Rev Esp Cardiol. 2025;78(5):389–400

Original article

The European Society of Cardiology quality indicators in atrial fibrillation in centers of excellence in Spain: the SEC-EXCELENTE FA registry

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Article history:
Received 13 June 2024
Accepted 28 August 2024
Available online 18 September 2024

Keywords:
Atrial fibrillation
Quality indicators
Outcomes
Accreditation programs

ABSTRACT

Introduction and objectives: By 2022, 9 centers had been accredited by the Spanish Society of Cardiology for the atrial fibrillation (AF) process. Our objective was to evaluate the performance of these centers based on the quality indicators (QIs) proposed by the European Society of Cardiology (ESC) in 2020.
Methods: Adults with AF who were attended in the cardiology departments of participating centers during the second week of May 2019 were included in a retrospective registry (n = 797, age 72 ± 11 years, 60% male). Key ESC QIs were assessed.
Results: CHA_2DS_2-VASc, HAS-BLED scores, and serum creatinine levels were documented in 24.9%, 6.1%, and 96.2% of patients, respectively. Anticoagulation was appropriately prescribed in 90.6% of high-risk patients according to the CHA_2DS_2-VASc score, but was inappropriately prescribed in 57.8% of low-risk patients. Among all patients, 84.1% received high-quality anticoagulation. Inappropriate antiarrhythmic drugs were prescribed in 7.2% of patients with permanent AF, 2.9% of those with structural heart disease, and 0.0% of those with end-stage kidney disease. Catheter ablation was offered to 70% of patients with symptomatic paroxysmal or persistent AF after the failure or intolerance of 1 antiarrhythmic drug. All modifiable risk factors were documented in 59.3% of patients. Rates of all-cause mortality, ischemic stroke or transient ischemic attack, and major bleeding were 8.1, 0.8, and 2.56 per 100 patients/y, respectively. QIs for anticoagulation and outcomes were similar between general cardiology and tertiary referral centers.
Conclusions: Although accredited centers in Spain demonstrated good performance in many of the ESC QIs for AF, there remains room for improvement. These data could serve as a starting point for enhancing the quality of care in this population.

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◇ The investigators of the SEC-EXCELENTE FA registry are listed in the supplementary data.

https://doi.org/10.1016/j.rec.2024.08.007

Los indicadores de calidad de la Sociedad Europea de Cardiología en fibrilación auricular en centros de excelencia en España: el registro SEC-EXCELENTE FA

Palabras clave:
Fibrilación auricular
Indicadores de calidad
Resultados
Programas de acreditación

RESUMEN

Introducción y objetivos: En 2022 estaban acreditados por la Sociedad Española de Cardiología en el proceso fibrilación auricular (FA) 9 centros. Nuestro objetivo es evaluar los indicadores de calidad (InCal) propuestos por la Sociedad Europea de Cardiología (ESC) en 2020 en estos centros.

Métodos: Se incluyó a los adultos con FA atendidos en los servicios de cardiología participantes en la segunda semana de mayo de 2019 en un registro retrospectivo (n = 797; edad, 72 ± 11 años; el 60% varones), y se evaluaron los principales InCal de la ESC.

Resultados: Las escalas CHA_2DS_2-VASc, HAS-BLED y la creatinina sérica estaban documentadas en el 24,9, el 6,1 y el 96,2% de los pacientes. Se prescribió anticoagulación apropiadamente según el CHA_2DS_2-VASc al 90,6% en alto riesgo, e inapropiadamente al 57,8% en bajo riesgo; al 84% se le prescribió anticoagulación con calidad adecuada. En FA permanente, cardiopatía estructural o nefropatía terminal, la prescripción inapropiada de antiarrítmicos fue del 7,2, el 2,9 y el 0%. Se ofreció ablación tras fracaso o intolerancia de un antiarrítmico al 70% de pacientes con FA sintomática paroxística o persistente. Se documentaron todos los factores de riesgo modificables en el 59,3% de los pacientes. Las tasas de mortalidad total, ictus o accidente isquémico transitorio y sangrado mayor fueron 8,1, 0,8 y 2,56/100 pacientes/año. Los InCal en anticoagulación y resultados fueron similares en los centros básicos y de referencia.

Conclusiones: Aunque los centros acreditados en España mostraron un buen desempeño en muchos InCal de la ESC, hay oportunidades para la mejora. Estos datos pueden constituir un punto de partida para mejorar la calidad de la atención a esta población.

Abbreviations

AF: atrial fibrillation
ESC: European Society of Cardiology
QI: quality indicators
RECALCAR: Resources and Quality in Cardiology (*REcursos y CALidad en CARdiología*)
SEC: Spanish Society of Cardiology (*Sociedad Española de Cardiología*)

INTRODUCTION

Atrial fibrillation (AF) is a major public health problem, with a huge and growing burden of morbidity and mortality.[1] The 2020 European Society of Cardiology (ESC) guidelines on AF proposed a set of quality indicators (QIs) aimed at improving the quality of AF care,[2,3] and granted a Class IIa recommendation to the introduction of tools to measure the quality of care and identify opportunities to improve treatment quality and patient outcomes in AF.[2] However, there are limited data on the evaluation of these QI in clinical settings.[4–6] In 2016, the Spanish Society of Cardiology (SEC) launched a strategy for quality improvement in cardiovascular disease, known as SEC-CALIDAD (SEC-Quality), which includes several key elements available on the SEC website.[7] One of these elements, the RECALCAR registry,[8–17] compiles data on discharges from all public Spanish hospitals, with information on resources, personnel, activity, and the structure of each cardiology unit. Another key component of the SEC-CALIDAD strategy is the SEC-EXCELENTE accreditation program. A set of processes and procedures were selected for accreditation based on their priority, as determined by the Quality Committee of the SEC; among these were heart failure[18,19] and AF processes. This voluntary accreditation process was offered to all cardiology units in Spain by the SEC, which also encouraged them to apply. By 2022, 9 centers had been granted SEC-EXCELENTE accreditation.

Our main objective was to evaluate the main QIs proposed by the ESC in 2020 in these centers. A secondary objective was to identify possible associations of these QI with the resources and structure of participating centers.

METHODS

The SEC-EXCELENTE in AF accreditation process

Since 2017, all interested centers have been required to submit a formal application to the SEC, including documentation proving compliance with the minimum requirements for the initial SEC-EXCELENTE accreditation in AF, which are available on the SEC website[7] and detailed in table 1. Once compliance with these quality standards is verified, the unit receives an initial accreditation. A reaccreditation is planned 5 years after the initial accreditation, based on participation in a registry and an evaluation of results.

The SEC-EXCELENTE FA registry: overall description of the project

By 2022, all units with SEC-EXCELENTE in AF accreditation participated in a retrospective, observational, noninterventional registry with single access to patients' clinical histories. This registry was planned in 2 phases. In the first phase, the objective was to evaluate the QI defined in the SEC-EXCELENTE in AF process. Based on these data, a comprehensive report—containing both global and detailed results for each center—was sent to the person responsible for the AF process and the head of department at each center. They were tasked with evaluating the results, sharing the data with health care professionals, and designing and implement-

Table 1
Characteristics and required standards of the centers with the SEC-EXCELENTE in atrial fibrillation accreditation in Spain

	General cardiology centers	Tertiary referral centers
Organizational and process structure		
An agreement between the stakeholders and institutions based on a regionally based care agreement that includes commitments to key performance indicators	Yes	Yes
An operational committee that addresses the elements of the program	Yes	Yes
An organizational chart	Yes	Yes
Portfolio of services, facilities, and equipment		
Provision of inpatient, outpatient, and day hospital care	Yes	Yes
Presence of an on-duty cardiologist 24 h/d, 7 d/wk, 365 d/y	Yes	Yes
Availability of:		
Hematological studies and routine clinical analysis	Yes	Yes
Electrocardiography	Yes	Yes
Transesophageal and transthoracic echocardiography	Yes	Yes
Holter and mid-term noninvasive electrocardiographic registries	Yes	Yes
Cardiac catheterization	Yes	Yes
Cardiac MRI and coronary CT	Yes	Yes
Electrophysiology laboratory with catheter ablation techniques	No	Yes
Implantation of cardiac implantable electronic devices (pacemakers, resynchronization therapy, internal defibrillators)	No	Yes
Cardiovascular surgery service	No	Yes
Hematology service with anticoagulation expertise	Yes	Yes
Human resources		
A responsible physician for the atrial fibrillation process must be formally appointed	Yes	Yes
A multidisciplinary atrial fibrillation team comprising at least one cardiologist, 1 internist, 1 emergency medicine specialist, 1 representative of the physicians in the primary care teams within the hospital catchment area	Yes	Yes
Process		
Development of a process for atrial fibrillation management, agreed by members of the multidisciplinary team, which must fulfil the diagnostic criteria and therapeutic management recommendations of the ESC guidelines	Yes	Yes
Information systems		
The cardiology unit should participate in the registries of the Spanish Society of Cardiology	Yes	Yes
The cardiology unit should implement a standardized discharge form, in all inpatients and outpatients, with a minimum standard dataset	Yes	Yes

ing quality improvement measures. A second phase of data collection is planned for the future to measure changes in QIs. This study describes the evaluation of the main ESC QIs in AF during the first phase of the registry.

Inclusion criteria

All adults (age $\geq$ 18 years) with a diagnosis of AF, whether previously established or made during medical attention from May 6 to 12, 2019, in the participating cardiology units (both outpatient clinics and hospitalization wards), were included in the registry, with no exclusion criteria. At that time, most centers had committed to managing patients with AF according to SEC-EXCELENTE standards, and a 7-day period was considered sufficient to balance feasibility and representativeness. Data from the Minimum Basic Dataset of hospital discharges were not suitable for this purpose, as outpatients are not yet included in this database. The date of inclusion was based on either the outpatient clinic visit or the date of hospital discharge.

Study procedures and ethical issues

There was only 1 study procedure, which involved accessing patients' clinical records to collect baseline and follow-up variables, followed by an anonymization process to permanently dissociate personal data from the clinical information included in the database. The principal investigator at each center (the person responsible for the AF process), in agreement with the head of department, appointed clinicians with care responsibilities to collect and anonymize the data. These clinicians were either clinical cardiologists or cardiology residents, working under the supervision of the principal investigators, who were electrophysiologists in 4 tertiary centers and clinical cardiologists in the remaining units. All variables were entered into an online database platform provided by the SEC, which included tools to ensure data validity and integrity. The study protocol was approved by the Research Ethics Committee of each center and complied with the recommendations of the Declaration of Helsinki for medical research. Since the study data were purely clinical-care, anonymous, and dissociated from personal information, the Research Ethics Committees determined that informed consent was not necessary.

Study variables

Demographic and clinical data were collected, with a focus on risk factors, established heart disease, comorbidities, thrombotic and bleeding scores, AF characterization, procedures, physical

examinations, complementary tests, antithrombotic management, and concomitant treatment. The presence of CHA_2DS_2-VASc and HAS-BLED scores in medical records was noted, and these scores were independently calculated using available variables. All patients were followed up until December 31, 2022, with records of stroke, transient ischemic attack, major bleeding (as defined by the International Society on Thrombosis and Haemostasis)[20] and all-cause death. The main QIs were calculated according to ESC definitions.[3] Data on the structure and resources of centers were obtained from the 2019 RECALCAR survey, categorizing centers into 2 types: those with arrhythmia units offering AF ablation programs and cardiac surgery facilities (tertiary referral hospitals) and those without (basic cardiology hospitals). All centers had a cardiology department with an outpatient clinic, hospitalization wards, and echocardiography and catheterization laboratories. Baseline data and QIs were compared between the 2 types of centers.

Statistical analysis

Quantitative variables were tested for normality and are expressed as mean ± standard deviation or median (25th-75th percentile), as appropriate. Qualitative variables are reported as numbers and percentages, with 95% confidence intervals provided for QIs. Event incidences are described as rates per 100-patients/y. The Student *t* test for independent data, Mann Whitney U test and chi-square test were used, as appropriate, to compare subgroups of variables. For QI comparisons, odds ratios and confidence intervals were calculated. Crude values were adjusted for variables with an imbalance between groups with a *P* value $< .1$ (table 2) using multivariable logistic regression models, with general cardiology centers as the reference group. For mortality, stroke or transient ischemic attack and major bleeding rates, hazard ratios and confidence intervals were calculated, and adjusted similarly using

Table 2
Baseline features of the patients according to the type of inclusion center

Variable	All series	General cardiology centers	Tertiary referral centers	*P*
Number of patients	797	175	622	
Demographics				
Age, y	72 ± 12	73 ± 10	71 ± 6	.105
Age > 75	346 (43.5)	79 (45.7)	267 (42.9)	.52
Sex (male)	476 (59.7)	112 (64.0)	364 (58.5)	.192
Hospitalized at inclusion	180 (22.6)	17 (9.7)	163 (26.2)	< .000
Risk factors				
Hypertension	548 (68.8)	126 (72.0)	422 (67.8)	.295
Diabetes	211 (26.5)	47 (26.9)	164 (26.4)	.897
Smoker (last year)	58 (7.4)	13 (7.8)	45 (7.3)	.834
Hypercholesterolemia	422 (54.9)	85 (55.6)	337 (54.7)	.850
Excessive alcohol intake	33 (4.3)	8 (5.1)	25 (4.1)	.574
Obesity	193 (37.3)	23 (30.3)	170 (38.5)	.172
Sedentary lifestyle	598 (78.1)	98 (65.3)	500 (81.2)	< .000
Cardiological history				
Previous heart disease	487 (61.1)	114 (65.1)	373 (60.0)	.215
Previous admission for heart failure	194 (24.3)	45 (25.7)	149 (24.0)	.632
Ischemic heart disease	190 (23.8)	35 (20.0)	155 (24.9)	.177
Percutaneous revascularization (stents)	122 (15.3)	23 (13.1)	99 (15.9)	.368
Coronary surgery	44 (5.5)	5 (2.9)	39 (6.3)	.081
At least moderate valvular heart disease	277 (34.8)	56 (32.0)	221 (35.5)	.386
Mitral stenosis (moderate-severe) or mechanical valve prosthesis	51 (6.4)	6 (3.4)	45 (7.2)	.069
Cardiomyopathy	59 (7.4)	13 (7.4)	46 (7.4)	.988
Other heart disease	70 (8.8)	22 (12.6)	48 (7.7)	.045
Comorbidities				
Renal failure	260 (32.6)	49 (28.0)	211 (33.9)	.140
Peripheral artery disease	48 (6.0)	9 (5.1)	39 (6.3)	.580
Previous stroke/transient ischemic attack	100 (12.5)	20 (11.4)	80 (12.9)	.613
Chronic obstructive pulmonary disease/asthma	107 (13.4)	17 (9.7)	90 (14.5)	.103
Sleep apnea/hypopnea	65 (8.7)	12 (8.1)	53 (8.8)	.792
Anemia	200 (25.1)	30 (17.1)	170 (27.3)	.006
Dementia	31 (3.9)	8 (4.6)	23 (3.7)	.597
Peptic ulcer disease	38 (4.8)	7 (4.0)	31 (5.0)	.589
Chronic liver disease	27 (3.4)	4 (2.3)	23 (3.7)	.362
Cancer history	115 (14.4)	21 (12.0)	94 (15.1)	.301
Risk scales				
CHA_2DS_2-VASc score	3.4 ± 1.8	3.3 ± 1.7	3.4 ± 1.9	.632
HAS-BLED score	1.8 ± 1.2	1.6 ± 1.0	1.8 ± 1.2	.030
Charlson score	2.4 ± 2.3	2.1 ± 2.0	2.5 ± 2.3	.056

Table 2 *(Continued)*
Baseline features of the patients according to the type of inclusion center

Variable	All series	General cardiology centers	Tertiary referral centers	*P*
Atrial fibrillation characteristics				
Type of atrial fibrillation				
First diagnosis	68 (8.6)	21 (12.1)	47 (7.6)	.008
Paroxysmal	297 (37.7)	47 (27.2)	250 (40.7)	
Persistent	113 (14.3)	33 (19.1)	80 (13.0)	
Long-standing persistent	32 (4.1)	9 (5.2)	23 (3.7)	
Permanent	278 (35.3)	63 (36.4)	215 (35.0)	
European Heart Rhythm Association functional class				
1 No symptoms	387 (49.1)	97 (56.4)	290 (47.1)	.073
2a Mild symptoms	218 (27.7)	48 (27.9)	170 (27.6)	
2b Moderate symptoms	99 (12.6)	14 (8.1)	85 (13.8)	
3 Severe symptoms	77 (9.8)	11 (6.4)	66 (10.7)	
4 Disabling symptoms	7 (0.9)	2 (1.2)	5 (0.8)	
Previous procedures				
Electrical cardioversion	163 (20.5)	38 (21.7)	125 (20.1)	.639
Pulmonary vein ablation	61 (7.7)	3 (1.7)	58 (9.3)	.001
Arrhythmia surgery	10 (1.3)	1 (0.6)	9 (1.4)	.358
Atrioventricular node ablation	13 (1.6)	2 (1.1)	11 (1.8)	.564
Left atrial appendage percutaneous closure	5 (0.6)	0 (0.0)	5 (0.8)	.234
Pacemaker/resynchronization therapy/Implantable defibrillator	105 (13.2)	21 (12.0)	84 (13.5)	.603
Physical exam				
Body mass index, kg/m^2	29 ± 5	28 ± 5	29 ± 5	.347
Systolic pressure, mmHg	128 ± 21	130 ± 22	128 ± 20	.386
Diastolic artery pressure, mmHg	75 ± 13	78 ± 13	74 ± 13	.022
Baseline heart rate, bpm	75 ± 18	74 ± 19	75 ± 17	.577
Complementary tests				
Sinus rhythm at inclusion visit	322 (42.9)	76 (46.9)	246 (41.8)	.248
Bundle brunch block				
No	588 (78.5)	129 (81.6)	459 (78.5)	.461
Right bundle branch block	69 (9.2)	14 (8.9)	55 (9.3)	
Left bundle branch block	77 (13.0)	92 (12.3)	15 (9.5)	
Left atrial enlargement	463 (68.2)	117 (78.0)	346 (65.4)	.003
Left ventricle ejection fraction	57 ± 13	59 ± 9	56 ± 13	.02
Anticoagulation prescribed in first visit				
No	98 (12.3)	22 (12.6)	76 (12.2)	.174
Vitamin K oral anticoagulants	239 (30.0)	41 (23.4)	198 (31.8)	
Direct oral anticoagulants	454 (57.0)	111 (63.4)	343 (55.1)	
Low molecular weight heparin	6 (0.8)	1 (0.6)	5 (0.8)	
Concomitant treatment				
Antiarrhythmic drugs	218 (27.4)	30 (17.1)	188 (30.2)	.001
Platelet aggregation inhibitors	100 (12.5)	18 (10.3)	82 (13.2)	.307
Digoxin	87 (10.9)	18 (10.3)	69 (11.1)	.762
Beta-blockers	544 (68.3)	119 (68.0)	425 (68.3)	.934
Verapamil/diltiazem	47 (5.9)	12 (6.9)	35 (5.6)	.542
ACEI/angiotensin receptor blockers/sacubitril-valsartan	442 (55.5)	111 (63.4)	331 (53.2)	.016
Statins	410 (51.4)	87 (49.7)	323 (51.9)	.605
Proton pump inhibitors	358 (44.9)	79 (45.1)	279 (44.9)	.946
Nonsteroidal antiinflammatory drugs	34 (4.3)	4 (2.3)	30 (4.8)	.142

ACEI, angiotensin conversing enzyme inhibitors.
Quantitative data are shown as mean ± standard deviation, and qualitative data as No. (%).

multivariate Cox proportional hazards models. SPSS software version 25.0 (IBM Corporation, United States) was used and $P < .05$ values were considered statistically significant.

RESULTS

Baseline features of the sample

A total of 797 patients were included in the study (age 72 ± 11 years, 60% men figure 1), representing 100% of all patients with AF attended during the inclusion week. Most participants were outpatients at the time of inclusion. The most common risk factors were a sedentary lifestyle and hypertension. Over half of the patients had heart disease, with the most frequent being valvular heart disease, followed by ischemic heart disease. Nearly 25% had a history of heart failure, and 6.4% had at least moderate mitral stenosis or a mechanical prosthesis. Common comorbidities included renal failure and anemia. The average CHA_2DS_2-VASc, HAS-BLED, and Charlson scores were 3.4 ± 1.8, 1.8 ± 1.2, and 2.4 ± 2.3, respectively. Most patients had paroxysmal or permanent AF and were either asymptomatic or mildly symptomatic. The mean ejection fraction was within the normal range, and most patients had left atrial dilation. Anticoagulation therapy was prescribed in 87.7% of patients, with 57% receiving direct oral anticoagulants. The most common concomitant treatment was beta-blockers, and 27.4% of patients were prescribed antiarrhythmic drugs (table 2).

ESC quality indicators in AF

The ESC Qis are detailed in table 3 and figure 1. In domain 1 (patient assessment), the highest indicator was the documentation of renal function (96.2%), while documentation of CHA_2DS_2-VASc and HAS-BLED scores was low (24.9%) and very low (6.1%), respectively. Nevertheless, the variables needed to calculate these scores were available in all patients. In domain 2 (anticoagulation), a high rate of appropriate anticoagulation in high-risk patients and a high quality of anticoagulation were observed. Conversely, the high rate of anticoagulation in low-risk patients was notable, and anticoagulation quality was assessed in just over half of the patients.

In domains 3 and 4 (rate and rhythm control), inappropriate use of antiarrhythmics was low, and more than 70% of symptomatic patients with paroxysmal or persistent AF were offered ablation after failure or intolerance of antiarrhythmics, although this QI could only be assessed in 30 patients (figure 1 of the supplementary data). In domain 5, all 7 modifiable risk factors were identified, as proposed by the ESC, in only 59.3% of the patients. When analyzed individually, all factors were included in > 90% of reports, except for obesity: weight and height were recorded in the clinical history in only 65% of patients.

Finally, in domain 6 (outcomes), the annual rates of total mortality, ischemic stroke/transient ischemic attack, and major bleeding were 8.1 (n = 126 patients), 0.8 (n = 13 patients), and 2.56 (n = 33 patients) per 100-patients/y, respectively. Vital status was known in all patients at the end of follow-up; 33% (42/126) of deaths were due to cardiovascular causes, and 12 patients died from unknown causes. The registry did not include data on mortality or major complications related to procedures or severe adverse events related to medications. Additionally, none of the centers used validated health-related quality of life scales in routine clinical practice.

Baseline features of patients and quality indicators in AF of the ESC according to the center complexity

A total of 3 hospitals were classified as general cardiology centers, and 6 were tertiary referral centers. Tertiary referral

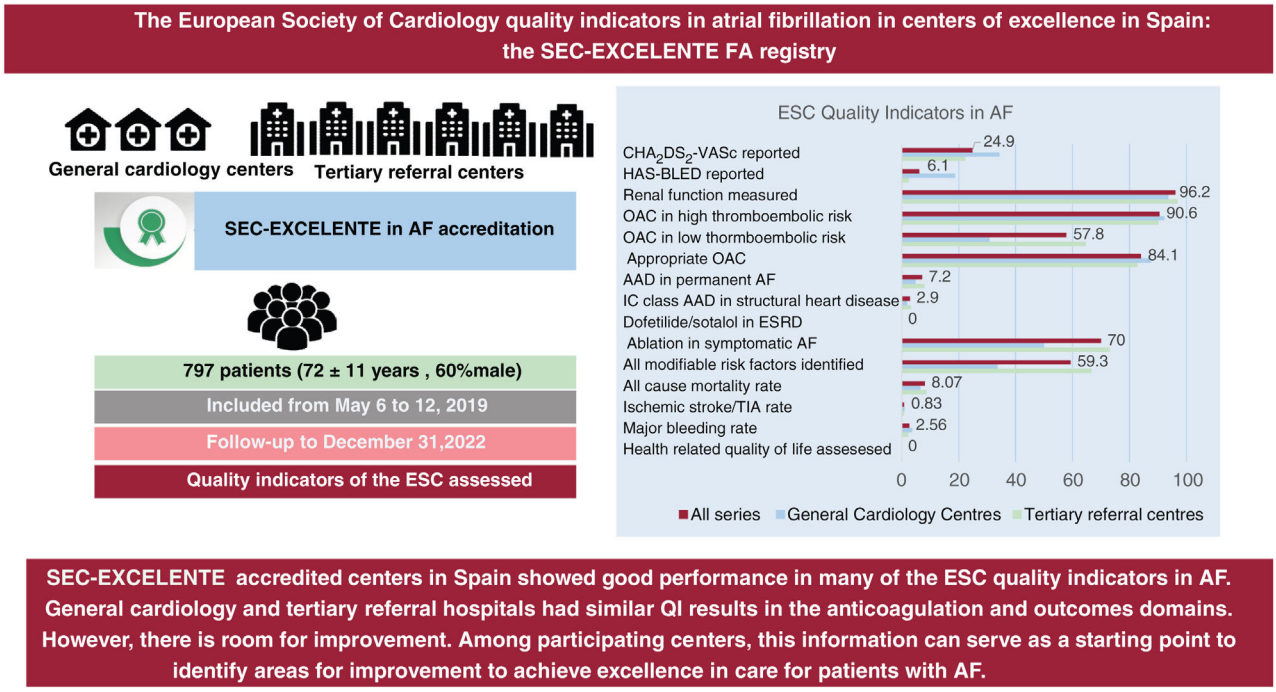

Figure 1. Central illustration. ESC quality indicators in AF management in 9 Spanish centers with SEC-EXCELENTE in AF accreditation. AAD, antiarrhythmic drugs; AF, atrial fibrillation; ESC, European Society of Cardiology; ESRD, end-stage renal disease; OAC, oral anticoagulation; SEC, Spanish Society of Cardiology (*Sociedad Española de Cardiología*); TIA, transient ischemic attack.

Table 3
Quality indicators of the European Society of Cardiology in centers with SEC-EXCELENTE in atrial fibrillation accreditation in Spain

Quality indicators	All series	General cardiology centers	Tertiary referral centers	Crude OR[a] (95%CI)	*P*	Adjusted OR[a] (95%CI)	*P*
Domain 01: patient assessment							
01MQI1. Proportion of patients with cardio-embolic risk assessment using CHA_2DS_2-VASc score	195/782 (24.9 [21.9-27.9])	59/172 (34.3 [27.2-41.4])	136/610 (22.3 [18.9-25.5])	0.55 (0.39-0.79)	.001	0.54 (0.35-0.83)	.005
01MQI2. Proportion of patients with bleeding risk assessment using a validated method, such as the HAS-BLED score	47/768 (6.1 [4.4-7.8])	32/170 (18.8 [12.9-24.7])	15/598 (2.5 [1.3-3.8])	0.11 (0.06-0.21)	< .000	0.09 (0.04-0.20)	< .000
01MQI3. Proportion of patients with a measurement of their serum creatinine (or creatinine clearance)	767/797 (96.2 [94.9-97.5])	164/175 (93.7 [90.1-97.3])	603/622 (96.9 [95.5-98.3])	2.13 (1.00-4.56)	.047	2.94 (1.09-7.91)	.032
Domain 02: anticoagulation							
02MQI1. Proportion of patients who are appropriately prescribed anticoagulation according to CHA_2DS_2-VASc score[b,c]	618/682 (90.6 [88.4-92.8])	144/156 (92.3 [88.1-96.5])	474/526 (90.1 [87.6-92.7])	0.76 (0.40-1.46)	.409	0.66 (0.30-1.44)	.293
02MQI2. Proportion of patients with a CHA_2DS_2-VASc score of 0 for men and 1 for women who are inappropriately prescribed long-term anticoagulation[c]	37/64 (57.8 [45.7-69.9])	4/13 (30.8 [5.7-55.9])	33/51 (64.7 [51.6-77.8])	4.13 (1.11-15.29)	.027	1.79 (0.11-29.63)	.685
02MQI3. Proportion of anticoagulated patients with "appropriate anticoagulation"[d]	322/383 (84.1 [80.4-87.8])	85/97 (87.6 [81.0-94.2]))	237/286 (82.9 [78.5-87.3])	0.68 (3.47-1.35)	.268	0.72 (0.33-1.57)	.408
Proportion of anticoagulated patients with data enough for evaluating anticoagulation quality	383/674 (56.8 [53.1-60.5])	97/147 (66.0[58.3-73.7])	286/527 (54.3 [50.1-58.6])	0.61 (0.42-0.90)	.011	0.54 (0.34-0.86)	.009
Domain 03: rate control							
03MQI1. Proportion of patients with permanent atrial fibrillation who are inappropriately prescribed antiarrhythmic drugs	20/278 (7.2 [4.2-10.2])	3/63 (4.8 [0.0-10.1])	17/215 (7.9 [4.3-11.5])	1.72 (0.49-6.06)	.396	2.82 (0.56-14.13)	.207
Domain 04: rhythm control							
04MQI1. Proportion of patients with structural heart disease who are inappropriately prescribed class IC antiarrhythmic drugs	14/487 (2.9 [1.4-4.4])	2/114 (1.8 [0.0-4.2])	12/373 (3.2 [1.4-5.0])	1.86 (0.41-8.44)	.413	6.08 (0.58-64.16)	.133
04MQI2. Proportion of patients with end-stage kidney disease who are inappropriately prescribed dofetilide or sotalol	0/6 (0.0)	0/1 (0.0)	0/5 (0.0)	NA	1.000	NA	NA
04MQI3. Proportion of patients with symptomatic paroxysmal or persistent AF who are offered AF catheter ablation after failure of, or intolerance to, one class I or class III antiarrhythmic drug	21/30 (70 [53.6-86.4])	2/4 (50 [1.0-99.0])	19/26 (73.1 [56.1-90.2])	2.71 (0.32-23.14)	.348	NA	NA
Domain 05: risk factor management							
05MQI1. Proportion of patients who have their modifiable risk factors identified[e]	473/797 (59.3 [55.9-62.7])	59/175 (33.7 [26.7-40.7])	414/622 (66.6 [62.9-70.3])	3.91 (2.74-5.58)	< .000	3.03 (2.04-4.53)	< .000
At least 6 modifiable risk factors identified[e]	741/797 (93 [91.2-94.8])	142/175 (81.1 [75.3-86.9])	599/622 (96.3 [94.8-97.8])	6.05 (3.45-10.63)	< .000	1.73 (0.69-4.31)	.242
Hypertension documented[f]	778/797 (97.6 [96.5-98.7])	171/175 (97.7 [95.7-100])	607/622 (97.6 [96.4-98.8])	0.95 (0.31-2.89)	.923	0.22 (0.03-1.93)	.172
Diabetes mellitus documented[f]	787/797 (98.7 [97.9-99.5])	169/175 (95.6 [92.6-98.6])	618/622 (99.4 [98.8-100.0])	5.49 (1.53-19.66)	.003	0.83 (0.05-13.34)	.899
Smoking documented[f]	783/797 (98.2 [97.3-99.1])	167/175 (95.4 [92.3-98.5]))	616/622 (99.0 [98.2-99.8])	4.92 (1.68-14.37)	.001	1.55 (0.35-6.95)	.564
Obesity documented[g]	518/797 (65.0 [61.7-68.3])	76/175 (43.4 [36.1-50.7])	442/622 (71.1 [67.5-74.7])	3.20 (2.26-4.52)	< .000	2.30 (1.55-3.43)	< .000
Sleep apnea documented[f]	751/797 (94.2 [92.6-95.8])	148/175 (84.6 [79.3-90.0])	603/622 (96.9 [95.5-98.3])	5.79 (3.13-10.70)	< .000	6.18 (2.80-13.62)	< .000
Excessive alcohol intake documented[f]	775/797 (97.2 [96.1-98.4])	158/175 (90.3 [85.9-94.7])	617/622 (99.2[98.5-99.9])	13.28 (4.83-36.54)	< .000	1.64 (0.02-116.22)	.821
Sedentary lifestyle documented[f]	766/797 (96.1 [94.8-97.4])	150/175 (85.7 [80.5-90.9])	616/622 (99.0[98.2-99.8])	17.11 (6.90-42.46)	< .000	13.60 (5.22-35.40)	< .000

Table 3 *(Continued)*
Quality indicators of the European Society of Cardiology in centers with SEC-EXCELENTE in atrial fibrillation accreditation in Spain

Quality indicators	All series	General cardiology centers	Tertiary referral centers	Crude OR[a] (95%CI)	*P*	Adjusted OR[a] (95%CI)	*P*
Domain 06: outcomes							
Subdomain 06.1. Consequences of the disease							
06.1MQI1. Annual rate of all-cause mortality[h]	126/1562 (8.07 [6.72-9.42])	27/411 (6.57 [4.18-8.97])	99/1151 (8.60 [6.98-10.22])	1.35 (0.88-2.07)[9]	.192	1.07 (0.66-1.74)[8]	.776
06.1MQI2. Annual rate of ischemic stroke or transient ischemic attack[h]	13/1562 (0.83 [0.38-1.28])	4/411 (0.97 [0.02-1.92])	9/1151 (0.78 [0.27-1.29])	0.80 (0.25-2.61)[9]	.711	0.52 (0.15-1.86)[8]	.313
Subdomain 06.2. Consequences of treatment							
06.2MQI1. Annual rate of life-threatening or major bleeding[h] events[g]	40/1562 (2.56 [1.78-3.34])	15/411 (3.65 [1.84-5.46])	25/1151 (2.17 [1.33-3.01])	0.70 (0.34-1.46)[9]	.094	0.45 (0.19-1.06)[8]	.069
06.2MQI2. Annual rate of procedure-related 30-day mortality	NA	NA	NA	NA	NA	NA	NA
06.2MQI3. Annual rate of procedure-related major complications or drug-related serious adverse events	NA	NA	NA	NA	NA	NA	NA
Subdomain 06.3. Patient-reported outcomes							
06.3MQI1. Proportion of patients with health-related quality of life assessment	0/797 (0.0)	0/175 (0.0)	0/622 (0.0)	NA	1.0	NA	NA

95%CI, 95% confidence interval; NA, not available; OR: odds ratio.
All values are expressed as numerator/valid denominator (percentage [95% confidence interval]).
[a] General cardiology centers as the reference category.
[b] Appropriateness of anticoagulation prescription was defined as CHA_2DS_2-VASc score of ≥ 1 for men and ≥ 2 for women as in the 2020 ESC Guidelines.
[c] Excluding at least moderate mitral stenosis and mechanical valve prosthesis.
[d] Anticoagulation was considered "appropriate" if time in therapeutic range was at least 70% for vitamin K antagonists, or the dose was correct according to the manufacturer's recommendations for direct anticoagulants.
[e] Modifiable risk factors: hypertension, diabetes mellitus, smoking, obesity, sleep apnea, excessive alcohol intake, and sedentary lifestyle.
[f] A risk factor was considered documented when its presence or absence was explicitly mentioned in the clinical record.
[g] Obesity was considered documented if weight and height were recorded in the clinical record.
[h] Expressed as number of events/total years of follow-up (rate per 100 patients/y) but compared by univariate and multivariate Cox proportional hazards models, with [i]hazard ratios and 95% confidence intervals calculated.

centers had significantly more cardiologists, a greater number of total hospitalization beds, more cardiology hospital discharges, and more outpatient clinic visits. These centers also performed a significantly higher number of percutaneous cardiac structural procedures, cardiac electronic device implantations, and AF ablation procedures (table 1 of the supplementary data).

Patients in tertiary referral centers were more frequently hospitalized at the time of inclusion and exhibited a higher prevalence of sedentary lifestyle, anemia, paroxysmal AF, previous pulmonary vein ablation, and antiarrhythmic drug prescriptions. They also had higher HAS-BLED scores and showed a trend toward higher Charlson indices, more severe symptoms, and a higher frequency of coronary surgery and mitral stenosis or mechanical valve prosthesis. Conversely, the frequency of atrial enlargement was lower in this group; these patients had a lower left ventricular ejection fraction, and renin-angiotensin system blockers were less frequently prescribed (table 2).

In general cardiology centers, CHA_2DS_2-VASc and HAS-BLED scores were more frequently documented, and inappropriate anticoagulation in low-risk patients was less common. Conversely, renal function and all modifiable risk factors were more frequently documented in tertiary referral centers. Despite these differences, both groups had a similar and high proportion of high-risk patients prescribed anticoagulation and those with appropriate anticoagulation. However, data availability for evaluating the quality of anticoagulation was higher in general cardiology centers. No significant differences were observed in QI in other domains.

After multivariate adjustment for unbalanced baseline features, the differences in inappropriate anticoagulation for low-risk patients disappeared. Discrepancies in the assessment of modifiable risk factors were primarily related to obesity, sedentary lifestyle, and sleep apnea, which were more frequently documented in tertiary referral centers. No significant differences were found in the outcomes domain QIs between the groups after adjustment (table 3).

DISCUSSION

The main findings of this study are that, in centers with SEC-EXCELENCE in AF accreditation in Spain, the results for several key QI were acceptable, particularly in the domains of outcomes, rate control, rhythm control, and select aspects of patient assessment and anticoagulation. However, worse values were found in areas such as documentation of cardioembolic and bleeding risk, anticoagulation in low-risk patients, risk factor management, and patient-reported outcomes, suggesting a need for significant improvement in these areas. Notably, most QI values were similar, independently of the complexity of the center, with few exceptions, mainly in patient assessment and risk factor management domains, but not in the outcomes domain.

Previous studies assessing quality indicators

Three previous studies have examined the QI in AF proposed by the ESC.[4–6] The BALKAN-AF survey included 2712 patients from 49 centers in 7 Balkan countries from December 2014 to February 2015, but without follow-up.[4] The ChiOTEAF registry included 6420 patients aged $\geq$ 65 years, with 1-year follow-up, in a prospective registry conducted between October 2014 and December 2018 in 44 centers in China.[5] The Danish AF registry evaluated several ESC QI in > 100 000 patients from 2017 to 2021.[6] This national-scale registry based on administrative databases includes nearly all Danish AF patients, except those exclusively attended in private cardiology or primary care facilities.

While these registries provide a strong foundation for understanding QI assessment in AF, they have limitations. The BALKAN-AF study could not assess outcome domain QIs, and results from the ChiOTEAF and Danish AF registries may not be directly applicable to Spain due to differences in racial characteristics, health care systems, and access to anticoagulants. Previous studies in Spain, published in 2012 and 2016, reported care indicators in 160 and 533 patients from 1 and 2 tertiary Spanish hospitals, respectively, but were conducted before the ESC QIs were available[21,22] and lacked follow-up data. Moreover, these studies did not explore the possible association of the type of center with the QI in patients with AF. Therefore, our study provides a contemporary evaluation of the QI proposed by the ESC, including the outcome domain, in a Spanish sample including centers of varying complexity.

Quality indicators: patient assessment and anticoagulation

Renal function was documented in 96.2% of patients, which is higher than the BALKAN-AF[4] and ChiOTEAF[5] registries (76.1% and 81.5%, respectively) and similar to the Danish AF registry[6] (93%). A possible reason for these discrepancies is the different timing of recruitment, as the implementation of recommendations is expected to improve over time. Our low rates of recording cardioembolic and bleeding risk scores compare unfavorably with other registries, which report figures of more than 90%.[4,5] However, the proportion of patients receiving anticoagulation among those with high cardioembolic risk was 90.6%, similar to the 90.4% reported by the Danish registry in 2021, and higher than the 74.4% and 44.7% reported by other registries.[4,5] Although the data from the BALKAN AF[4] registry could be explained by the timing of inclusion (the Danish AF registry observed an increase in this proportion from 85.3% in 2017 to 90.4% in 2021), the 44.7% reported by the ChiOTEAF registry suggests that other factors may affect the underuse of anticoagulants in this population. The high proportion of anticoagulation in low-risk patients in our series (57.8%) has also been reported in other studies (39%-60%).[4,5,21] Some of these patients could be in the pre- or postcardioversion or postablation period, but therapeutic inertia or the low rate of documentation of the CHA_2DS_2-VASc score, combined with the mistaken perception of higher embolic than bleeding risk, could contribute to this issue. Although all efforts were made by investigators to avoid missing any embolic risk factors during data collection, it is impossible to ensure that this was not the case in some instances.

Quality indicators: rate and rhythm control

Antiarrhythmic drugs were inappropriately prescribed in 7.2% of patients with permanent AF, which is similar to the percentages reported in other studies (3.6% and 10%).[4,5] No patients with end-stage kidney disease received dofetilide or sotalol, and 2.9% of those with structural heart disease were prescribed Class IC antiarrhythmic drugs, which is consistent with previous reports (0.7% and 2.2%).[4,5] Although these QI values are low, they represent a clear opportunity for improvement. None of the previous registries assessed the proportion of patients with symptomatic paroxysmal or persistent AF who were resistant to or intolerant $\geq$ 1 class I or III antiarrhythmic drug and were offered catheter ablation. While the 70% observed in our study is promising, it

should be interpreted with caution due to the clearly insufficient sample size to draw solid conclusions

Quality indicators: risk factor management

Most risk factors were correctly documented, except for obesity: weight and height were recorded in in the electronic medical record in only 65% of patients. A reporting bias for obesity (ie, weight and height being more frequently registered in obese patients) could partly explain the high obesity rate in our sample (37.3%), which is higher than that reported in other studies (5.4% and 24.7%).[4,5] Other series including consecutive AF patients attended in cardiology outpatient clinics in Spain have reported a prevalence of obesity ranging from 10% to 26.2%.[22,23] However, another Spanish study described a body mass index of 29.2 ± 3.9 kg/m^2, which is nearly identical to the 29 ± 5 kg/m^2 found in our series. Notably, the prevalence of obesity in the general population in Spain was 15.7% in 2020,[24] suggesting that it is unlikely to be lower in AF patients. For the other risk factors, the prevalence in our study was similar to that in previous studies.[4,5,21–23,25]

Quality indicators: outcomes

The rate of stroke/transient ischemic attack in our study (0.83/100-patients/y) was identical to that reported by the Danish AF registry for 2019 (0.83/100-patients/y),[6] and similar to another contemporary Spanish study (1.07/100-patients/y)[23] and the ChiOTEAF registry (1.1/100-patients/y).[5] The rate of major bleeding was 2.23/100-patients/y for 2019 in the Danish registry,[6] which is very similar to the rate in our study (2.56/100-patients/y). However, this rate was 1.6/100-patients/y in the ChiOTEAF registry,[5] possibly related to the lower anticoagulation rate in that work. For all-cause mortality, our rate (8.07/100-patients/y) was similar to those of other Spanish series (8.24/100-patients/y),[23] but slightly higher than that reported by the ChiOTEAF registry (6.8/100-patients/y).[5] This last result is somewhat surprising, given that the median age in our study was 76 years, compared with a mean age of 72 years in our work and 73.8 years in the other Spanish registry.[23] However, the 95% confidence interval for this QI in our series [6.72-9.42/100-patients/y] included the rate reported by the ChiOTEAF registry.[5] In all 3 studies, most deaths were noncardiovascular.

Validated health-related quality of life scales were not used in routine clinical practice in our study. The BALKAN-AF study[4] reported the frequency of "patient-reported outcomes", but the description of the data suggested that these outcomes were mainly "physician perceived symptoms". In contrast, the ChiOTEAF registry[5] measured quality of life outcomes using visual analog scales. The 2020 ESC AF guidelines recommend routine collection of patient-reported outcomes,[2] but this objective should be achieved using validated tools.[3] Implementing these measurements in daily clinical practice will clearly be a challenge for health care centers in the coming years.[26]

Assessment of quality indicators by center complexity

To the best of our knowledge, the present study is the first to describe results by center complexity in the AF process. Although some differences were observed in the domains of patient evaluation and risk factor management, the QIs for anticoagulation and outcome domains were not significantly different, suggesting that general cardiology centers can achieve the same quality of care in the AF process as tertiary referral centers. Notably, the inclusion period preceded the publication of the QIs. However, although physicians were not aware of them at the time, many of the QIs of the SEC-EXCELENTE in AF[7] overlap with those of the ESC, which could partly explain the observed results.

Clinical implications

The main clinical implication of this work is that it highlights the importance of evaluating the quality of care using robust indicators, such as those proposed by the ESC. Identifying opportunities to improve the quality of care is the only way to address gaps in patient management. We believe that systematically monitoring QIs, as proposed by the ESC guidelines, could be an effective way to achieve this objective, both at a national and European level.

Limitations

The main limitation of this study is that the sample size was insufficient to precisely estimate some of the QIs (eg, ablation offered to symptomatic patients with AF), and therefore these results must be interpreted with caution. In addition, details of clinical events were not revised by an independent committee, nor was an external audit performed. Furthermore, the inclusion of patients treated by cardiologists exclusively limits our conclusions to this specialty. In addition, these data represent the performance of 9 centers with an active interest in improving AF management, which may not be representative of national health care in Spain. Therefore, comparisons with other registries that are nearly all-inclusive, such as the Danish registry,[6] are applicable only to this set of cardiology units. The causes of 12 deaths were unknown, and consequently the true number of events may be underestimated. Moreover, hospital admissions in private centers could have been missed as events. Equally, we were unable to evaluate the secondary QIs proposed by the ESC. Finally, we were unable to assess the true adherence of patients with prescribed medications or follow-up, as we only had access to physicians' prescription at the first visit.

CONCLUSIONS

Although accredited centers in Spain demonstrated good performance in many of the ESC QIs for AF, and general cardiology and tertiary referral hospitals showed similar results in the anticoagulation and outcomes domains, there is still room for improvement. This information could serve as a starting point for the participating centers to identify areas for improvement and work toward achieving excellence in the care of patients with AF.

PRINCIPAL INVESTIGATORS AND PARTICIPATING CENTERS

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WHAT IS KNOWN ABOUT THE TOPIC?

- AF is the most common cardiac arrhythmia and is associated with substantial morbidity and mortality.
- The ESC proposed a set of QI for AF in its 2020 guidelines.
- These QI have been assessed in several populations outside Spain.

WHAT DOES THIS STUDY ADD?

- This is the first study to assess the ESC QIs for AF in Spain.
- The anticoagulation and outcome QIs were similar to or better than those reported in other European countries.
- Similar results were found among general cardiology and tertiary referral centers for anticoagulation and outcome QIs.

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FUNDING

The Spanish Society of Cardiology provided the online database for collecting data and financed the contract research organization for management of administrative authorizations and support of the study process.

ETHICAL CONSIDERATIONS

The study protocol was approved by the Research Ethics Committee of each center and complied with the recommendations for medical studies outlined in the Declaration of Helsinki. Since the data used in the study were purely clinical-care related, anonymous, and dissociated from personal information, the Research Committees approved a waiver of informed consent. The SAGER guidelines on sex/gender reporting were followed.

STATEMENT ON THE USE OF ARTIFICIAL INTELLIGENCE

Artificial intelligence was not used to write any section of this manuscript.

AUTHORS' CONTRIBUTIONS

Conceptualization, formal analysis, writing—original draft preparation, supervision, project administration, and funding acquisition were carried out by M. Ruiz Ortiz. Investigation was conducted by all authors. Writing—review and editing were performed by all other authors. All authors have approved the final version of the manuscript for publication and are accountable for all aspects of the work.

CONFLICTS OF INTEREST

None.

SUPPLEMENTARY DATA

Supplementary data associated with this article can be found in the online version available at https://doi.org/10.1016/j.rec.2024.08.007.

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