 and Université Paris Descartes, Paris, France

²Tel Aviv University, Tel Aviv, Israel

³University College London, London, UK

⁴Hospital General Universitario Gregorio Marañón and Instituto de Investigación Sanitaria Gregorio Marañón, Madrid, Spain

⁵Rigshospitalet, Copenhagen, Denmark

⁶Centre Hospitalier Universitaire de Dijon, Dijon, France

⁷University of Edinburgh, Edinburgh, UK

⁸Eskisehir Osmangazi University, Eskisehir, Turkey

⁹Department of Cardiology, Kerckhoff-Klinik, Bad Nauheim, Germany

¹⁰Wilhelminenhospital, Vienna, Austria

¹¹IRCCS Istituto Clinico Humanitas, Milano, Italy

¹²Uppsala University, Uppsala, Sweden

¹³University Hospital Basel, Basel, Switzerland

¹⁴National Scientific Center, Kiev, Ukraine

¹⁵Imperial College, London, UK

¹⁶University of Surrey, Guildford, UK

¹⁷Centre Hospitalier Univesitaire Jean Minjoz, Besançon, France

¹⁸Thorax Center, Rotterdam, The Netherlands

¹⁹Spitalul Clinic de Urgenta Floreasca, Bucharest, Romania

²⁰San Filippo Neri Hospital, Rome, Italy

²¹Antwerp University Hospital and University of Antwerp, Antwerp, Belgium

²²Ben Gurion University of the Negev, Beer Sheva, Israel

²³Klinikum Ludwigshafen and Institut für Herzinfarktforschung, Ludwigshafen, Germany

Corresponding author:

Nicolas Danchin, Department of Cardiology, Hôpital Européen Georges Pompidou, 75015 Paris, France

Email: danchin.hegg@yahoo.fr

inhibitors were used in >80% of the patients. In-hospital mortality was 6.2%. Regional differences were observed, both in terms of population characteristics, management, and outcomes.

Conclusions: In-hospital mortality of patients admitted for AMI in Europe is low. Although regional variations exist in their presentation and management, differences are limited and have only moderate impact on early outcomes.

Keywords

Acute myocardial infarction, Europe, hospital outcomes, survey

Received 21 April 2013; revised manuscript accepted 18 June 2013

Introduction

Cardiovascular disease is the leading cause of death worldwide.^{1–3} Among cardiovascular conditions, coronary artery disease is the most prevalent, and myocardial infarction is a major cause of cardiovascular hospitalizations, with high rates of acute complications. The situation has improved in recent decades, with a major decrease in cardiovascular mortality, beginning with Western countries followed additionally by falling mortality in Eastern European countries. This general trend to decreased cardiovascular mortality is observed in countries having initially high cardiovascular disease burden, such as Northern European countries or North America, and in those with initially low cardiovascular disease rates, such as most Mediterranean countries.² This remarkable achievement is attributed to both improved primary prevention and improved treatment of established cardiovascular disease. In particular, over the preceding 20 years several major clinical trials have documented the ability of new cardiovascular medications and/or procedures to improve clinical outcomes in patients with acute coronary syndromes (ACS), both with and without ST-segment elevation. The results of these trials have been incorporated in guidelines providing clear practice recommendations for clinicians.^{4,5}

Observational data collected from cohorts of patients presenting with ACS give the opportunity to determine whether the guidelines have been implemented and translated into changes in everyday practice. They also permit researchers and clinicians to determine the risk profile and characteristics of patients experiencing an ACS event, according to the countries they inhabit. Finally, they give the opportunity to make a link between different management strategies and clinical outcomes, and to study the characteristics and outcomes of populations which are largely underrepresented in randomized controlled trials, such as patients with significant comorbidities, women, or elderly patients.⁶

In the early 2000s, the European Society of Cardiology (ESC) launched the Euro Heart Survey (EHS) programme, which was designed to gather information on the management and outcome of patients presenting with ACS in participating centres from the ESC member countries. The initial surveys provided some of the first multinational

estimates of ACS patients' profiles in Europe and brought invaluable information to the cardiology community. However, the design (recruitment over a prolonged period of several months or years) and innovative nature of the initial surveys, in which a limited number of centres participated, precluded use of the data as a true epidemiological tool; thus, the first EHS-ACS survey (2000–2001) included 103 hospitals from 25 countries,⁷ the second (2004) included 190 institutions from 32 countries,⁸ and EHS-ACS 3 (2006–2008) included 138 centres from 21 countries.⁹ In order to maximize the number of participating institutions and to increase the representativeness of the survey and to explore potential regional variations in baseline characteristics and management of patients admitted with acute myocardial infarction (AMI), the EHS developed a so-called snapshot design with a brief, 1-week, inclusion period,

Aims of the survey

The main objectives of the survey were to assess characteristics, management, and hospital outcomes of patients presenting with ACS throughout ESC member countries. Secondary objectives were to describe in-hospital outcomes according to initial management and assess how current guidelines were implemented in a contemporary setting.

Methods

Inclusion criteria

The EHS 2009 AMI snapshot is a prospective, multicentre observational study, including consecutive adult (≥ 18 years) men and women admitted with a diagnosis of AMI from 7 to 13 December 2009 at participating institutions in 47 countries.

The following inclusion criteria were used:

- acute myocardial infarction (AMI), defined by elevated cardiac markers (troponin, CK, CK-MB), and one or more of the following characteristics: symptoms compatible with myocardial ischaemia, development of new Q waves, or development of ST-T abnormalities considered of ischaemic origin

- AMI occurring spontaneously or after non-cardiac procedures, according to the universal definition of AMI in use at the time of the survey¹⁰
- admission within 48 hours of the onset of symptoms
- informed consent to participate in the registry.

Patients dying in the first hours following admission, or before blood was drawn, did not require the typical pattern of cardiac markers, provided they had typical symptoms associated with typical ST-T abnormalities, and the diagnosis of AMI was thus considered evident by the investigators. Patients were excluded if their age was <18 years, if symptoms had occurred >48 hours prior to admission, or if the AMI occurred following cardiovascular procedures such as percutaneous coronary interventions or coronary artery bypass graft surgery.

Three patients were excluded from the SWEDEHEART dataset because age was missing (1%), as were 75 patients in whom hospital survival status was missing (64 patients from the MINAP dataset, 8%, and 11 patients from the main survey, 0.3%).

All data were recorded anonymously. Patients gave informed consent for participating in the survey according to the laws applicable in each participating country. Informed consent, however, was not requested for patients dying very early after admission. The protocol was reviewed and approved by ethics committees of the different countries according to national laws applicable.

Data collection

One physician was responsible for collecting the data in each participating centre, and the data were collected on an electronic case record form (CRF) specifically designed by the steering committee members and implemented at the European Heart House. The CRF comprised electronic data controls, generating queries in case of discrepancies in the data entered.

The CRF was used in 45 of the participating countries. In addition, Swedish centres and English and Welsh centres used national CRFs to routinely collect information on patients hospitalized for acute coronary syndromes in the SWEDEHEART¹¹ and Myocardial Ischaemia National Audit Project (MINAP),¹² respectively. Principal investigators of these registries agreed to extract data collected for patients with ST-segment elevation (STEMI) or non-ST-segment elevation (NSTEMI) during the survey recruitment period, and the data were merged with those from the main snapshot CRF. Because some of the data collected differed between each of the two national registries and the EHS Snapshot database, only those defined in a similar manner were used in the global dataset.

A number of variables collected in the main survey were not collected in the MINAP and/or SWEDEHEART databases (among those: place of arrival, type of hospital,

means of transportation to hospital, treatment with nitrates, calcium-channel blockers, diuretics, digoxin, antiarrhythmic agents or oral hypoglycaemic agents before current event, type of presenting symptoms, admission Killip class, arterial access for coronary angiography, in-hospital treatment with loading dose of clopidogrel, glycoprotein IIb/IIIa inhibitors, fondaparinux, bivalirudin, diuretics or amiodarone, and complications such as atrial fibrillation, conduction disturbances, stroke, transfusion, or mechanical complications).

Participating centres and countries

Participation was proposed to all institutions in member countries of the ESC, by way of information through the ESC organization (website and mailing lists) and by informing working groups on acute cardiac care in the countries where such groups existed; all participating centres did so on a voluntary basis.

Forty-seven countries participated in the survey, with 465 participating centres in the main survey (70% with percutaneous coronary intervention, PCI, capability on site), 139 additional centres in MINAP (27% with PCI capability on site), and 73 in SWEDEHEART (38% with PCI capability). Most centres (88%) had an intensive cardiac care unit on site.

The participating countries were grouped into five main geographical regions, adapted from the United Nations geoscheme for Europe:¹³ Western Europe (Austria, Belgium, France, Germany, Switzerland, The Netherlands: 496 patients), Northern Europe (Denmark, Estonia, Finland, Iceland, Ireland, Latvia, Lithuania, UK, Sweden: 1271 patients), Central (Bosnia-Herzegovina, Croatia, Czech Republic, Hungary, Kosovo, Macedonia, Poland, Serbia and Montenegro, Slovakia, Slovenia: 634 patients), Eastern countries (Armenia, Bulgaria, Georgia, Kazakhstan, Moldova, Romania, Russian Federation, Ukraine: 695 patients), and Mediterranean countries (Algeria, Cyprus, Egypt, Greece, Israel, Italy, Libya, Malta, Portugal, Spain, Syrian Arab Republic, Tunisia, Turkey, United Arab Emirates: 1140 patients).

Data recorded

Socio-demographic characteristics comprised age, sex, body mass index, and level of education. Prior medical history and risk factors, as well as medications used regularly for at least 1 month at the time of the infarct, were recorded. Admission characteristics comprised type of AMI (STEMI or NSTEMI), initial symptoms, Killip class on admission, in-hospital medications, and use of invasive procedures.

Statistical analysis

For quantitative variables, means, standard deviations, and minimum and maximum values were calculated. In addition,

medians with the interquartile range were calculated for some variables. Discrete variables are presented as percentages. Comparisons were made with chi-squared or Fisher's Exact tests for discrete variables, and by unpaired t-tests, Mann-Whitney tests, Wilcoxon sign-rank tests, or one-way analyses of variance for continuous variables, as appropriate. Odds ratios are given with their 95% confidence intervals. Multivariate analyses of predictors of in-hospital outcome or management were performed by stepwise backward multiple logistic regression analysis, including age, sex, type of MI, and risk factors as covariates. *p*-values <0.05 were considered significant.

Results

Overall population

Overall, 4236 patients were included in the study: 3198 in the main survey, 732 in MINAP, and 306 in SWEDEHEART.

The mean age of the population was 66±13 years, with 16% aged 80 years or more; 31% were women. The risk factors and previous history are described in Table 1.

Chest pain was the most common presenting symptom. Half of the patients had used an emergency call number, but most, however, were first admitted to the emergency room; 56% were initially admitted to hospitals with PCI capability.

Overall, 69% had a coronary angiography during the hospital stay and 55% underwent a PCI (Table 2). The in-hospital death rate was 6.3%. Antithrombotic treatment, other major medications used in hospital, and other complications are displayed in Table 2.

Presentation, management, and outcomes according to type of AMI

Sixty per cent of the patients presented with STEMI or presumed new left bundle branch block, with 39% located in the anterior territory. The main characteristics of the patients according to type of MI are presented in Table 1. Compared with NSTEMI, STEMI patients were younger, more often men, had less diabetes, hypertension, or hyperlipidaemia, but were more often current smokers. Prior medical cardiovascular and noncardiovascular history was less common in STEMI patients, and accordingly they received fewer cardiovascular medications before the index event. At presentation, cardiac arrest and cardiogenic shock were more frequent in STEMI patients.

In STEMI patients, median time from symptom onset to first call was 105 minutes (Table 2), and 9% were directly brought to the catheterization laboratory.

Primary PCI was the most frequently used reperfusion strategy (50%); 29% of STEMI patients did not get reperfusion therapy (Table 2). Median time from qualifying ECG to lysis was 47 minutes, with less than 25% of the patients

having lytic treatment within 20 minutes of ECG; median time from ECG to primary PCI was 115 minutes. Time from symptom onset to first call was considerably longer in patients who did not get reperfusion therapy (median time: 250 min vs. 75 min for patients with reperfusion therapy). Reperfusion therapy was used in 77% of patients with first medical contact ≤12 hours from symptom onset (primary PCI 53% and fibrinolysis 24%). By multivariate analysis, time to first call >12 hours (OR 7.17, 95% CI 5.24–9.81), age ≥75 years (OR 1.71, 95% CI 1.22–2.39), history of previous MI (OR 3.29, 95% CI 2.26–4.80), and history of hypertension (OR 1.37, 95% CI 1.06–1.77) were independent correlates of lack of reperfusion therapy, while admission to centres with catheterization laboratories (OR 0.38, 95% CI 0.30–0.49), history of previous PCI (OR 0.31, 95% CI 0.18–0.52), and current smoking (OR 0.66, 95% CI 0.50–0.87) were associated with a lower risk of not getting reperfusion therapy.

There were no significant differences regarding the early use of oral antiplatelet agents, angiotensin-converting enzyme (ACE) inhibitors, statins, or beta-blockers. Higher loading doses of clopidogrel were used in STEMI patients, and more received glycoprotein IIb/IIIa inhibitors, while fewer were treated with low-molecular-weight heparin or fondaparinux.

Guideline-recommended secondary prevention medications at discharge (aspirin, clopidogrel, statins, beta-blockers, ACE inhibitors) were more often prescribed in STEMI patients; the differences remained statistically significant after multivariate adjustment.

STEMI patients had more frequent in-hospital complications, including death (STEMI 7.9% vs. NSTEMI 3.9%; Table 2).

Presentation, management, and outcomes according to main geographical regions

There were important differences in baseline characteristics according to main regions (Table 3). Patients in Northern countries were older, and those in Central, Eastern, or Mediterranean countries younger, with a 5-year mean age difference between Northern and Central European countries. The proportion of STEMI was the highest in Eastern countries (74%) and the lowest in Northern countries (46%), with a similar age pattern for STEMI and NSTEMI patients across regions. Patients in Northern countries were more often admitted to non-PCI hospitals, while admission to PCI hospitals was the highest in Western countries.

Median time from symptom onset to call in STEMI patients was longer in Eastern and Western countries than in other regions, with a higher proportion of patients calling beyond 12 hours from onset (24 and 19%, respectively, compared with 12% on average in other regions). The highest use of primary PCI for STEMI was found in Western countries (70%) and the lowest in Eastern countries (23%);

Table 1. Main baseline characteristics according to type of myocardial infarction.

	All AMI (n=4236)	NSTEMI (n=1673)	STEMI (n=2563)	p-value
Socio-demographic characteristics				
Age (years)	65.9±13.2	68.4±12.8	64.3±13.2	<0.001
Age ≥75 years	1206 (28.5)	580 (35)	626 (24)	<0.001
Women	1296 (31)	552 (33)	744 (29)	0.006
Body mass index (kg/m ²)	[2592] 27.6±4.6	[1323] 27.6±4.9	[2301] 27.5±4.5	0.779
Primary education or less	3002 [1037 (34.5)]	[1009] 400 (40)	[1993] 637 (32)	<0.001
Risk factors				
Hypertension	[4177] 2551 (61)	[1654] 1080 (65)	[2523] 1471 (58)	<0.001
Diabetes mellitus	[4223] 1007 (24)	[1670] 455 (27)	[2543] 552 (22)	<0.001
Hypercholesterolaemia	[3875] 1642 (42)	[1485] 691 (46.5)	[2390] 951 (40)	<0.001
Current smoking	[4183] 930 (37)	[1652] 404 (24.5)	[2531] 930 (37)	<0.001
Family history	[3867] 1042 (27)	[1480] 398 (27)	[2387] 644 (27)	0.836
Past history				
Prior MI	[4185] 950 (23)	[1658] 499 (30)	[2527] 451 (18)	<0.001
Prior PCI	[4178] 549 (13)	[1655] 277 (17)	[2523] 272 (11)	<0.001
Prior CABG	[4180] 214 (5)	[1656] 140 (8.5)	[2524] 74 (3)	<0.001
Prior stroke	[4172] 299 (7)	[1654] 134 (8)	[2518] 165 (7)	0.058
PAD	[3864] 212 (5.5)	[1482] 107 (7)	[2382] 105 (4)	<0.001
History of CHF	[4170] 361 (9)	[1654] 175 (11)	[2516] 186 (7)	<0.001
CKD	[3871] 264 (7)	[1484] 125 (8)	[2387] 139 (6)	0.002
COPD	[3865] 321 (8)	[1475] 157 (11)	[2390] 164 (7)	<0.001
Cancer	[3156] 131 (4)	[1073] 62 (6)	[2083] 69 (3)	0.001
Medications before index AMI				
Aspirin	[4028] 1420 (35)	[1604] 709 (44)	[2424] 711 (29)	<0.001
Clopidogrel	[4123] 332 (8)	[1645] 165 (10)	[2478] 167 (7)	<0.001
Statin	[4009] 1361 (34)	[1600] 688 (43)	[2409] 673 (28)	<0.001
Beta-blocker	[3966] 1299 (33)	[1587] 632 (40)	[2379] 667 (28)	<0.001
ACE-inhibitor	[3976] 1695 (43)	[1588] 796 (50)	[2388] 899 (38)	<0.001
Nitrate	[3362] 547 (16)	[1212] 268 (22)	[2150] 279 (13)	<0.001
CCB	[3369] 472 (14)	[1210] 214 (18)	[2159] 258 (12)	<0.001
Loop diuretic	[3074] 323 (10.5)	[1041] 148 (14)	[2033] 175 (9)	<0.001
Thiazide	[3068] 294 (10)	[1036] 110 (11)	[2031] 184 (9)	0.168
Aldosterone blocker	[3072] 128 (4)	[1040] 62 (6)	[2032] 66 (3)	<0.001
Digoxin	[3391] 90 (3)	[1218] 41 (3)	[2173] 49 (2)	0.053
Amiodarone	[3088] 45 (1.5)	[1049] 18 (2)	[2039] 27 (1)	0.390
Antiarrhythmic agent	[3093] 26 (1)	[1051] 13 (1)	[2042] 13 (1)	0.083
Insulin	[4144] 285 (7)	[1652] 129 (8)	[2492] 156 (6)	0.054
Oral antidiabetic agents	[3408] 542 (16)	[1227] 222 (18)	[2181] 320 (15)	0.009
Presentation at admission				
Chest pain as main symptom	[3495] 3224 (92)	[1247] 1130 (91)	[2248] 2094 (93)	0.007
Dyspnoea on presentation	[3472] 1158 (33)	[1249] 412 (33)	[2223] 746 (34)	0.732
Arrhythmia on presentation	[3494] 107 (3)	[1248] 126 (10)	[2246] 137 (6)	<0.001
Cardiac arrest	[3486] 127 (4)	[1248] 18 (1)	[2238] 109 (5)	<0.001
Admission Killip class	[3360]	[1217]	[2143]	<0.001
I	2522 (75)	938 (77)	1584 (74)	
II	566 (17)	196 (16)	370 (17)	
III	179 (5)	68 (6)	111 (5)	
IV	93 (3)	15 (1)	78 (4)	

Data are mean±SD or n (%). Data in square brackets are number available.

ACE, angiotensin-converting enzyme; AMI, acute myocardial infarction; CABG, coronary artery bypass graft surgery; CCB, calcium channel blocker; CHF, congestive heart failure; CKD, chronic kidney disease; COPD, chronic obstructive pulmonary disease; MI, myocardial infarction; PAD, peripheral artery disease; PCI, percutaneous coronary intervention.

Table 2. Pathways, time delays, early management, and in-hospital outcomes according to the type of AMI.

	All AMI (n=4236)	NSTEMI (n=1673)	STEMI (n=2563)	p-value
Pathways				
Use of emergency call number	[3653] 1826 (50)	[1402] 655 (47)	[2251] 1171 (52)	0.002
Transport by mobile ICU	[3181] 502 (16)	[1115] 136 (12)	[2066] 366 (18)	<0.001
Place of admission	[3091]	[1280]	[1811]	<0.001
Emergency room	2191 (71)	1010 (79)	1181 (65)	
ICU	721 (23)	257 (20)	464 (26)	
Catheterisation laboratory	179 (6)	13 (1)	166 (9)	
Initial admission to non-PCI hospital	[3998] 2228 (56)	[1498] 738 (49)	[2500] 1032 (41)	<0.001
Time delays (min)				
Symptom onset to first call		[1117] 165 (59–592)	[2093] 105 (37–360)	<0.001
First call to qualifying ECG		[863] 27 (14–51)	[1752] 24 (11–45)	0.009
ECG to lysis			[328] 47 (21–85)	
ECG to primary PCI			[883] 115 (75–94)	
Early management				
Coronary angiography	2913 (69)	1103 (66)	1810 (71)	0.001
Any PCI	2347 (55)	788 (47)	1559 (61)	<0.001
Reperfusion therapy in STEMI			[2262]	
No reperfusion			649 (29)	
Fibrinolysis			476 (21)	
Primary PCI			1137 (50)	
Coronary bypass graft	[4007] 140 (3.5)	[1538] 88 (6)	[2469] 44 (2)	<0.001
Aspirin	[4211] 4093 (97)	[1662] 1615 (97)	[2478] 2499 (97)	0.935
Clopidogrel	[4117] 3729 (91)	[1620] 1466 (90.5)	[2497] 2263 (91)	0.885
Prasugrel	[4236] 35 (1)	[1673] 10 (0.6)	[2563] 25 (1.0)	0.184
Clopidogrel loading dose	[2201]	[742]	[1459]	<0.001
300 mg	832 (38)	357 (48)	475 (33)	
≥600 mg	1281 (58)	346 (47)	935 (64)	
GPIIb/IIIa inhibitors	[3504] 889 (25)	[1249] 232 (19)	[2255] 657 (29)	<0.001
LMWH	[4236] 2272 (54)	[1673] 982 (59)	[2563] 1290 (50)	<0.001
UFH	[4236] 2281 (54)	[1673] 836 (50)	[2563] 1445 (56)	<0.001
Fondaparinux	[3504] 503 (14)	[1249] 261 (21)	[2255] 242 (11)	<0.001
Bivalirudin	[3504] 87 (2.5)	[1249] 36 (3)	[2255] 51 (2)	0.258
ACE inhibitor	[4186] 3481 (83)	[1650] 1374 (83)	[2536] 2107 (83)	0.873
Beta-blocker	[4190] 3519 (84)	[1656] 1375 (83)	[2534] 2144 (85)	0.173
Statin	[4207] 3801 (90)	[1662] 1492 (90)	[2545] 2309 (91)	0.305
Loop diuretic	[3789] 1165 (31)	[1438] 465 (32)	[2351] 700 (30)	0.097
Amiodarone	[3198] 362 (11)	[1078] 102 (9.5)	[2120] 260 (12)	0.018
Discharge medications				
Aspirin	[3799] 3533 (93)	[1518] 1394 (92)	[2281] 2139 (94)	0.021
Clopidogrel	[3826] 3189 (83)	[1549] 1262 (81.5)	[2277] 1927 (85)	0.010
Statin	[3797] 3458 (91)	[1519] 1362 (90)	[2278] 2096 (92)	0.013
ACE-inhibitor or ARB	[3791] 3090 (81.5)	[1515] 1200 (79)	[2276] 1890 (83)	0.003
Beta-blocker	[3788] 3186 (84)	[1513] 1244 (82)	[2275] 1942 (85)	0.010
In-hospital complications				
Death	268 (6.3)	66 (3.9)	202 (7.9)	<0.001
Recurrent MI	[4170] 111 (2.7)	[1649] 40 (2.4)	[2521] 71 (2.8)	0.444
Stroke	[3909] 37 (0.9)	[1499] 5 (0.3)	[2410] 32 (1.3)	0.002
TIMI major bleed	[4216] 65 (1.5)	[1669] 26 (1.6)	[2547] 39 (1.5)	0.945
Transfusion	[3185] 114 (3.6)	[1074] 48 (4.5)	[2111] 66 (3.1)	0.054
Cardiogenic shock	[3086] 196 (6.4)	[1056] 46 (4.4)	[2030] 150 (7.4)	<0.001
Atrial fibrillation	[3497] 232 (6.7)	[1245] 93 (7.5)	[2237] 139 (6.2)	0.154
Ventricular tachycardia or fibrillation	[3511] 270 (7.7)	[1255] 47 (3.7)	[2256] 223 (9.9)	<0.001
2nd or 3rd degree AV block	[3489] 127 (3.6)	[1246] 26 (2.1)	[2243] 101 (4.5)	<0.001

Data are mean±SD, n (%) or median (IQR). Data in square brackets are number available.

ACE, angiotensin-converting enzyme; ARB, angiotensin receptor blocker; AV, atrio-ventricular; GP, glycoprotein; GRACE, Global Registry of Acute Coronary Events; ICU, intensive care unit; IQR, interquartile range; LMWH, low-molecular-weight heparin; MI, myocardial infarction; PCI, percutaneous coronary intervention; STEMI, ST-elevation myocardial infarction; TIMI, Thrombolysis In Myocardial Infarction; UFH, unfractionated heparin.

Table 3. Baseline characteristics, management and outcomes according to geographical region.

	Western (n=496)	Northern (n=1271)	Central (n=634)	Eastern (n=695)	Mediterranean (n=1140)	p-value
Participating centres	86	239	75	104	173	
Centres with PCI on site	79 (92)	86 (36)	49 (65)	40 (38)	135 (78)	
Centres with ICCU	[71] 58 (82)	[24] 16 (67)	[63] 59 (94)	[86] 81 (94)	[148] 132 (89)	
Socio-demographic characteristics						
Age (years)	65.7±13.4	68.9±13.4	64.3±12.6	64.4±11.9	64.6±13.5	<0.001
Age in STEMI patients (years)	[273] 64.1±13.1	[483] 66.5±13.3	[402] 62.9±12.7	[607] 61.9±13.8	[516] 63.8±12.2	
Age ≥75 years	142 (29)	464 (36.5)	145 (23)	160 (23)	295 (26)	<0.001
Women	138 (28)	413 (32.5)	215 (34)	235 (34)	295 (26)	<0.001
Body mass index (kg/m ²)	[475] 27.1±4.7	[759] 27.4±5.2	[622] 27.5±4.3	[674] 28.3±4.5	[1094] 27.5±4.4	<0.001
Primary education or less	[414] 147 (35.5)	[187] 53 (28)	[618] 177 (29)	[687] 114 (17)	[1096] 546 (50)	<0.001
Risk factors						
Hypertension	307 (62)	[1212] 598 (49)	417 (66)	522 (75)	707 (62)	<0.001
Diabetes mellitus	114 (23)	[1258] 229 (18)	165 (26)	164 (24)	335 (29)	<0.001
Hypercholesterolaemia	215 (43)	[910] 340 (37)	296 (47)	266 (38)	525 (46)	0.001
Current smoking	154 (31)	[1218] 341 (28)	217 (34)	213 (31)	409 (36)	0.001
Family history	[494] 109 (22)	[904] 291 (32)	198 (31)	176 (25)	268 (23.5)	<0.001
Past history						
Prior MI	80 (16)	[1220] 308 (25)	150 (24)	161 (23)	251 (22)	0.001
Prior PCI	91 (18)	[1213] 150 (12)	89 (14)	24 (3.5)	195 (17)	<0.001
Prior CABG	28 (6)	[1215] 95 (8)	22 (3.5)	9 (1)	60 (5)	<0.001
Prior stroke	21 (4)	[1207] 84 (7)	53 (8)	72 (10)	69 (6)	0.002
PAD	33 (7)	[899] 40 (4)	43 (7)	25 (4)	71 (6)	0.021
Hx of CHF	26 (5)	[1205] 86 (7)	53 (8)	129 (19)	67 (6)	<0.001
CKD	41 (8)	[906] 44 (5)	38 (6)	40 (6)	101 (9)	0.002
COPD	21 (4)	[900] 106 (12)	36 (6)	55 (8)	103 (9)	<0.001
Cancer	37 (8)	[233] 15 (6)	23 (4)	11 (2)	45 (4)	<0.001
Medications before index AMI						
Aspirin	[487] 152 (31)	[1200] 386 (32)	[570] 249 (44)	[653] 191 (29)	[1118] 442 (39.5)	<0.001
Clopidogrel	[485] 59 (12)	[1263] 65 (5)	[587] 56 (9.5)	[667] 29 (4)	[1121] 123 (11)	<0.001
Statin	[480] 169 (35)	[1192] 451 (38)	[577] 198 (34)	[653] 135 (21)	[1107] 408 (37)	<0.001
Beta-blocker	[482] 163 (34)	[1155] 405 (35)	[572] 218 (38)	[655] 192 (29)	[1102] 321 (29)	0.001
ACE-inhibitor	[482] 204 (42)	[1154] 446 (39)	[581] 262 (46)	[657] 289 (44)	[1109] 494 (44.5)	0.019
Insulin	[488] 41 (8)	[1263] 76 (6)	[597] 59 (10)	[675] 30 (4)	[1121] 79 (7)	0.001
Presentation						
STEMI or LBBB	315 (63.5)	588 (46)	436 (69)	518 (74.5)	706 (62)	<0.001
Time from onset to first call in STEMI patients (min)	[239] 120 (45–480)	[317] 83 (31–207)	[401] 80 (30–305)	[486] 145 (45–704)	[650] 100 (40–270)	<0.001
Chest pain	[494] 443 (90)	[538] 468 (87)	[632] 600 (95)	[695] 659 (95)	[1136] 1054 (93)	<0.001
Dyspnoea	[488] 148 (30)	[534] 104 (19.5)	[631] 238 (38)	[683] 342 (50)	[1136] 326 (29)	<0.001
Cardiac arrest	[492] 19 (4)	[536] 6 (1)	[632] 25 (4)	[688] 32 (5)	[1138] 45 (4)	0.015
Shock	[495] 16 (3)	[538] 6 (1)	[634] 17 (3)	[695] 78 (4)	[1140] 27 (2)	0.040

(Continued)

Table 3. Continued

	Western (n=496)	Northern (n=1271)	Central (n=634)	Eastern (n=695)	Mediterranean (n=1140)	p-value
GRACE score	[296] 159±40	[435] 148±36	[520] 153±36	[536] 155±35	[805] 154±36	<0.001
Call to emergency number	[466] 234 (50)	[850] 609 (72)	[602] 296 (49)	[662] 352 (53)	[1073] 335 (31)	<0.001
Admission to emergency room	[482] 312 (65)	[227] 177 (78)	[611] 402 (66)	[668] 300 (45)	[1103] 1000 (91)	<0.001
Admission or referral to university hospital	[435] 166 (38)	[221] 170 (77)	[570] 397 (70)	[608] 295 (48.5)	[1016] 555 (55)	<0.001
Patient initial admission to non-PCI centre	134 (27)	[1033] 568 (55)	332 (52)	381 (55)	355 (31)	<0.001
In-hospital procedures						
Coronary angiography	461 (93)	893 (70)	480 (76)	202 (29)	877 (77)	<0.001
Radial access	[460] 168 (36.5)	[191] 50 (26)	[478] 155 (32)	[202] 27 (13)	[865] 251 (29)	<0.001
Any PCI	360 (73)	757 (60)	400 (63)	159 (23)	671 (59)	<0.001
CABG	24 (5)	[1042] 37 (4)	17 (3)	6 (1)	56 (5)	<0.001
In-hospital management						
Reperfusion therapy in STEMI	[273]	[462]	[402]	[516]	[609]	<0.001
No reperfusion	60 (22)	95 (21)	87 (22)	261 (51)	145 (24)	
Fibrinolysis	21 (8)	132 (29)	51 (13)	138 (27)	134 (22)	
Primary PCI	192 (70)	235 (51)	264 (66)	117 (23)	330 (54)	
No reperfusion therapy in patients calling <12 hours of symptom onset	[175] 36 (21)	[272] 36 (13)	[319] 49 (15)	[340] 150 (44)	[502] 95 (19)	<0.001
Aspirin	487 (98)	[1246] 1214 (97)	619 (98)	659 (95)	1114 (98)	0.003
Clopidogrel	[495] 468 (94.5)	[1153] 1025 (89)	594 (94)	561 (81)	1081 (95)	<0.001
Clopidogrel loading dose	[460]	[191]	[478]	[202]	[870]	<0.001
300 mg	126 (27)	47 (25)	78 (16)	129 (64)	452 (52)	
≥600 mg	315 (68.5)	131 (69)	375 (78.5)	63 (31)	397 (46)	
GPIIb/IIIa inhibitors	216 (43.5)	[539] 135 (25)	136 (21.5)	28 (4)	374 (33)	<0.001
LMWH	281 (57)	587 (46)	356 (56)	331 (48)	717 (63)	<0.001
UFH	312 (63)	807 (63.5)	370 (58)	325 (47)	467 (41)	<0.001
Fondaparinux	59 (12)	[539] 177 (33)	22 (3.5)	149 (21)	96 (8)	<0.001
Bivalirudin	7 (1.4)	[539] 57 (11)	2 (0.3)	1 (0.1)	20 (1.8)	<0.001
ACE inhibitor	411 (83)	[1221] 977 (80)	550 (87)	589 (85)	954 (84)	0.003
Beta-blocker	440 (89)	[1225] 989 (81)	524 (83)	598 (86)	968 (85)	<0.001
Statin	459 (92.5)	[1242] 1056 (85)	586 (92)	632 (91)	1068 (94)	<0.001
Diuretic	169 (34)	[238] 91 (38)	247 (39)	343 (49)	402 (35)	<0.001
Amiodarone	51 (10)	[233] 19 (8)	72 (11)	99 (14)	121 (11)	0.053
Discharge medications						
Aspirin	[467] 436 (93)	[1070] 997 (93)	[582] 543 (93)	[624] 566 (91)	[1056] 991 (94)	0.169
Clopidogrel	[467] 383 (82)	[1097] 961 (88)	[581] 501 (86)	[624] 447 (72)	[1057] 897 (85)	<0.001
Statin	[465] 423 (91)	[1072] 963 (90)	[582] 535 (92)	[624] 576 (92)	[1054] 961 (91)	0.958
ACE-inhibitor or ARB	[465] 380 (82)	[1067] 839 (79)	[582] 497 (85)	[623] 530 (85)	[1054] 844 (80)	0.001
Beta-blocker	[464] 401 (86)	[1063] 912 (86)	[582] 478 (82)	[624] 533 (85)	[1055] 862 (82)	0.025

(Continued)

Table 3. Continued

	Western (n=496)	Northern (n=1271)	Central (n=634)	Eastern (n=695)	Mediterranean (n=1140)	p-value
In-hospital complications						
Death	26 (5.2)	52 (4.1)	50 (7.9)	70 (10.1)	70 (6.1)	<0.001
Death (STEMI patients)	[315] 20 (6.3)	[588] 29 (4.9)	[436] 43 (9.9)	[518] 56 (10.8)	[706] 54 (7.6)	0.022
Recurrent MI	[481] 13 (2.7)	[1233] 19 (1.5)	[630] 21 (3.3)	[689] 30 (4.4)	[1129] 28 (2.5)	0.005
Stroke	[491] 3 (0.6)	[960] 1 (0.1)	[628] 8 (1.3)	[693] 4 (0.6)	[1137] 21 (1.8)	0.001
TIMI major bleed	[488] 6 (1.2)	[1265] 16 (1.3)	[631] 13 (2.1)	[694] 8 (1.2)	[1138] 22 (1.9)	0.418
Transfusion	[487] 17 (3.5)	[233] 14 (6.0)	[634] 17 (2.7)	[694] 5 (0.7)	[1137] 61 (5.4)	<0.001
Cardiogenic shock	[438] 22 (5.0)	[221] 17 (7.7)	[630] 35 (5.6)	[673] 52 (7.7)	[1124] 70 (6.2)	0.308
Atrial fibrillation	[490] 39 (8.0)	[538] 28 (4.8)	[630] 41 (6.5)	[688] 40 (5.8)	[1136] 86 (7.6)	0.162
Ventricular tachycardia or fibrillation	[490] 35 (7.1)	[559] 34 (6.1)	[637] 51 (8.1)	[693] 69 (8.1)	[1137] 94 (8.3)	0.549

Data are mean±SD, n (%) or median (IQR). Data in square brackets are number available.

ACE, angiotensin-converting enzyme; AML, acute myocardial infarction; ARB, angiotensin receptor blocker; CABG, coronary artery bypass graft surgery; CHF, congestive heart failure; CKD, chronic kidney disease; COPD, chronic obstructive pulmonary disease; GP, glycoprotein; GRACE, Global Registry of Acute Coronary Events; ICCU, intensive cardiac care unit; LBBB, left bundle branch block; LMWH, low-molecular-weight heparin; MI, myocardial infarction; PAD, peripheral artery disease; PCI, percutaneous coronary intervention; STEMI, ST-elevation myocardial infarction; TIMI, Thrombolysis In Myocardial Infarction; UFH, unfractionated heparin.

overall, more than twice as many patients in Eastern countries had no reperfusion therapy, compared to other regions. The same trend existed in patients having called within 12 hours of symptom onset (44% with no reperfusion therapy in Eastern, and 21% in Western countries, compared with 13% in Northern countries). After multivariate adjustment, compared with Western countries, primary PCI use was significantly less in all other regions except Central Europe: Northern adjusted OR 0.27 (95% CI 0.20–0.37); Central OR 0.84 (95% CI 0.61–1.17); Eastern OR 0.11 (95% CI 0.07–0.15); Mediterranean OR 0.49 (95% CI 0.36–0.66). In contrast, the use of any reperfusion therapy (either by fibrinolysis or primary PCI) was similar in all regions except Eastern countries, where it was significantly lower (OR 0.22, 95% CI 0.16–0.31). Early medications used in hospital differed notably across regions (Table 3).

At discharge, there was no difference regarding aspirin and statin prescription; unadjusted rates of clopidogrel, beta-blockers, and ACE inhibitors differed. After multivariate adjustment, clopidogrel was prescribed more often in Northern compared with Western countries (adjusted OR 1.82, 95% CI 1.35–2.47) and less often in Eastern countries (OR 0.53, 95% CI 0.39–0.71); beta-blockers were less often used in Mediterranean (OR 0.70, 95% CI 0.51–0.95), and Northern countries (OR 0.70, 95% CI 0.50–0.99). ACE inhibitors were more often prescribed in Central (OR 1.54, 95% CI 1.17–2.03) and Eastern (OR 1.48, 95% CI 1.13–1.94) countries, compared with Northern countries. There were no significant differences for statin prescription at discharge.

In-hospital death was lowest in Northern countries and highest in Eastern and Central European countries, both in the overall patient population and in STEMI patients. Compared with Western countries, the adjusted OR was 1.66 (95% CI 1.01–2.74; $p=0.047$) for Central European countries and 2.13 (95% CI 1.32–3.43; $p=0.002$) for Eastern countries. The statistical significance disappeared, however, when use of PCI was added to the model both for Eastern (OR 1.54, 95% CI 0.93–2.53) and Central European countries (OR 1.55, 95% CI 0.93–2.56). Major bleeding was not significantly different across regions, but transfusions were used less often in Eastern and more often in Northern countries. The occurrence of cardiogenic shock was not significantly different across regions. There were differences in baseline characteristics, type of MI, use of reperfusion therapy in STEMI, and in-hospital mortality among individual countries, but the number of patients included per country was too small to draw firm conclusions in this regard (Supplementary Figures S1 and S2, available online).

Discussion

This study provides a global overview of the characteristics, management, and outcomes of patients admitted for

STEMI or NSTEMI in 47 ESC member countries at the end of 2009. With nearly 700 centres involved, it constitutes the largest effort to date to obtain a broader and more comprehensive view, compared with previously reported data, including the previous Euro Heart Surveys.⁷⁻⁹ It gives information on the type of population admitted to hospitals for AMI, and shows differences in presentation, invasive and medical management, and in-hospital outcomes according to the main geographical regions.

STEMI represented the majority of AMI patients admitted to intensive cardiac care units/cardiology departments at the participating centres, with variations across regions which might represent differences in practice regarding admission to intensive care units of NSTEMI patients, rather than true regional differences in the incidence of STEMI vs. NSTEMI. In line with many previous surveys and registries, patients with NSTEMI were older and with more comorbidity. Their in-hospital mortality, however, was lower than that of STEMI patients, as was the occurrence of stroke, cardiogenic shock, and rhythm disturbances. These results are in keeping with most data worldwide.

The survey results also represent a first attempt at assessing the global picture of patients hospitalized for AMI, comparing regional differences in presentation, management and outcomes within member countries of the ESC. There were substantial regional differences in terms of patient profile; in particular, patients from Central or Eastern countries were notably younger than patients in Northern countries. Such differences reflect data reported from national registries published in the 2000s,¹⁴⁻¹⁸ as well as from administrative databases.¹⁹ Likewise, patient management was significantly different across regions. In STEMI patients, the use of primary PCI, as well as that of reperfusion therapy, was less in Eastern countries, but high in Western and Central European countries; the same trend was noted in National reports,¹⁸ and in the recent Stent for Life ESC survey on primary PCI, where several countries such as the Czech Republic, Poland, or Slovenia had high rates of primary PCI.²⁰ Primary PCI represented the first reperfusion method in all regions except Eastern countries, where fibrinolysis was used more often. Interestingly, the rate of use of primary PCI and intravenous fibrinolysis in Eastern countries at the end of 2009 was quite similar to the rates observed in Western countries just a few years earlier.²¹ The relatively low rate of primary PCI in Northern countries (51%) was largely driven by the practice in England and Wales at the time, where fibrinolytic treatment was still largely used, consistent with the figures reported in the 2009 MINAP report;²² in contrast, primary PCI was used in 61% of Swedish patients as early as 2006-2007.²³ The use of guideline-recommended medications at discharge was high in all regions: aspirin in 91-94%, clopidogrel, ACE inhibitors, and beta-blockers in about or over 80% of the patients, and statins in 91% of the patients.

In-hospital complications were not frequent. Recurrent myocardial infarction ranged from 1.5 to 4.4%, cardiogenic shock from 5.0 to 7.7%, and major bleeding was reported in 1.2 to 2.1% of patients. In-hospital mortality ranged from 4.1% (Northern countries) to 10.1% (Eastern countries). Interestingly, early mortality in Central and Eastern European countries was comparable to what was found in Western/Northern countries in the early or mid-2000s. Thus, in the French USIC 2000 registry, carried out in November 2000, in-hospital mortality was 8.7%,¹⁶ and it decreased to 5.4% in the FAST-MI 2005 registry²⁴ and 4.4% in the FAST-MI 2010 registry;^{25,26} in the SWEDEHEART RIKS-HIA registry, in-hospital mortality was also 8.7% in 2000, and was still 7.2% in 2004, to reach a low 5.1% in 2007;²³ in the SWISS registry, in-hospital death rate was 7.6% in 2000 and decreased to 6% in 2007.²⁷ Overall, there were no gross inequalities in management and outcomes among ESC member countries; we observed a less than 10-year gap for the use of invasive strategies and early mortality between European regions, with a nearly uniform use of recommended medications at discharge.

This study has several limitations that must be taken into consideration when interpreting its results. The most important pertains to its voluntary nature. Although participation was considerably higher than in all previous European surveys, only a minority of the centres providing care for AMI patients actually took part in the survey, thereby limiting the ability of the survey to provide definitive representative figures of the current landscape of AMI management in Europe. A majority of the centres participating in the survey were university hospitals or hospitals with catheterization laboratories on site, which does reflect a lower participation of non-university or smaller hospitals in the survey; even after accounting for patients transferred to larger hospitals, less than half of the patients in the survey were initially admitted to hospitals without PCI capability, a most likely underestimate of their true proportion. Also, participation in some countries was low, so that comparisons between countries should be taken with extreme care and should not be considered more than purely indicative. In addition, because of the short duration of the inclusion period, the number of patients included in any given country remains relatively small, and therefore limit the ability to perform country-wise comparisons. The results of the survey, however, are in line with most national or regional contemporary surveys. Conversely, the short duration of the study makes it more likely that patient inclusion at the participating centres was truly consecutive. Finally, the source of the data came from both a specific case record form, designed for the snapshot survey, and from extractions from national databases (MINAP and SWEDEHEART) for the survey inclusion period; as the structure of the three databases differed, some variables were not available for all patients, and therefore limit the

potential for some comparisons between Northern countries and the other participating countries.

In conclusion, overall, this survey provides a global picture of AMI presentation, management and outcomes in Europe at the end of 2009. Differences continue to exist between regions, in terms of patient populations and management, but these differences are relatively modest and are likely to rapidly attenuate further with the growing use of invasive strategies and reperfusion therapy for STEMI patients. One of the key determinants of improved outcomes, particularly for the STEMI population, is the implementation of regional networks, which is now strongly advocated in the most recent ESC guidelines.⁴ In addition, implementing regional, national or international surveys of practice is likely to further improve quality of care for this acute cardiac condition.

Acknowledgements

The authors wish to thank the patients who accepted to participate in the survey, as well as all clinicians at the participating centres. The list of participating centres, with number of patients per country is given in Annex 1 (available online). Special thanks to Cécile Laroche and Malika Manini, at the European Heart House, who implemented the specific electronic database and provided data management, with the help of Emanuela Fiorucci.

EHS Snapshot steering committee

Nicolas Danchin (chair), Alex Battler, Hector Bueno, Keith Fox, Christian Hamm, Bertil Lindahl, Francois Schiele, Maarten Simoons, Michal Tendera, and Marco Tubaro, with Anselm Gitt, advisor.

Conflict of interest

H Bueno: Advisory/consulting fees from AstraZeneca, Bayer, Daiichi-Sankyo, Eli-Lilly, Novartis, Roche; research grants from AstraZeneca.

P Clemmensen: Research contracts, consulting or received research and educational grants from Abbott, AstraZeneca, Aventis, Bayer, Bristol Myers Squibb, Daiichi-Sankyo, Eli-Lilly, Merck, Myogen, Medtronic, Mitsubishi Pharma, Nycomed, Organon, Pfizer, Pharmacia, Philips, Roche, Sanofi-Synthelabo, Searle, The Medicines Company.

N Danchin: Research grants from AstraZeneca, Daiichi-Sankyo, Eli-Lilly, GSK, Merck, Novartis, Pfizer, Sanofi-aventis, Servier, The Medicines Company; speaker and consulting fees from AstraZeneca, Bayer, Bristol-Myers Squibb, Boehringer-Ingelheim, Daiichi-Sankyo, Eli-Lilly, GlaxoSmithKline, MSD-Schering, Novartis, Novo-Nordisk, Pfizer, Roche, Sanofi-Aventis, Servier, The Medicines Company.

KAA Fox: Research grants and honoraria from Bayer/Johnson & Johnson, Lilly, Sanofi Aventis, AstraZeneca, Boehringer-Ingelheim.

K Huber: Lecture fees from AstraZeneca, Bayer, Boehringer Ingelheim, Bristol Myers Squibb, Daiichi Sankyo, Eli Lilly, Pfizer, Sanofi-Aventis, The Medicines Company.

M Lettino: Speaker fees from Astra Zeneca, Daiichi Sankyo, Eli Lilly, Boehringer, Bayer, The Medicines Company, Pfizer; advisory board fees from Boehringer, Eli Lilly, The Medicines Company, BMS, MSD, Pfizer.

C Mueller: Research support from Abbott, Alere, Brahms, Nanosphere, Roche, Siemens, 8sense, Nanosphere, and Department of Internal Medicine, University Hospital Basel; speaker honoraria from Abbott, Alere, Brahms, Lilly, Novartis, Roche, Siemens.

A Parkhomenko: Research grants from Bayer, GSK, Sanofi-aventis, Servier, BHFZ; speaker fees from AstraZeneca, Bayer, Boehringer-Ingelheim, GlaxoSmithKline, Sanofi-Aventis, Servier.

S Price: Educational contract fees from Medtronic; advisory board fees from Abbott; speaking honorarium from Pfizer.

T Quinn: consultancy fees from Boehringer Ingelheim (STREAM trial), MedCo (EUROMAX).

F Schiele: Research grant from GlaxoSmithKline, St Jude Medical, Sanofi-Aventis, Servier, Daiichi-Sankyo/Lilly; lecture fees from Boehringer Ingelheim, Daiichi-Sankyo/Lilly, Novartis, Sanofi-Aventis, Servier, The Medicines Company, Astra Zeneca; consulting fees from Sanofi, Astra Zeneca, Lilly.

C Vrints: Research grants from Abbott, Medtronic, Bracco.

D Zahger: Consultant fees from AstraZeneca, Eli-Lilly, Bayer, Rafa Laboratories, Sanofi-Aventis, Pfizer.

U Zeymer: Research grants from Daiichi Sankyo, Lilly, Novartis, Sanofi-aventis; speakers honoraria from AstraZeneca, Bayer Healthcare, Daiichi Sankyo, Iroko, Lilly, Medicines Company, MSD, Novartis, Sanofi-aventis.

The other authors report no disclosure.

Funding

This study was supported by Bristol Myers Squibb and Sanofi-Aventis.

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