European Heart Journal Supplements (2024) **26** (Supplement 4), iv19–iv32
The Heart of the Matter
https://doi.org/10.1093/eurheartjsupp/suae076

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European Society
of Cardiology

The budget impact of implementing atrial fibrillation-screening in European countries

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KEYWORDS
Atrial fibrillation;
Budget impact analysis;
Screening;
ECG monitoring;
Anticoagulation;
Stroke prevention

A budget impact analysis estimates the short-term difference between the cost of the current treatment strategy and a new treatment strategy, in this case to implement population screening for atrial fibrillation (AF). The aim of this study is to estimate the financial impact of implementing population-based AF-screening of 75-year-olds compared with the current setting of no screening from a healthcare payer perspective in eight European countries. The net budget impact of AF-screening was estimated in country-specific settings for Denmark, Germany, Ireland, Italy, Netherlands, Serbia, Spain, and Sweden. Country-specific parameters were used to allow for variations in healthcare systems and to reflect the healthcare sector in the country of interest. Similar results can be seen in all countries AF-screening incurs savings of stroke-related costs since AF treatment reduces the number of strokes. However, the increased number of detected AF and higher drug acquisition will increase the drug costs as well as the costs of physician- and control visits. The net budget impact per invited varied from €10 in Ireland to €122 in the Netherlands. The results showed the increased costs of implementing AF-screening were mainly

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driven by increased drug costs and screening costs. In conclusion, across Europe, though the initial cost of screening and more frequent use of oral anti-coagulants will increase the healthcare payers' costs, introducing population screening for AF will result in savings of stroke-related costs.

Introduction

The estimated prevalence of atrial fibrillation (AF) in 2016 was 7.7% in the population over 65 years old across Europe,[1] and the estimated lifetime risk for development of AF is over 24% by the age of 90 years[2]. Incidence of AF is estimated to increase further in the future as the population ages[3]. In the European Union, it is estimated that the number of individuals with AF will more than double between 2010 and 2060. This increase is especially significant in the population 55 years or older.[3,4] The increased prevalence of AF comes with a significant public health burden as AF is associated with significant morbidity and mortality.[4] The risk of stroke is almost five-fold for a patient with AF, and 15–23% of all stroke-cases are attributed to AF.[3,5] Asymptomatic AF seems to have similar risk for ischaemic stroke as symptomatic AF.[6] Atrial fibrillation-related strokes are associated with worse outcomes in terms of severity, morbidity, and mortality compared to non-AF-related strokes.[3,7,8] The increased severity of AF-related stroke also increases the costs of stroke by 50%.[7,9] The total direct and indirect cost of stroke globally in 2017 was estimated at €835 billion.[10]

Oral anticoagulant (OAC) treatment may prevent 66% of AF-related ischaemic strokes.[11] However, uptake of OAC treatment is far from optimal even though European guidelines encourage the use of OAC treatment for AF, especially in patients at higher stroke risk, i.e. a higher CHA_2DS_2-VASc-score.[9] Since untreated AF is associated with higher risk than treated AF, screening programmes could be used to identify undetected AF patients.[9] Opportunistic screening by pulse palpation or ECG rhythm strip in patients aged 65 years or older is currently recommended in the ESC guidelines.[9] However, opportunistic screening alone will likely fail to identify a significant proportion of people with AF not coming to medical attention. With systematic screening on the other hand, it may be possible to identify specific individuals at high risk of stroke and to reduce this risk through the use of anticoagulants.[3,6]

A budget impact analysis (BIA) assesses the affordability of introducing a new healthcare intervention into a healthcare system.[12] Specifically, it estimates the expected annual change in total costs from the budget holders (payers) perspective. Budget holders and decision-makers commonly use BIA to determine whether an intervention is affordable and can be accommodated within the existing budget.[12] The BIA can also provide information on the financial implications of using an intervention in different patient populations, healthcare settings, and geographical regions. BIA is a valuable tool for healthcare decision-makers to assess the financial impact of introducing interventions into the healthcare system and to make informed decisions about resource allocation.[12-14] The BIA of AF-screening gives an understanding of the total financial burden of implementation. The incremental cost of implementing AF-screening, the net budget impact, compares the budget impact of screening with the current state of standard care. It presents any potential savings or extra spendings that the AF-screening induces and allows the budget holders to assess the overall budget impact.[13]

This study will estimate budget impact of AF-screening from a healthcare payer perspective in country-specific settings for Denmark, Germany, Ireland, Italy, Netherlands, Serbia, Spain, and Sweden. Country-specific parameters are used to allow for variations in healthcare systems, costs, population size, gender distribution, oral anti-coagulation treatment strategies, screening devices, and to meet the guidelines and needs of the healthcare sector in the country of interest. Previous BIAs regarding AF have studied the financial impact of different treatment strategies for detected AF. The motive has been that AF patients with moderate- and high risk for stroke should increase OAC use to decrease the clinical and economic burden of stroke. Generally, the results show cost savings as more effective treatment of AF results in fewer strokes.[15-18]

This study aims to estimate the financial impact of implementing systematic AF-screening of 75-year-olds compared with standard of care in eight European countries. A budget impact analysis is important since affordability is a critical factor for budget holders who need to make informed decisions on healthcare interventions and helps to quantify the potential budgetary effects of adopting new programs.

Methods

Budget impact model

This BIA is based on a cost-effectiveness (CE) model developed within the AFFECT-EU project (see *Figure 1*).[19] The eligible population is individuals aged 65 and over, given their higher risk of AF. The model consisted of two parts: the first is a decision tree describing the screening procedure. The second part is a Markov model tracking long-term costs and effects, including treatment with OACs and the risk of clinical events. First, the number of screening-detected people is determined by age- and gender-specific prevalence of known and unknown AF as well as the sensitivity of the screening device. The second part of the model consists of the three states: (i) detected AF, (ii) non-detected AF, and (iii) no AF, followed by states describing the OAC treatment and the risk of stroke, bleeding, and mortality. The clinical events included in the model were ischaemic stroke (IS), haemorrhagic stroke, other intracranial bleeding, extracranial bleeding (EB), and systemic embolism (SE). Risk stratification for IS is based on CHA2DS2-VASc, but no risk stratification was made for other events.

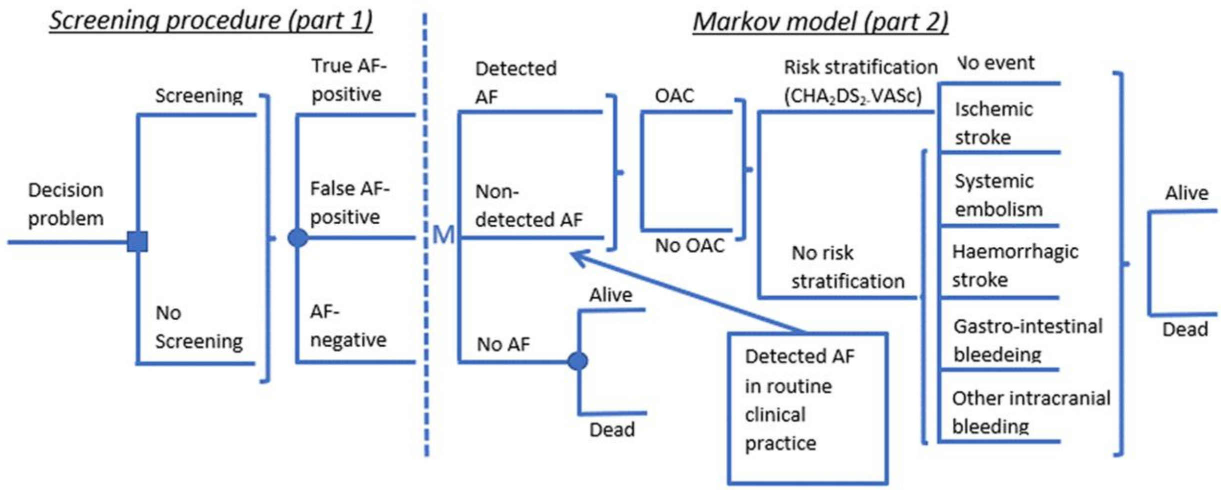

Figure 1 The AFFECT-EU cost-effectiveness model.

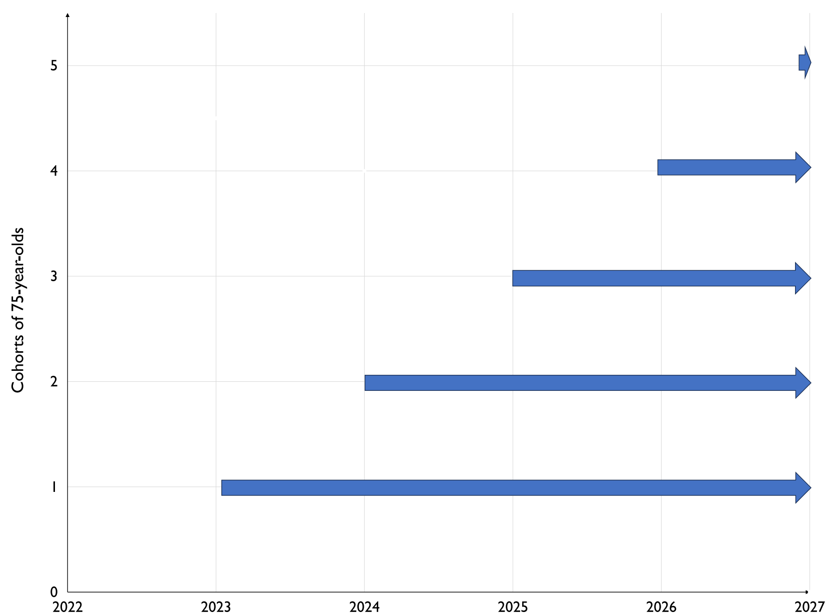

Figure 2 Description of open population where the 2023 cohort is followed up to 5 years, the 2024 cohort up to 4 years etc.

The BIA compares the financial impact of implementing AF-screening with the current strategy of no screening. The difference between these strategies is the net budget impact of implementing AF-screening, i.e. the potential added costs or cost savings of implementing AF-screening. The relevant costs are estimated and summed for the country-specific budget holder for both treatment strategies. The budget holders that are relevant in this study are the country-specific healthcare payer. Due to future external economic and political uncertainty budget holders typically have short-term budgets to adhere to. Hence, the BIA is performed with a 5-year time horizon.[12,20] Because of the short-term budgets there are no discounting in the model.[12–14,21]

The budget impact model is dynamic and considers various time-dependent factors such as patent expiration for direct oral anti-coagulants (DOACs), and age- and gender-dependent changes in the eligible population. The country-specific models are developed with country-specific parameters and allowed for several adjustments to fit the local healthcare systems. The country-specific inputs were OAC treatment strategies, AF-prevalence, screening yield and preferred screening device, mortality, participant rate, population size, budget holder, and cost estimates. The BIA reflects real-world conditions where a new cohort of 75-year-olds is added to the model annually (open population, as per *Figure 2*) and presents the total cost of implementing of AF-screening over 5 years. The budget impact per invitee was estimated and presents the 5-year cost of inviting one 75-year-old in 2023 (closed population).

Country-specific budget holder

In Denmark, 98% of the population has chosen to belong to insurance coverage group 1. Since retirees (age > 66–68) rarely have any additional private insurance, we do not account for

Table 1 Input parameters

	Denmark	Germany	Ireland	Italy	Netherlands	Serbia	Spain	Sweden
Participant rate	51%[39]	62%[40]	51%[39]	51%[39]	51%[39]	51%[39]	51%[39]	51%[39]
Screening costs (€)								
Screening invitation cost per invitee	1.57[41]	2.50[41]	1.46[41]	1.39[41]	1.75[42]	0.36[41]	1.22[41]	2.00[41]
Screening cost per participant	36[c]	28[a]	27[43]	220[b]	233[42]	42[43]	136[44]	235[43]
Choice of treatment, detected AF (%)								
DOAC	85.0%[c]	73.6%[a]	73.6%[a]	80.0%[d]	88.5%[45]	14.0%[46]	63.7%[47]	86.5%[48]
VKA	10.0%[c]	19.4%[a]	19.4%[a]	15.0%[d]	8.1%[45]	74.0%[46]	36.3%[47]	6.5%[48]
No treatment	5.0%[c]	7.0%[a]	7.0%[a]	5.0%[d]	3.4%[45]	12.0%[46]	0.0%[47]	7.0%[48]
Costs associated with newly detected AF (€)								
No. of cardiologist visits	1.00[49]	0.50[a]	[e]	1.00[f]	[e]	1.00[f]	1.00[f]	1.00[f]
No. of PHC visits	3.00[49]	1.00[a]	[e]	1.00[f]	[e]	1.00[f]	1.00[f]	1.00[f]
Unit cost cardiologist visit	265[50]	112[a]	[e]	125[51]	[e]	50[52]	150[53]	277[52]
Unit cost PHC visit	21[50]	13[a]	[e]	26[54]	[e]	35[55]	40[53]	193[55]
Total cost	328	118	225[56]	151	388[42]	85	190	470
DOAC (€)								
Annual drug cost	879[57]	1 038[58]	792[59]	506[g]	785[60]	506[61]	1 059[62]	631[61]
No. of cardiologist visits	0	0	[e]	0.50[f]	1.00[42]	0.50[f]	0.50[f]	0.50[f]
No. of PHC/GP visits	1[49]	1[a]	[e]	1.25[f]	0.50[42]	1.25[f]	1.25[f]	1.25[f]
Unit cost cardiology visit	[e]	[e]	[e]	125[51]	107[42]	34[52]	150[53]	186[52]
Unit cost PHC visit	21[50]	13[63]	[e]	26[54]	39[64]	35[55]	40[53]	193[55]
Physician visits total	21	13	231	95	127	60	125	334
VKA (€)								
Annual drug cost	128[65]	88[58]	28[59]	19[66]	54[60]	19[61]	21[67]	63[61]
No. of cardiologist visits	0	[e]	[e]	1.00[d]	1.00[42]	0.50[f]	[e]	0.50[f]
No. of PHC visits	0	[e]	[e]	1.00[d]	0.50[42]	0.50[f]	[e]	0.50[f]
Unit cost cardiology visit	[e]	[e]	[e]	125[51]	107[42]	34[52]	[e]	186[52]
Unit cost PHC visit	[e]	[e]	[e]	26[54]	39[64]	35[55]	[e]	193[55]
INR controls	1 116[49]	[g]	446[40]	432	167[42]	63	479[67]	349
Physician visits total	1 116	329	446	568	293	97	479	538
Ischaemic stroke (annual) (€)								
Inpatient (≤1 year)	15 626[68]	6 018[40]	9 805[69]	13 724[70]	29 850[42]	3 772[71]	6 563[72]	20 862[71]
Outpatient (≤1 year)	486[68]	4 014[73]	2 657[69]	—	2 994[42]	727[71]	2 979[72]	4 0234[71]
Other[h] (≤1 year)	—	8 331[73]	3 917[69]	—	10 069[42]	3 445[71]	—	—
Out- and inpatient (>1 year)	1 272[68]	4 331[73]	4 584[69]	10 618[74]	—	3 772[71]	2 353[75]	7 031[71]
Other[h] (>1 year)	—	948[73]	15 364[69]	—	6 628[42]	727[71]	—	—
Haemorrhagic stroke (annual) (€)								
Inpatient (≤1 year)	18 075[68]	13 182[40]	9 609[69]	22 084[70]	27 218[42]	5 878[71]	5 460[72]	32 510[71]
Outpatient (≤1 year)	146[68]	4 014[73]	3 565[69]	—	1 895[42]	647[71]	2 424[72]	3 576[71]
Other[h] (≤1 year)	—	8 331[73]	3 811[69]	—	10 069[42]	3 352[71]	—	—
Out- and inpatient (>1 year)	1 287[68]	4 331[73]	4 928[69]	10 618[74]	—	1 203[71]	2 353[75]	6 656[71]
Other[h] (>1 year)	—	948[73]	17 368[69]	—	6 628[42]	7 161[71]	—	—

Continued

Table 1 Continued

	Denmark	Germany	Ireland	Italy	Netherlands	Serbia	Spain	Sweden
Other events (per event) (€)								
Systemic embolism	3 696[49]	2 640[76]	3 975[69]	3 123[76]	1 992[42]	784[76]	2 723[76]	4 338[76]
Other internal bleedings	4 597[76]	3 446[76]	2 669[69]	4 075[76]	4 614[42]	1 024[76]	3 553[76]	5 661[76]
Extracranial bleeding	3 877[76]	2 906[76]	2 669[69]	3 437[76]	10 823[42]	863[76]	2 997[76]	4 775[76]

[a]R. Schnabel, personal communication. 22 February 2022.
[b]G. Boriani, Personal communication. 24 March 2022.
[c]J. H. Svendsen, personal communication. 30 March 2022.
[d]G. Boriani, personal communication. 12 March 2022.
[e]Not specified.
[f]L. Friberg, personal communication. 17 May 2021.
[g]G. Boriani, personal communication. 23 January 2023.
[h]Other costs include rehabilitation and home care services.

any additional insurance.[22] Group 1 covered patients are persons who do not pay out-of-pocket (OOP) for primary or specialist care. The budget holder of interest in Germany is the statutory health insurance (SHI), as 88% of the German population use the SHI and it is mandatory for everyone with an annual income below €60 750, including retirees (> 67 years).[23,24] Ireland has a medical scheme that gives most patients 65 years and older free general practitioner (GP) services and prescription drugs. Since most Irish retirees are on the scheme, this is the budget holder of interest. According to the Irish BIA-guidelines one should take value added tax (VAT) paid by the budget holder into consideration in the BIA.[13,25] But since there is no VAT on the costs considered in this model, VAT was excluded.[26] The national health service (NHS) covers all Italian healthcare costs[27,28] and is hence the budget holder of interest. In the Netherlands, healthcare insurances cover all healthcare costs. There are some deductibles and insurance premiums, but those are assumed to be paid irrespective of the implementation of AF-screening or not.[29,30] The Serbian healthcare system is mainly financed by the health insurance, Republic Foundation for Health Insurance (RFHI). There are some co-payments, but vulnerable groups and low-income individuals are exempt from this,[31] hence RFHI is the budget holder of interest. In Spain, all retirees (age > 65) are enrolled in a healthcare insurance system. Thus, the budget holder in the model is the Spanish national health system (SNS).[32] The Swedish healthcare system is mainly administered locally by regions and municipalities. The Ministry of Health and Social Affairs sets overall health policy, the regions finance and deliver healthcare services, and the municipalities are responsible for the care of the elderly and disabled.[33,34] While both primary and specialist care are covered by the regional healthcare systems, there are co-payments for patients younger than 85.[33] However, for the eligible population aged 75 or older, we assumed that the maximum ceiling for OOP payments is reached regardless of whether screening is implemented or not. Hence, the regions are the budget holders of interest.

Inputs

Cost parameters in the model are adjusted for country-specific healthcare inflation to 2023 by Harmonised Indices of Consumer Prices by Classification of Individual Consumption by Purpose (Coicop)-divisions.[35,36] Likewise, when needed, costs parameters are adjusted with healthcare Purchasing Power Parities[37] to fit the country of interest. The Danish and Swedish costs are recalculated to Euros by using the average August 2023 country-specific exchange rates.[38]

All cost parameters are presented in *Table 1*. To implement AF-screening, there is a cost for the invitation as well as the screening procedure. The latter is dependent on the cost of the screening device and the cost of interpreting the results. The devices used are a 12-lead ECG in Denmark, Germany, Ireland, and Serbia, handheld ECG in Netherlands, Spain and Sweden, and smartphones in Italy. In the Netherlands and Spain, there is an algorithm-based interpretation of the results while in the other countries there is a cardiologist interpretation. The sensitivity and specificity of the different screening devices can be found in Supplementary material online, *Table S1*. For newly detected AF, costs associated with primary health care (PHC), and/or cardiologist visits are included.

Atrial fibrillation patients are usually treated with OACs, and no other treatment is considered in the model. The treatment for those with detected AF is either DOACs, vitamin K antagonists (VKAs), or no treatment at all. First line treatment was DOAC in all countries except for Serbia where VKA is the primary treatment. It is estimated that most patients receive the same dose of drug for lifetime. In all countries except Germany and

Sweden, all drug costs were covered by the healthcare payer. In Germany, the model considers that there is a co-payment for the patients for each prescribed drug covered by the SHI. The co-payment is 10% of the cost with a maximum of €10 and minimum of €5.[23] This implies that since DOAC was on average prescribed 3 times a year, with a cost above €100 per prescription we estimated an annual OOP payment of €30 per patient. Vitamin K antagonist on the other hand was prescribed on average 7 times a year to a cost below €50 which gives an annual OOP cost of €35 per patient. In Sweden, drugs covered by the national drug benefit scheme are subsidized by the state, resulting in a rebate for the patient, while not covered drugs results in full price for the patient. Thus, the state reimburses the regions for all drug costs covered by the national drug scheme the year following their occurrence.[77] Nevertheless, all drugs are assumed to be covered by the national drug benefit scheme. Regardless of the type of OAC treatment, there are costs for control visits, including both cardiology, PHC, and international normalized ratio (INR) controls. The latter only applies for VKA treatments, which demand more intensive monitoring.

Costs for stroke include in- and outpatient care as well as home care services and special housing. These costs differ from the first-year post-stroke to the following years. In Denmark and Sweden, the healthcare payer covers in- and outpatient care but home care services, rehabilitations, and special housing were paid by the municipality.[22,33,34] Similarly, in Germany the statutory healthcare insurance covers in- and outpatient care and rehabilitation, while home care service and special housing is covered by the long-term care insurance in combination with some patient co-payments.[24,27,28] Likewise, the SNS in Spain covers direct healthcare costs, but there are some OOP payments of non-healthcare costs for the patient, family, and social service.[32]

Other event costs included in the model were SE, other internal bleedings, and EB. The cost for EB is assumed to be equal to gastrointestinal bleeding. All costs associated with other events are assumed to be paid by the healthcare systems. The CHA2DS2-VASc specific 3-months risks of ischaemic stroke for patients with DOAC, VKA, or no treatment as well as risk stratification for other events are described in Supplementary material online, *Table S2* and *S3*.

Due to patent expirations for DOACs, we performed sensitivity analyses where patents are expected to expire in 2026.[78] It is estimated that the proportion of patients treated with DOACs will increase, while the proportion receiving VKAs will decrease. This shift in proportions reflects the expected changes as DOACs become more widely available and affordable. Those proportions affect drug costs, physician visits associated with OAC treatment, cost of stroke, and other events. It also estimated that patent expiration of DOACs will decrease the annual cost of DOACs by 90%.

The age- and gender-divided population projections for the years 2023–2027 are retrieved from country-specific population databases (see Supplementary material online, *Table S4-S11*). Prevalent AF represent the number of individuals in the given age and gender group with known AF at the start of the year and incident AF present the number of individuals in the given age and gender group that get a non-screening-detected AF-diagnosis during the year. In the Netherlands, the projections are retrieved in 5-year age-groups (65-69, 70–74, 75-79, etc.), therefore a fixed population growth rate, as well as gender- and age-distribution is used to estimate the annual population. The same was done for Serbia where the population projections are in 5-year age-groups and 5-year intervals (2021, 2026, 2031).

The prevalence of known AF by sex and age is based on the average prevalence of seven published studies.[3,79-84] Smoothing with linear interpolation was used to obtain 1-year intervals out of the original prevalence (5- or 10-year intervals). The prevalence of unknown AF by sex and age were taken from a large meta-analysis investigating newly detected AFs found in various screening studies.[85] The number of screening-detected AFs was generated by multiplying the proportion of unknown AF with the number of screened individuals and with a device-specific sensitivity. To assess the impact of the screening yield, the number of patients with spontaneously found asymptomatic AF was subtracted from the cumulative number of patients with screening-detected AFs. The proportion of spontaneous detection of asymptomatic AF was estimated to 5% per year for patients with a screening-detected AF.[86] Detailed tables are found in Supplementary material online, *Table S12*.

Results

Total budget impact of implementing population atrial fibrillation-screening

With the current standard of care, no population-based AF-screening, a large share of the costs was stroke-related costs. In most countries, costs for stroke had the largest budget impact in the no-screening analysis, while in Denmark it was the cost of drugs (see *Figure 3A* and *B* and *Table 2*). Since the cost of physician, specialist visits, and drug prescriptions generally increases with age, there was an increase in control visits as well as drug costs over time. The share of the other costs decreased over the studied time horizon. As there was an open population, the annual total costs increased as the number of detected AF increased. As the screening cost only applied to the new cohort of 75 years old entering the population each year the annual screening cost was approximately the same.

In Italy, the Netherlands, Serbia, Spain, and Sweden, the largest share of the budget impact of AF-screening was associated with screening costs followed by stroke costs (see *Figure 4*). In Denmark, Germany, and Ireland, the largest shares were from drug costs and stroke costs. Figures of the budget impact of AF-screening and no screening in total and per invited can be found in Supplementary material online, *Figures S1 and S2*.

The net budget impact showed that implementation of AF-screening, increased savings of stroke-related costs in all countries since screening for AF decreased the number of strokes. It also increased the number of detected AF which in turn increased costs for physician visits for newly detected AF, drug costs, and OAC-treatment control visits. More detected AFs increased the use of OACs, which in turn increased the costs of bleedings. The increasing net budget impact was mainly driven by increased drug costs and screening costs.

Five-year budget impact of atrial fibrillation-screening per invitee

The per invitee budget impact of no screening for AF varied from €93 in Serbia to €364 in Germany (*Table 2*), and the budget impact of AF-screening per invitee varied from €114 in Serbia to €450 in the Netherlands (*Table 3*). Thus, the net budget impact per invited varied from €10 in Ireland to €122 in the Netherlands. These differences were mainly driven by the fact that Italy and the Netherlands had among the highest screening costs.

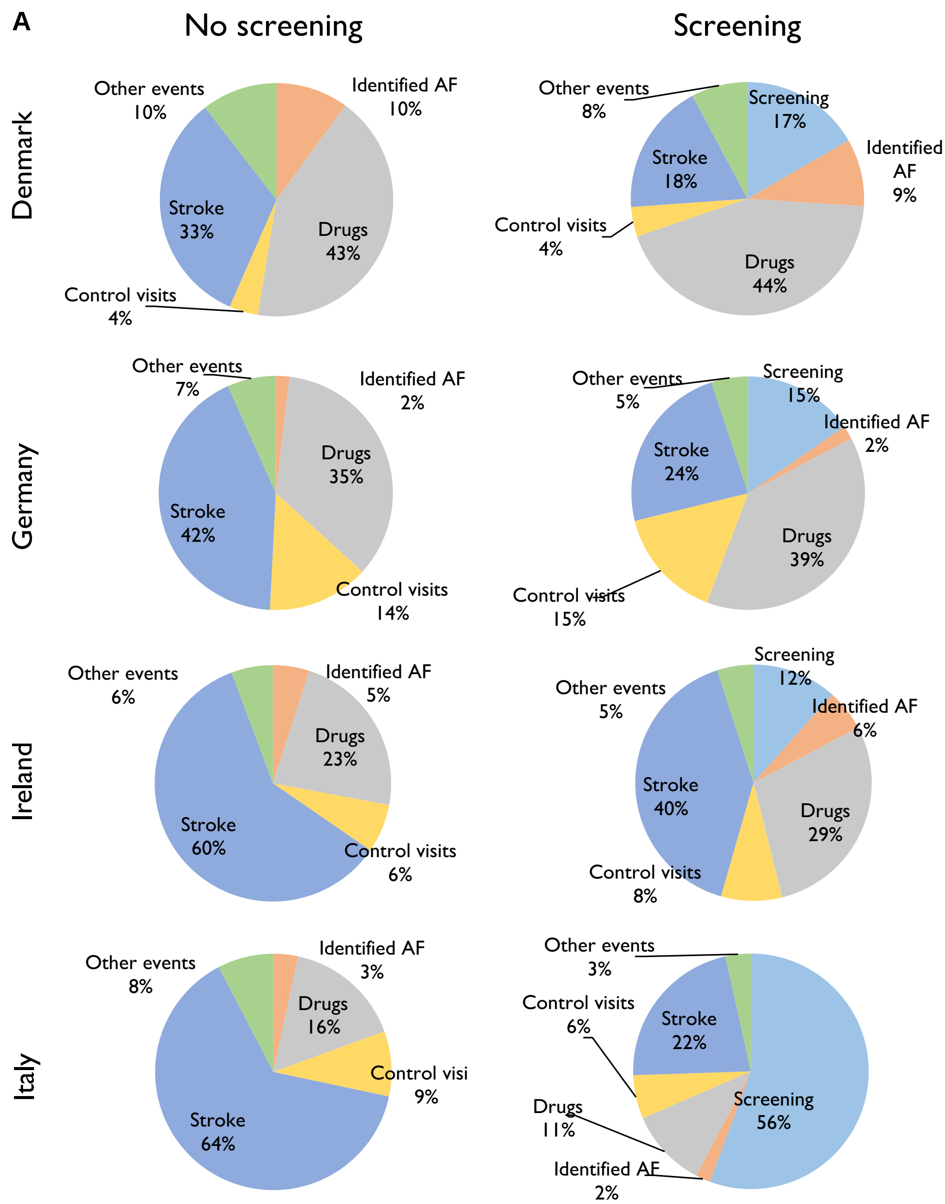

Figure 3 (*A*, *B*) Budget impact of no screening and screening divided into different cost types (%). Note: Identified AF = AF investigation and treatment initiation. Control visits = controls for OAC treatment. Other events include costs for systematic embolism and bleedings.

Sweden and Ireland had the largest savings in stroke costs of €31 per invitee. In both Germany and Sweden, there were other budget holders that pay for parts of the drug costs; hence, the healthcare payers had lower drug costs per invitee. Similarly in Denmark, Germany, Italy, Spain, and Sweden, there were other payers who received lower costs due to reduced number of strokes. Since Denmark, the Netherlands and Sweden had higher unit costs for physician visits, there were a larger increase of physician visit costs associated with AF investigation and treatment initiation in these countries.

There was an increase in the net budget impact per invitee (*Figure 5*) the first year following implementation of AF-screening, which then declined in the following years. This was due to the screening costs which only occur the first year. The following years it show cost savings for all countries except for Germany to implement AF-screening. But in the longer run it seems to be a trend towards cost savings in all countries.

Sensitivity analyses

Sensitivity analyses were performed assuming that the patent for DOACs will expire in 2026 (*Table 4*). Due to the BIAs short time horizon, these changes had a marginal decreasing effect on the net budget impact of AF-screening for all countries.

Discussion

This is the first study that has estimated the added cost and/or cost savings of implementing an AF-screening

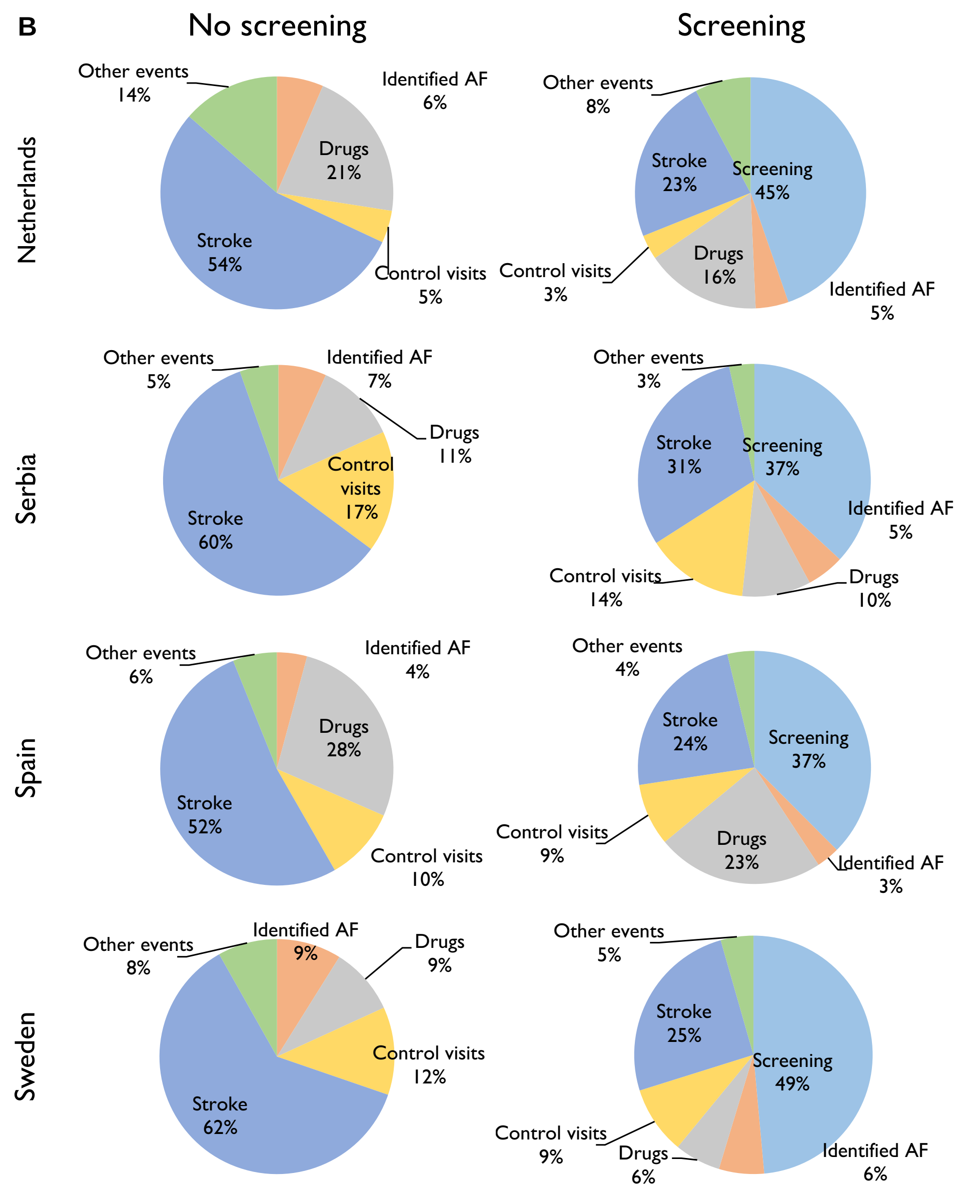

Figure 3 Continued

program for 75-year-olds in eight European countries (Denmark, Germany, Ireland, Italy, Netherlands, Serbia, Spain, and Sweden) from a healthcare payer perspective. Based on the results similar conclusions can be drawn in each country, AF-screening incurs savings of stroke-related costs since early detection of AF and subsequent preventative treatment reduces the number of AF-related strokes. However, the increased number of detected AF and higher drug acquisition will increase the drug costs as well as the costs of physician- and control visits. Increased use of OACs also increases the number of bleedings and bleeding-associated costs. The results showed that the increased costs of implementing AF-screening were mainly driven by increased drug and screening costs. However, the drug cost will decrease with introduction of generic DOACs, even if this decrease is counterbalanced by the screening cost during the five years included in this BIA. By estimating the 5-year cost per invited in 2023, we showed that the cost per invited is decreasing over time. The cost per invitee is decreasing annually towards cost saving in each country. The cost per invitee varies between countries, this is mainly explained by differences in cost of preferred screening devices.

The cost per quality adjusted life years measure is an important basis for priority setting, summarizing the cost and health effect over a lifelong perspective. It has previously been shown that implementation of population screening for AF is cost-effective in 75-year-olds.[43] Further opportunistic screening of AF in 65-year-olds and older is cost-effective.[42,69,87] This means that AF-screening is money well spent and

Table 2 Cumulative budget impact of atrial fibrillation-screening 2023-2027 (in million Euros)

	Den	Ger	Ire	Ita	Net	Ser	Spa	Swe
n (millions of 75-year-olds 2023-2027)	0.29	4.02	0.19	3.19	0.74	0.31	2.13	0.50
Budget impact of no AF-screening								
AF investigation and treatment initiation	2.42	6.85	1.03	9.34	8.53	0.75	9.54	5.68
Drugs	10.24	127.09	4.75	44.47	27.70	1.27	62.23	5.90
Control visits OAC	0.96	51.22	1.37	24.64	5.91	1.90	23.14	7.71
Stroke	7.93	154.87	12.35	177.26	71.79	6.62	118.70	31.55
Other events	2.53	24.44	1.18	21.16	17.92	0.60	13.89	5.21
Total cost	24.07	364.46	20.68	276.88	131.85	11.15	227.51	124.18
Budget impact of AF-screening								
Screening	5.70	78.64	2.83	359.87	111.43	6.81	148.82	60.30
AF investigation and treatment initiation	3.19	9.58	1.38	13.00	11.49	0.96	12.82	7.60
Drugs	14.92	197.06	7.04	69.89	40.34	1.76	92.14	7.78
Control visits	1.40	79.05	2.03	38.73	8.61	2.63	34.26	11.45
Stroke	6.25	121.42	9.90	142.52	57.97	5.64	93.89	39.24
Other events	2.66	26.09	1.21	22.46	19.50	0.64	14.83	5.50
Total cost	34.11	511.83	24.39	646.46	249.34	18.45	396.76	63.74
Net budget impact of AF-screening								
Screening	5.69	78.64	2.83	359.87	111.43	6.81	148.82	60.30
AF investigation and treatment initiation	0.77	2.73	0.35	3.66	2.96	0.21	3.28	1.92
Drugs	4.67	69.98	2.28	25.42	12.65	0.49	29.91	1.88
Control visits	0.44	27.82	0.66	14.08	2.70	0.74	11.12	3.74
Stroke	−1.67	−33.45	−2.45	−34.74	−13.82	−0.99	−24.82	−7.69
Other events	0.14	1.65	0.04	1.29	1.57	0.04	0.94	0.29
Total cost	10.04	147.37	3.72	369.59	117.49	7.30	169.25	63.74

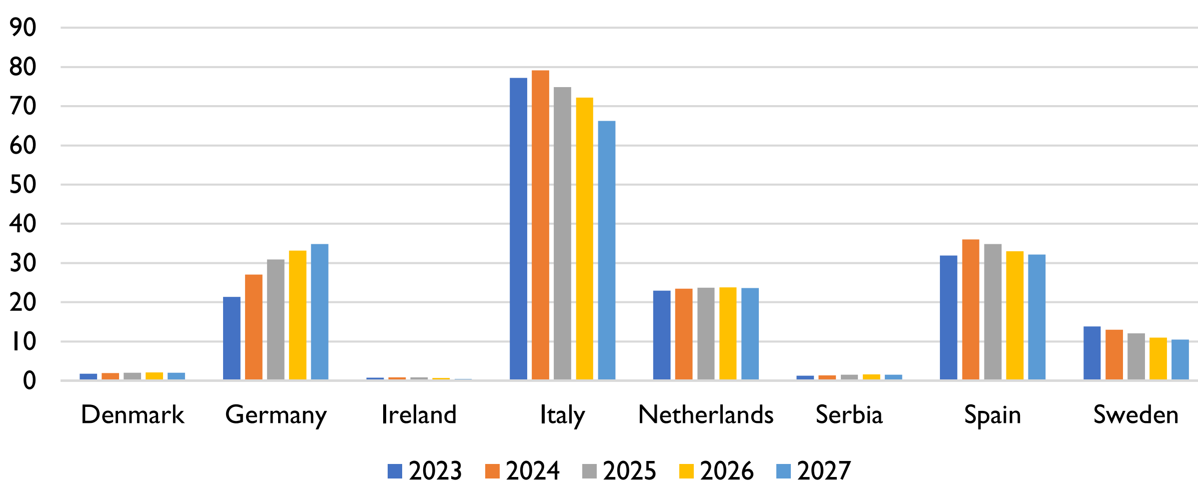

Figure 4 Annual net budget impact of atrial fibrillation-screening, total population (in million euros).

should be highly prioritized and implemented in healthcare systems. As an addition to these CE analyses, this BIA estimates the budget impact of AF-screening which can serve as the basis for affordability assessments. In this BIA, we show that there are relatively low added costs of implementing AF-screening in the studied countries. Even though systematic detected AF may not result in better prognosis than spontaneously detected AF, we have shown that systematic screening of 75-year-olds will incur important savings in stroke-related costs.

A BIA requires accurate and reliable data for costs and resource utilization both regarding the AF-screening and the current standard of care. The complexity of healthcare systems could make it challenging to collect such data. Therefore, estimates are collected from up-to-date, relevant sources and clinical trials. However, the availability and quality of valid estimates for input parameters differs between countries. Allowing for several budget holders for the same cost category catches some of the complexity in the country-specific healthcare systems. However, assumptions and estimates

Table 3 Five-year budget impact of atrial fibrillation-screening per invited (per 75-year-old) in 2023 (in Euros)

	Den	Ger	Ire	Ita	Net	Ser	Spa	Swe
Budget impact of no AF-screening								
AF investigation and treatment initiation	16	3	11	6	18	5	9	22
Drugs	83	80	62	35	74	11	71	22
Control visits	8	32	18	19	16	16	26	36
Stroke	69	93	172	132	177	57	136	175
Other events	18	13	13	14	43	5	14	22
Total cost	194	222	275	206	328	93	256	277
Budget impact of AF-screening								
Screening	20	20	15	113	120	22	70	121
AF investigation and treatment initiation	19	4	12	7	21	6	10	25
Drugs	108	108	81	48	96	13	92	26
Control visits	10	44	23	26	21	20	34	48
Stroke	55	75	140	108	146	49	111	144
Other events	19	14	14	15	46	5	15	23
Total cost	231	265	285	316	450	114	332	387
Net budget impact of AF-screening								
Screening	20	20	15	113	120	22	70	121
AF investigation and treatment initiation	3	1	2	1	3	1	1	4
Drugs	26	28	19	13	22	3	21	3
Control visits	2	11	6	7	5	4	8	12
Stroke	−14	−18	−31	−24	−30	−7	−25	−31
Other events	1	1	0	1	3	0	1	1
Total cost	34	43	10	110	122	22	77	110

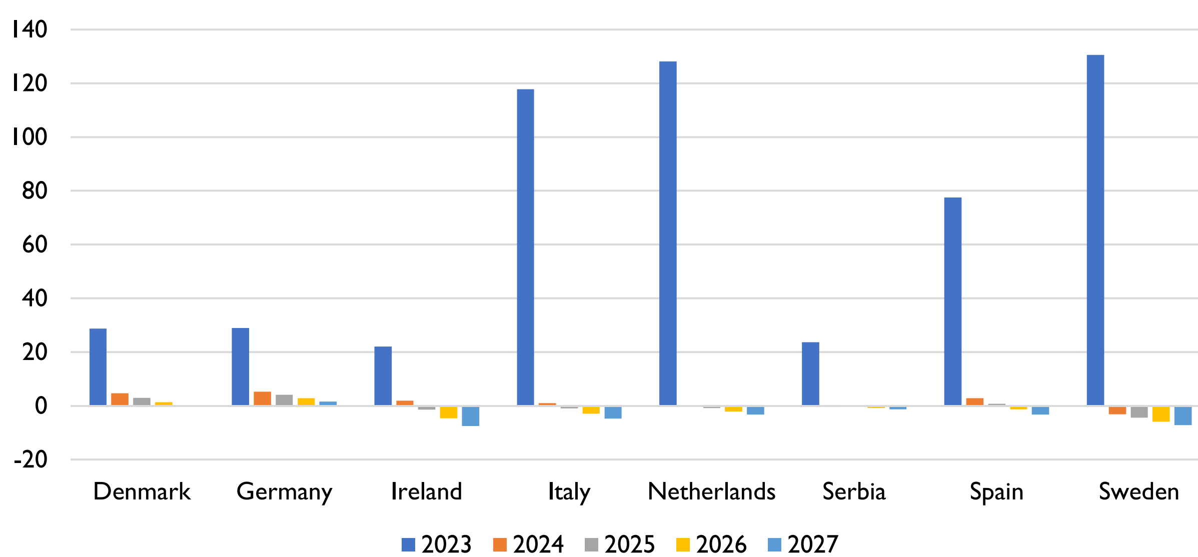

Figure 5 Annual net budget impact of atrial fibrillation-screening per invited in 2023 (in euros).

create uncertainties throughout the model. The BIA's short 5-year time horizon may not capture long-term effects, such as shifts in the prevalence of the condition treated or changes in healthcare resource utilization. The transferability of the budget impact results to other countries which were not object of this study is limited, due to differences in population sizes and structures, cost estimation methods, healthcare systems and economic development levels. The results are also limited to 75-year-old participants and are not valid for a younger population. The total budget impact of AF-screening presents the total added cost of implementation in each country while the budget impact per invitee presents the added costs over 5 years for one invited 75-year-old in 2023. The latter is comparable between the studied countries.

Table 4 Budget impact of atrial fibrillation-screening, 2023-2027, direct oral anti-coagulant patent expiration (in million Euros)

	Den	Ger	Ire	Ita	Net	Ser	Spa	Swe
n	0.29	4.02	0.19	3.19	0.74	0.31	2.13	0.50
Budget impact of no AF-screening								
AF investigation and treatment initiation	2.42	6.85	1.03	9.34	8.53	0.75	9.54	5.68
Drugs	3.19	35.56	1.45	12.56	8.21	0.61	19.03	0.65
Control visits	0.98	42.87	1.45	22.13	5.86	1.64	21.15	7.97
Stroke	7.92	154.78	12.34	177.22	71.79	6.61	118.63	30.82
Other events	2.52	24.38	1.17	21.13	17.92	0.60	13.84	5.23
Total cost	17.03	264.44	17.44	242.38	112.31	10.20	182.19	93.62
Total cost 75-year-old[a]	144	170	239	182	282	87	212	116.95
Budget impact of AF-screening								
Screening	5.69	78.64	2.83	359.87	111.43	6.81	148.82	60.30
AF investigation and treatment initiation	3.19	9.58	1.39	13.00	11.49	0.96	12.61	7.60
Drugs	5.48	67.72	2.54	24.79	14.22	0.86	32.46	0.86
Control visits	1.41	66.21	2.11	34.96	8.53	2.22	30.50	11.84
Stroke	6.26	121.93	9.93	142.75	58.00	5.70	95.83	38.80
Other events	2.66	25.94	1.21	22.39	19.49	0.63	14.66	5.23
Total cost	24.69	370.03	19.99	597.75	223.15	17.18	334.89	143.90
Total cost per invitee[a]	173	203	243	288	397	108	281	58.34
Net budget impact of AF-screening								
Screening	5.69	78.64	2.83	359.87	111.43	6.81	148.82	60.30
AF investigation and treatment initiation	0.77	2.73	0.35	3.66	2.96	0.21	3.08	1.92
Drugs	2.29	32.16	1.09	12.23	6.00	0.25	13.44	0.21
Control visits	0.44	23.35	0.66	12.82	2.67	0.58	9.35	3.87
Stroke	−1.67	−32.85	−2.42	−34.47	−13.79	−0.91	−22.80	−7.98
Other events	0.13	1.56	0.03	1.26	1.57	0.03	0.82	0.30
Total cost	7.66	105.59	2.55	355.37	110.84	6.98	152.70	58.61
Total cost per invitee[a]	29	33	4	106	115	21	70	106

[a]Not in millions.

Conclusion

In conclusion, across Europe, though the initial cost of screening and more frequent use of OACs will increase the healthcare payers' costs, introducing population screening for AF will result in savings of stroke costs.

Supplementary material

Supplementary material is available at *European Heart Journal Supplements* online.

Acknowledgements

We thank Christian Kronborg, Wim Lucassen, Maartje S. Jacobs, Aileen Callanan, and Breda Smyth for data and contributions to the model.

Funding

This work has received funding from the European Union's Horizon 2020 research and innovation programme under the grant agreement No 847770 (AFFECT-EU). Data from the LOOP Study was used and LOOP was supported by Innovation Fund Denmark [grant number 12-1352259], The Research Foundation for the Capital Region of Denmark, The Danish Heart Foundation [grant number 11-04-R83-A3363-22625], Aalborg University Talent Management Program, Arvid Nilssons Fond, Skibsreder Per Henriksen, R og Hustrus Fond, the European Union's Horizon 2020 program [grant number 847770 to the AFFECT-EU consortium], Læge Sophus Carl Emil Friis og hustru Olga Doris Friis' Legat, and an unrestricted grant from Medtronic. R.B.S. has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme under the grant agreement No 648131, from the European Union's Horizon 2020 research and innovation programme under the grant agreement No 847770 (AFFECT-EU) and German Center for Cardiovascular Research (DZHK e.V.) (81Z1710103 and 81Z0710114); German Ministry of Research and Education (BMBF 01ZX1408A) and ERACoSysMed3 (031L0239). Wolfgang Seefried project funding German Heart Foundation. From the European Union's Horizon Europe research and innovation programme under the grant agreement No. 101095480 (HYPERMAKER).

Conflict of interest: M.E., J.L., L.B., and K.A. report no conflicts of interest. L.Å.L. has received lecture fees and advisory board fees from BMS/Pfizer, Bayer, Boehringer Ingelheim, and Zenicor and own stocks in Astra Zeneca. J.H.S. reports to be a member of Medtronic and Vital Beats advisory boards and to have received speaker honoraria and research grants from Medtronic. R.B.S. has received lecture fees and advisory board fees from BMS/Pfizer and Bayer outside this work. D.E. reports no conflicts of interest. C.M. and C.W. are employees of the Institute for Epidemiology, Statistics and Informatics GmbH. The Institute for Epidemiology, Statistics and Informatics GmbH has

received grants from Astra Zeneca, Bayer, Bristol-Myers Squibb and CSL Behring outside the submitted work. S.Z.D. reports consultancy fees from VitalBeats, BMS/Pfizer, Cortrium, and Acesion Pharma, speaker grants from BMS/Pfizer and Bayer, and travel grants from Abbott and Boston Scientific. G.B. reports speaker's fees of small amount from Bayer, Boehringer Ingelheim, Boston, Daiichi Sankyo, Janssen, and Sanofi outside of the submitted work. C.M.B. reports no conflicts of interest.

Data availability

Data available on request.

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