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# The impact of inter-clinician electronic consultation in patients diagnosed with atrial fibrillation in primary care

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## Abstract

**Background:** An early diagnosis and early initiation of oral anticoagulants (OAC) are main determinants for outcomes in patients with atrial fibrillation (AF). Inter-clinician electronic consultations (e-consultations) program for the general practitioner referrals to cardiologist may improve health care access by reducing the elapsed time for cardiology care.

**Objective:** To evaluate the effect of a reduced elapsed time to care after a inter-clinician e-consultations program implementation (2013–2019) in comparison with previous in-person consultation (2010–2012) in the outpatient health care management in a Cardiology Department.

**Methodology:** We included 10,488 patients with AF from 1 January 2010, to 31 December 2019. Until 2012, all patients attended an in-person consultation (2010–2012). In 2013, we instituted an e-consult program (2013–2019) for all primary care referrals to cardiologists that preceded patient's in-person consultation when considered. The shared electronic patient dossier (EPD) was available between GP and cardiologist, and any change in therapy advice from cardiologist was directly implemented in this EPD.

**Results:** During the e-consultation period (2013–2019) were referred 6627 patients by GPs to cardiology versus 3861 during the in-person consultation (2010–2012). The e-consultation implementation was associated with a reduction in the elapsed time to anticoagulation prescription (177.6 ± 8.9 vs. 22.5 ± 8.1 days, $p < .001$), and an increase of OAC use (61% [95% IC: 19.6%–102.4%], $p < .001$). The e-consult program implementation was associated with a reduction in the 1-year CV mortality (.48 [95% CI: .30–.75]) and all-cause mortality (.42 [95% CI: .29–.62]). The OAC reduces the stroke mortality (.15 [95% CI: .06–.39]) and CV mortality (.43 [95% CI: .29–.62]) and all-cause mortality (.23 [95% CI: .17–.31]).

**Conclusion:** A shared EPD-based inter-clinician e-consultation program significantly reduced the elapsed time for cardiology consultation and initiation of OAC. The implementation of this program was associated with a lower risk of stroke and cardiovascular/all-cause mortality.

**KEYWORDS**

atrial fibrillation, cardiovascular diseases, inter-clinician e-consultation, oral anticoagulants, stroke

## 1 | INTRODUCTION

Telemedicine models improve healthcare accessibility and play an important role in organising the growing demand for care. Electronic consults (e-consults) are asynchronous, inter-clinician exchanges that answer focused patient-specific questions using the electronic medical records.[1–3] To date, few publications have addressed the impact of incorporating e-consultation on cardiology-related health outcomes. This aspect is of particular relevance in patients who have a diagnosed cardiovascular disease (CVD), as an e-consultation could be less efficient than a traditional in-person consultation in identifying clinical symptoms and may therefore influence the patient's clinical progression.[4,5]

Atrial fibrillation (AF) is a condition that relies heavily on specialised care for early thromboembolic risk stratification and comprehensive clinical evaluation to improve clinical outcomes.[6] Recently, the temporal association between episodes of AF and the risk of ischaemic stroke has been assessed, indicating that the risk is higher in patients who encountered episodes of AF a few days before stroke.[7] These findings emphasise the importance of the early detection of AF and the subsequent early and adequate antithrombotic management. In recent years, the use of direct oral anticoagulants (OACs) has increased, which has improved the outcomes of healthcare with important reductions in mortality.[8,9]

Despite the growing implementation of telematic consultation models and recommendations to regularly evaluate the quality of care to ensure patient safety and the best possible diagnosis and treatment practices in telemedicine, there is scanty evidence to support the quality of healthcare in terms of delays, prognostic impact, and patient and professional satisfaction. Few studies have addressed the impact of the incorporation of e-consultation for healthcare in cardiology-related health outcomes, with no information on patients with AF.

We recently published the characteristics of our ambulatory care model for referrals between general practitioners (GPs) and our cardiology department (CD), and the impact on the delay time of care, health care accessibility, and clinical outcomes after the implementation of an e-consultation as a first step in our ambulatory care program.[3,8]

The present study was conducted based on our experience with this program. We aimed to evaluate the synergistic effect of a reduced elapsed time to care after an inter-clinician e-consultations program implementation and the temporal trend changes in the use of oral anticoagulation on outcomes in patients with AF.

## 2 | MATERIAL AND METHODS

### 2.1 | Patients

The Santiago de Compostela Healthcare Area provides healthcare coverage to 446,603 citizens, and it is endowed with 301 general physicians (GPs) who refer their patients to our CD. In the present analysis we included 10,488 patients (22.1% of the total referrals, 41.258) with AF who were referred by their GP for at least one consultation with the CD between 2010 and 2019. The diagnosis of AF was carried out by the referral GP or by the cardiologist during the e-consultation or the first in-person consultation when considered after the e-consutation. The diagnosis of AF made by the GP was based in the clinical evaluation and ECG, other complementary tests like Holter monitoring are not available in the GP setting in our health area.

This study was approved by the local ethics committee on 23rd March 2022, with this 2021/496.

### 2.2 | Consultation models

Figure S1 summarises the patient ambulatory care pathways used in our CD to meet the demands of care from GPs. The e-consultation model was introduced in 2013. This model provided e-consultation as the first step in ambulatory care for all GP referrals to CD follow by an in-person consultation when considered. The cause of the demand for cardiology care and the results of the complementary exams (electrocardiogram and blood exam)

were included in the electronic patient dossier (EPD) and analysed by a cardiologist within 72 h of GP referral. The EPD was available between GP and cardiologist, and any change in therapy advice from cardiologist was directly implemented in this EPD and also a specific comment related to the GP referral.

## 2.3 | Variables

Once the list of patients with AF was obtained, the following variables were recorded: sex, age at the date of first e-consultation, date of e-consultation, diagnoses related to cardiovascular risk factors and previous history of CVD, date of cardiology consultation, number of subsequent consultations, whether a face-to-face consultation was conducted after the e-consultation, and the healthcare centre from which the e-consultation was made. The patients were classified as high (≥3 females or ≥2 males), intermediate (1–2 female or 1 male) or low thromboembolic risk according to the $CHA_2DS_2$-VASc score. We also assessed emergency department visits, strokes, and hospital admissions for cardiovascular causes as the main diagnoses during the first year after the first consultation or e-consultation in the CD; hospital admissions for stroke were classified according to the type, as ischaemic, haemorrhagic or unspecified. The pathogenesis of stroke was defined according to the International Statistical Classification of Diseases and Related Health Problems (ICD-10) codes as ischaemic (I63.0–I63.9), haemorrhagic (I61.0–I61.9), or unspecified (I64.X). Strokes not indexed as ischaemic or haemorrhagic were also categorised as unspecified. Mortality during the first year after consultation with the CD patients was also assessed.

In addition to the descriptive analysis discussed above, an analysis was conducted on the temporal trend variations after e-consultations regarding waiting time for assistance from CD consultation and emergency department assistance, total cardiovascular hospital admissions, and mortality in the first year after consultation.

Owing to the importance of OAC in the prognosis of patients with AF, we carried out two different analyses: first, on the impact of the temporal-trend changes in the OAC rates and e-consult implementation on the incidence of stroke and haemorrhage, where we considered the annual incidence between both periods (e-consultation vs. in-person consultation) and their incidence relative risk (iRR); and second, we analysed the differences in the effect of e-consultation and OAC on the incidence of stroke and mortality. In this analysis, we used a Spearman correlation to assess the type of consult or OAC and both outcomes.

## 2.4 | Statistical analysis

The results of this study are expressed as absolute frequencies (%) for qualitative variables and as mean ± standard deviation (SD) or median [25th percentile (P25), 75th percentile (P75)] for quantitative variables. The $\chi^2$ test was used to assess significant associations between qualitative variables, and Student's *t*-test or analysis of variance was used to investigate the association between quantitative and qualitative variables after checking the assumptions for normal distribution. Statistical significance was set at $p < .05$.

To investigate the impact of the e-consultation program on (i) delay time in care, (ii) hospital admissions, (iii) mortality, and (iv) anticoagulant use, an interrupted time series (ITS) regression approach was performed.[10] We used the time elapsed from the beginning of the study in months and the type of consultation as predictors. Overdispersion was considered and controlled.

To investigate the impact of the e-consultation program and OAC on the prognosis of AF-related stroke and haemorrhage, the annual incidence for each outcome in both periods was calculated. The temporal trend analyses for each outcome were performed by estimating the iRR with these incidences for the e-consultation.[10]

A multivariate logistic regression was performed for each one of those outcomes, and the variables included in the model were those that could influence the prognosis, such as personal characteristics (age, gender) and comorbidities (arterial hypertension, diabetes *mellitus*, ischemic heart disease, heart failure, cerebrovascular disease, peripheral arterial disease), and features that had to do with the disease management (waiting time until the e-consultation was answered, model of consultation, and number of visits to the emergency department during the 1st year after the e-consultation).

For data analysis, we used the statistic package SPSS, version 22.0 (SPSS Inc.) and R version 4.1.0, with open-source BAYESX software.

# 3 | RESULTS

## 3.1 | Clinical characteristics of the patient population with AF

We included 10,488 patients (22.1% of the overall referrals; 41,258 patients) with AF sent to our CD from GPs between 2010 and 2019 (Figure S1). Table 1 shows the epidemiological characteristics, personal history, and healthcare data of patients with AF during both the periods (in-person consultation and e-consultation). Of these patients, 36.8% ($n$ = 3861) were from the

**TABLE 1** Epidemiological characteristics and personal history of the sample population

| | Total | In-person consultation | e-consultation | *p* Value |
|---|---|---|---|---|
| *N* | 10,488 | 3861 | 6627 | |
| Women (%) | 49.5 | 48.4 | 50.2 | .072 |
| Age (years) | 73.8 (10.9) | 72.8 (10.7) | 74.5 (10.9) | <.001 |
| Personal history | | | | |
| Arterial hypertension (%) | 75.5 | 76.1 | 75.2 | .294 |
| Diabetes mellitus (%) | 26.2 | 27.8 | 25.3 | .005 |
| Ischemic heart disease (%) | 14.8 | 16.9 | 13.6 | <.001 |
| Heart failure (%) | 25.0 | 29.4 | 22.5 | <.001 |
| Cerebral vascular disease (%) | 9.6 | 11.8 | 8.3 | <.001 |
| Peripheral arterial disease (%) | 5.4 | 5.9 | 5.1 | .071 |

*Note*: Data are expressed as percentage. Age is expressed as a mean (SD).

**TABLE 2** Emergency department visits, hospital admissions, mortality and causes of mortality at one year after in-person or e-consultation

| | Total | In-person consultation | e-consultation | *p* Value |
|---|---|---|---|---|
| *N* | 10,488 | 3861 | 6627 | |
| Delay in face-to-face consultation (days) | 10 (5, 23) | 24 (2, 5, 50) | 6 (5, 9) | <.001 |
| Number of cardiology tests (no.) | 1 (.2) | 2 (1, 5) | 1 (0, 2) | <.001 |
| Emergencies assistance first year (no.) | 3 (1.6) | 5 (3, 10) | 4 (2, 7) | <.001 |
| Death in the first year (%) | 3.9 | 3.5 | 4.1 | .167 |
| CV death in the first year (%) | 1.6 | 1.6 | 1.6 | .986 |
| Causes of death | | | | |
| Cancer (%) | 17.8 | 17.5 | 18.2 | .864 |
| Ischemic heart disease (%) | 6.4 | 6.9 | 5.7 | <.001 |
| Heart failure (%) | 10.9 | 9.6 | 13.0 | <.001 |
| Ischaemic stroke (%) | 5.2 | 6.0 | 4.0 | <.001 |
| Valvular heart disease (%) | 3.8 | 3.4 | 4.5 | <.001 |
| COPD (%) | 3.5 | 4.2 | 2.2 | <.001 |
| Respiratory infection (%) | 2.6 | 1.7 | 4.0 | <.001 |
| Kidney failure (%) | 2.3 | 2.6 | 1.7 | <.001 |
| Haemorrhagic stroke (%) | 2.1 | 1.9 | 2.5 | <.001 |

*Note*: Data are expressed as percentage. The quantitative variables are expressed as median and (P25, P75).

Abbreviations: CV, cardiovascular; COPD, chronic obstructive pulmonary disease.

in-person consultation model, and 63.2% were from the e-consultation model; (9.8%) patients sent for e-consultation the demand of care was solved without the need for in-person visit (Figure S1 and Table 1). Compared with the patients who visited during the in-person consultation period, the patients in the e-consultation period were older ($p < .001$) but had a lower prevalence of diabetes ($p = .005$) and CVD ($p < .001$).

Tables 2 and 3 summarises the emergency department visits, total hospital admissions, and hospital admissions for the defined stroke types. After the implementation e-consult program was observed a reduction in the elapsed time for a face-to-face consultation when considered ($p < .001$) and fewer cardiology tests ($p < .001$). In addition, the need for emergency visits, total hospital admissions, and hospital admissions for stroke was significantly lower after the e-consultation program implementation. The most frequent causes of hospital admission were heart failure (37.7%) unstable AF (18.0%), and ischaemic heart disease (9.6%).

**TABLE 3** Hospital admissions and causes of hospitalisation at one year after in-person or e-consultation

| | Total | In-person consultation | e-consultation | *p* Value |
|---|---|---|---|---|
| Hospital CV admission first year (%) | 7.3 | 6.9 | 7.6 | .203 |
| Causes of CV hospital admission | | | | |
| Heart failure (%) | 3.3 | 3.2 | 3.3 | .774 |
| Atrial fibrillation (%) | 1.6 | 1.1 | 1.8 | <.001 |
| Ischaemic heart disease (%) | .8 | .8 | .8 | .964 |
| Valvular heart disease (%) | .7 | .8 | .6 | .644 |
| Flutter (%) | .6 | .4 | .7 | .02 |
| Ischaemic stroke (%) | .3 | .3 | .3 | .966 |
| Haemorrhagic stroke (%) | .2 | .2 | .2 | .978 |

*Note*: Data are expressed as percentage.

Abbreviation: CV, cardiovascular.

Table 2 summarises the total mortalities and causes of death. The causes of death in our group of AF patients included cancer (17.8%), heart failure (10.2%), ischaemic heart disease (6.8%), and ischaemic stroke (5.2%).

## 3.2 | Temporal trend in oral anticoagulation rate and elapsed time to consultation in patients with AF

Using the $CHA_2DS_2$-VASc score, 5.4% ($n = 571$) of the patients with AF were at low, 10.2% ($n = 1067$) at intermediate and 84.4% ($n = 8850$) at high risk. Throughout the 10 years of analysis, we observed a significant increase in the use of OACs in patients with AF ($p < .001$) and the rate of OAC in the high, intermediate, and low-thromboembolic risk groups was 23.9%, 51.8% and 64.8%, respectively. The overall rate increased from 44.8% in 2010, to 78.4% in 2019 (Figure 1A). The most important change in the OAC rate was observed in patients with a high thromboembolism risk, increasing from 40.2% to 70.4%. The changes in the intermediate (3.7%–6.4%) and low (.9%–1.6%) risk patients were less clinically relevant (Figure 1B). The most prominently used OAC medication was acenocoumarin; however, as per our observations, in the last four years, the use of Direct Oral Anticoagulation (DOACs) increased from 27% (in 2017) to 35.5% (in 2018) to 45.7% (in 2019) to 95.0% (in 2020, related to the regulatory changes in the COVID-19 pandemic) (Figures S2 and S3). In the group of patients submitted for e-consultation the vast majority started the anticoagulation before the cardiologist in-person visit ($22.5 \pm 8.1$ days before), only in 19.2% of cases the OAC was initiated after the e-consultation was solved by the cardiologist. The mean delay for OAC in the group of patients during the in-person period was $177.6 \pm 8.9$ days because the anticoagulation was started after the cardiologist in-person visit in 80.8% of the patients, $p < .001$.

The analysis of the interrupted temporal trend shows that the delay between GP referral and CD assistance in the in-person consultation period was reduced by 57.4 (20.5) days per year ($p = .006$). The e-consultation implementation slightly reduced this delay by .2 (.07) days per year ($p = .007$) (Figure 2A). In the e-consultation period, the use of OAC increased by 61.0% (19.6%–102.4%) ($p = .004$), and this rate was higher by 5.7% than that in the in-person consultation (5.3%–6.1%) ($p < .001$) (Figure 2B). The implementation of e-consultation supposed un iRR 1.56 (1.13–1.99) ($p < .001$) in the use of OAC.

In the multivariate analysis, the increasing use of OAC and the implementation of our e-consultation program were significatively associated with an independent effect on 1-year reduction in mortality for stroke, CV an all-cause death; Table 4.

The CV hospital admissions were observed to increase in the in-person consultation to 8.0 (95% CI: 7.2–8.8) per 100 patients/month ($p < .001$) and were significantly reduced after e-consultation program to 6.0 (95% CI: 2.0–10.0) per 100 patients/month ($p = .002$), iRR: .09 [95% CI: .02–.41] (Figure 3A). Also, the incidence of stroke was found to be lower after e-consult than in the in-person consultation (iRR: .09 [95% CI: .02–.41]) (Figure 3B). The occurrence of haemorrhagic complications after e-consultation implementation were like the trends observed after in-person consultations (iRR: .32 [95% CI: .04–2.58]) (Figure 3C). Finally, the all-cause mortality in the in-person consultation model increased by 19.0 (95% CI: 14.8–23.0) per 100 patients/month ($p < .001$), with a significative reduction after e-consultation (iRR .36 [95% CI: .33–.39]) followed with a slight increase of .04 (95% CI: .034–.046) per 100 patients/month ($p < .001$), Figure 2C.

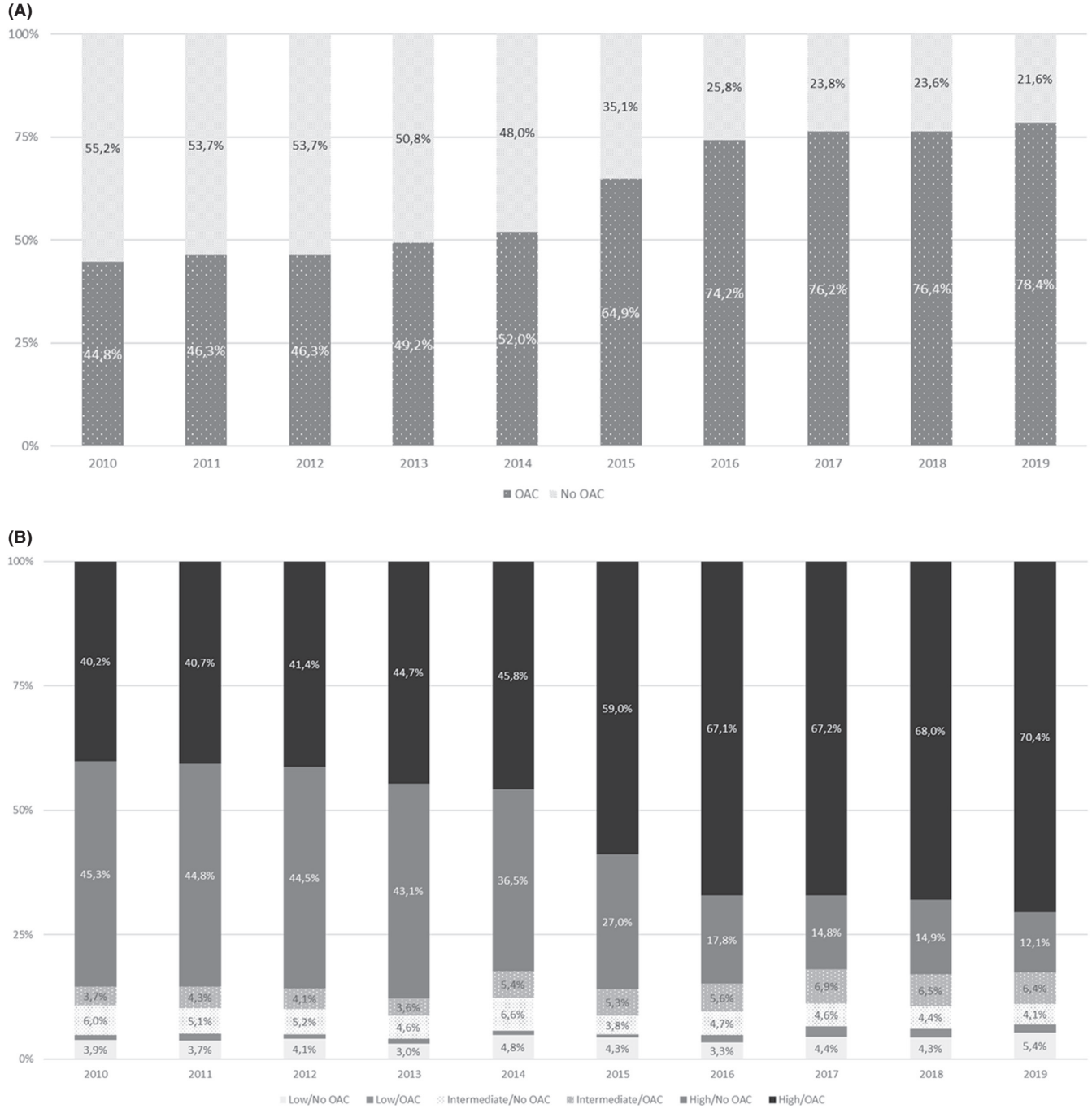


**FIGURE 1** (A) Temporal trends in the use of OAC in patients with AF and (B) Using OAC according to CHA2DS2-VASc score. AF, atrial fibrillation; OAC, oral anticoagulants

## 4 | DISCUSSION

Our findings reveal that the implementation of an inter-clinician e-consultation program as a first step in an outpatient management program for patients with AF is associated with a reduced elapsed time to care and improved outcomes (stroke, cardiovascular and all-cause mortality) while increased the OAC use and a mean delay for initiate the OAC significantly lower compared with the previous period of in-person visit for all the GPs referrals.

To our knowledge, this is the first time that the project results to manage ambulatory care demand in patients with AF through the application of e-consultations, while analysing the results on accessibility to healthcare and outcomes have been described. An increased OAC rate and a faster provision of patient risk stratification based on the clinical information provided by the GP e-consultation, may explain the better outcomes over the long observation period. Patients with AF with greater critical needs were identified sooner with e-consultation; however, they may

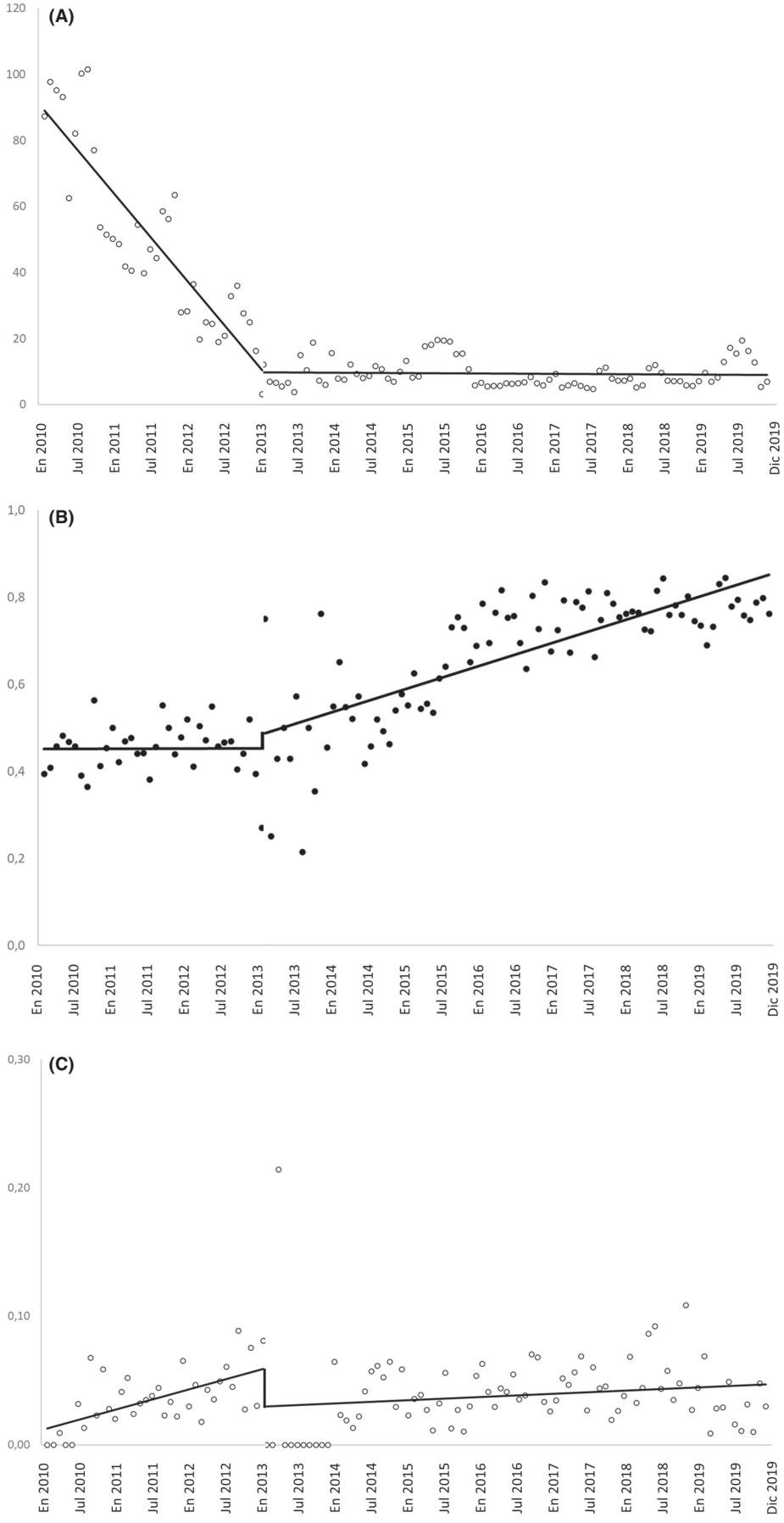


**FIGURE 2** Analysis of the interrupted temporal trends of elapsed time to care (A), use of OAC (B) and total mortality in the first year after consultation (C). OAC, oral anticoagulants

**TABLE 4** Multivariate analysis of factors linked to stroke and cardiovascular hospitalisation and death

| | Stroke hospitalisation | Stroke mortality | CV hospitalisation | CV mortality | All-cause mortality |
|---|---|---|---|---|---|
| | OR (IC 95%) | OR (IC 95%) | OR (IC 95%) | OR (IC 95%) | OR (IC 95%) |
| Age | 1.05 (.98–1.14) | 1.03 (.97–1.11) | .99 (.98–1.01) | **1.08 (1.04–1.12)** | **1.09 (1.06–1.12)** |
| Gender | | | | | |
| Woman (ref) | 1 | 1 | 1 | 1 | 1 |
| Man | .49 (.14–1.77) | .38 (.10–1.41) | **1.47 (1.14–1.90)** | .93 (.50–1.74) | **2.29 (1.45–3.64)** |
| Comorbidities | | | | | |
| Arterial hypertension | 3.42 (.77–15.23) | .57 (.15–2.16) | .77 (.59–1.01) | 1.92 (.61–2.33) | .87 (.54–1.42) |
| Diabetes mellitus | 2.26 (.61–8.31) | .78 (.19–3.13) | 1.21 (.29–1.57) | 1.07 (.56–2.05) | .96 (.59–1.56) |
| Ischemic cardiopathy | 1.71 (.46–6.36) | .87 (.22–3.43) | **1.75 (1.35–2.26)** | 1.54 (.83–2.87) | 1.19 (.75–1.91) |
| Heart failure | .27 (.05–1.33) | .80 (.21–3.08) | **2.32 (1.78–3.02)** | 2.09 (1.09–3.99) | **1.73 (1.07–2.79)** |
| Cerebrovascular disease | **77.24 (8.31–717.48)** | 3.26 (.34–30.79) | 1.24 (.78–1.99) | 1.65 (.51–5.33) | 1.25 (.53–2.97) |
| Peripheral arterial disease | 1.90 (.43–8.36) | .71 (.13–4.02) | 1.11 (.80–1.52) | 1.05 (.49–2.23) | 1.44 (.84–2.47) |
| AF characteristics | | | | | |
| $CHA_2DS_2$-VASc score | .63 (.23–1.74) | 1.22 (.42–3.55) | 1.06 (.87–1.30) | .90 (.53–1.53) | 1.00 (.68–1.47) |
| Oral anticoagulation | .83 (.38–1.80) | **.15 (.06–.39)** | .89 (.77–1.06) | **.43 (.29–.62)** | **.23 (.17–.31)** |
| Healthcare activity | | | | | |
| Number of visits to the emergency department (1 year) | **6.50 (2.78–15.22)** | **5.89 (2.68–13.01)** | **2.60 (2.11–3.21)** | **33.95 (22.95–50.23)** | **102.04 (72.98–142.68)** |
| Waiting time until the e-consultation is answered | .98 (.96–1.00) | .99 (.98–1.01) | **.99 (.992–.997)** | **1.00 (.99–1.00)** | 1.00 (.99–1.01) |
| In-person consultation model (ref) | 1 | 1 | 1 | 1 | 1 |
| E-consultation model | .47 (.19–1.14) | .54 (.24–1.19) | .94 (.78–1.13) | **.48 (.30–.75)** | **.42 (.29–.62)** |

*Note*: In bold: statistically significant factors ($p < .05$).

Abbrevations: AF, atrial fibrillation; CI, confidence Interval; CV, cardiovascular; e-consultation, electronic consultation; OR, odds ratio.

also have been treated significantly sooner, particularly with early OAC.

Undetected AF may increase the risk of stroke. Since OACs are associated with a reduced risk of AF-related stroke, e-consultation in patients with demonstrated or suspected AF may enable early clinical evaluation and initiation of OACs together with management of other AF-related conditions and co-morbidities. A recent publication assessed the temporal association between episodes of AF and stroke in 891 patients with cardiac implantable electronic devices. In this large cohort of patients, the increased stroke risk above baseline was highest within 5 days of the AF episode, lasting for a duration of 5.5 h or more.[7] These results are consistent with the traditional view that AF is directly associated with ischaemic stroke, and therefore support the need for early AF diagnosis, patient risk stratification, and management.

The implementation of e-consultation programs necessitates the evaluation of its impact on accessibility to healthcare and the influence on hard clinical endpoints such as mortality or hospital admissions. In previous publications, we have demonstrated that our e-consultation model was associated with improved accessibility to care[11] and reduced cardiovascular mortality and hospital admissions.[3] These facts are particularly relevant in patients with suspected or confirmed AF, since a delayed diagnosis may lead to a poor outcome related to delayed rhythm and rate control[12,13] and, most importantly, a delayed optimisation of OAC.[7]

The increased rate of OAC use and the reduction in the elapsed time for clinical assessment of patients with AF after the implementation of our e-consultation program may have influenced our findings. Here, we describe an additive and synergistic effect on the outcomes of improved OAC rates and early patient clinical evaluation.

Several contemporary studies have assessed the impact of OACs on the stroke incidence in patients with AF. The results from earlier studies suggest a decline in stroke rates

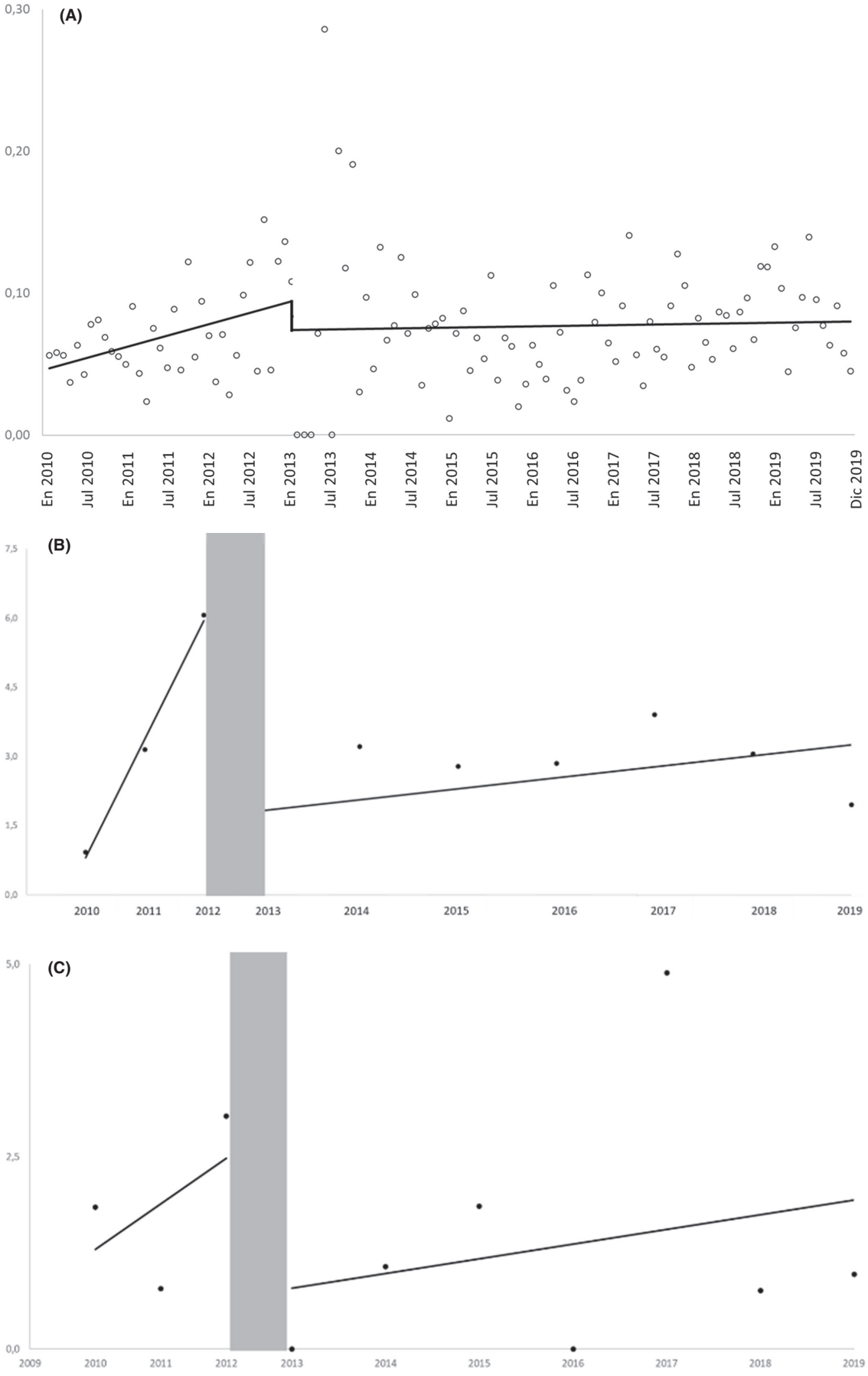


**FIGURE 3** Analysis of the interrupted temporal trends of hospital admissions for CVD in the first year after consultation (A), fatal and non-fatal stroke (B), fatal and non-fatal haemorrhagic events (C). CVD, cardiovascular diseases

related to increasing levels of OAC uptake.[8,9,14] However, more recent studies have, in general, not indicated progressive benefit, perhaps due to a levelling off of OAC uptake.[15–17] A particular limitation of all these studies lies in defining the prevalence of known AF events and OAC uptake among the at-risk AF population. One of the strengths of our analysis is related to the final diagnosis of AF, which is confirmed by experienced cardiologists and the subsequent adjustment OAC indications according to patient risk stratification. These factors may influence our results; in our cohort of patients with AF, the increased temporal trend rates of OAC in patients with a demonstrated indication based on the $CHA_2DS_2$-VASc score were associated with a reduction in stroke incidence and an overall better outcome.

Campbell et al. recently published a 10-year study on hospitalised AF-related stroke patients in England and its association with OAC uptake.[9] In this study involving national multi-source electronic health records between 2006 and 2016, we found that an increase in the nationwide uptake of OACs in patients with AF and a $CHA_2DS_2$-VASc score of >2 was significantly associated with a decline in patients that were hospitalised due to AF-related stroke.[9] From 2011 to 2016, a nationwide shift in the clinical use of antithrombotic strategy in patients with AF, an increased use of OACs, and a corresponding decrease in the use of antiplatelet drugs among patients with AF and a $CHA_2DS_2$-VASc score of >2 was seen. Based on our results, stroke risk reduction in patients with AF may also be related to an earlier clinical evaluation and a corresponding earlier OAC use, according to the time-related stroke risk in patients with AF. In practice, other possible contributory factors may be guideline changes, quality improvement initiatives, and increased prescription of DOACs. Our results also suggest that an improvement in the AF patient pathway with an early clinical assessment of patients with confirmed or suspected AF through our integrated electronic medical record (e-consultation) may influence the observed rate reductions in stroke and other outcomes (emergency department visits, hospitalisations, and mortality in the first year after consultation).

The epidemiology of AF-related stroke and its association with DOAC uptake in Spain were recently published.[18] Data were obtained from the Registry of Activity of Specialised Healthcare of the Spanish Ministry of Health (RAE-MDS). Before the DOAC use, the adjusted incidence rate (IR) of AF-related ischaemic stroke steadily increased from 2005 (IR = 2.20 per 100,000 person/year) to 2012 (IR = 2.67). Upon DOAC uptake in AF-related ischaemic stroke prevention, in Spain, from 2012, the IR remained constant or decreased slightly (IR in 2018 = 2.66).[18] The DOAC uptake was a significant predictor of the rate of AF-related ischaemic stroke in patients aged >65 years. The authors stated that while this association is based on aggregate data and cannot demonstrate causality, their findings suggest that a higher DOAC uptake could improve the health outcomes in patients with AF in Spain. These results were in line with studies on various other groups of patients from several European countries.[8] In our cohort, over the last four years, the use of DOACs was seen to increase, and owing to their efficiency, they have an important role in the reduction of hospital admission due to thromboembolic complications, as seen in reports from other countries.[8,9,14]

Although we acknowledge certain limitations of our study, the large cohort of patients with AF with demographic, clinical, and prognostic information integrated into our electronic medical records strengthens the relevance of the healthcare management aspects of our findings. On the other hand, an analysis of interrupted time series is the one that presents the greatest strength among the quasi-experimental studies to estimate the effect of an intervention in non-randomised studies. Unlike cross-sectional studies, this type of analysis makes it possible to control for previous trends in events while studying the dynamics of change in relation to the intervention. Another strong point is that it allows intuitive visualisation of the dynamics of the response to an intervention, in this case the inclusion of an e-consultation in outpatient cardiology intervention, showing whether the effects occur immediately or are delayed, if this is temporary. or persist.

A possible information bias derived from the analysis of retrospective data with limited access to the cause of death could qualify some of our findings, although all the deaths that occurred during our follow-up period are available.

## 5 | CONCLUSION

In conclusion, we have observed an association between the outpatient care program that includes e-consultations and an increase in OAC uptake, with a decline in AF prevalence corrected stroke rate, and other outcomes, such as, the need for emergency department visits, cardiovascular hospital admissions, and mortality. While our study reports a descriptive association and cannot demonstrate causality, our analysis suggests that a lesser delay in the cardiological evaluation and optimised OAC use, both influence improved clinical outcomes in patients with AF.

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The authors did not receive any funding for the development of this study.

## CONFLICT OF INTEREST

The authors declare no conflicts of interest in relation to this article.

## DATA AVAILABILITY STATEMENT

the data underlying this article are available in RUNA (https://runa.sergas.gal/) and can be accessed at https://runa.sergas.gal/xmlui/handle/20.500.11940/15301

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## REFERENCES

1. Martin D, Miller AP, Quesnel-Vallée A, Caron NR, Vissandjée B, Marchildon GP. Canada's universal health-care system: achieving its potential. *Lancet*. 2018;391(10131):1718-1735.
2. Liddy C, Moroz I, Mihan A, Nawar N, Keely E. A systematic review of asynchronous, provider-to-provider, electronic consultation services to improve access to specialty care available worldwide. *Telemed J E Health*. 2019;25(3):184-198.
3. Rey-Aldana D, Cinza-Sanjurjo S, Portela-Romero M, et al. Programa de consulta electrónica universal (e-consulta) de un servicio de cardiología. Resultados a largo plazo. *Rev Esp Cardiol*. 2022;75(2):159-165. https://linkinghub.elsevier.com/retrieve/pii/S0300893220306588
4. Geissler KH. Differences in referral patterns for rural primary care physicians from 2005 to 2016. *Health Serv Res*. 2020;55(1):94-102.
5. Cinza Sanjurjo S, Mazón Ramos P, Iglesias Álvarez D, Rey Aldana D, Portela Romero M, González-Juanatey JR. Consulta electrónica (e-consulta) para pacientes con insuficiencia cardiaca. Resultados a largo plazo. *Rev Esp Cardiol*. 2022;75(1):93-95. https://linkinghub.elsevier.com/retrieve/pii/S0300893221002694
6. Hindricks G, Potpara T, Dagres N, et al. 2020 ESC guidelines for the diagnosis and management of atrial fibrillation developed in collaboration with the European Association for Cardio-Thoracic Surgery (EACTS). *Eur Heart J*. 2021;42(5):373-498.
7. Singer DE, Ziegler PD, Koehler JL, Sarkar S, Passman RS. Temporal association between episodes of atrial fibrillation and risk of ischemic stroke. *JAMA Cardiol*. 2021;6(12):1364-1369.
8. Maggioni AP, Dondi L, Andreotti F, et al. Four-year trends in oral anticoagulant use and declining rates of ischemic stroke among 194,030 atrial fibrillation patients drawn from a sample of 12 million people. *Am Heart J*. 2020;220:12-19.
9. Cowan JC, Wu J, Hall M, Orlowski A, West RM, Gale CP. A 10 year study of hospitalized atrial fibrillation-related stroke in England and its association with uptake of oral anticoagulation. *Eur Heart J*. 2018;39(32):2975-2983.
10. McDowall D, McCleary RBB. *Interrupted Time Series Analysis*. Oxford University Press; 2019.
11. Rey-Aldana D, Mazón-Ramos P, Portela-Romero M, et al. Longer-term results of a universal electronic consultation program at the cardiology Department of a Galician Healthcare Area. *Circ Cardiovasc Qual Outcomes*. 2022;15(1):16-24. https://www.ahajournals.org/doi/10.1161/CIRCOUTCOMES.121.008130
12. Zhao Y, Krupadev V, Dagher L, et al. Pharmacological rhythm versus rate control in patients with atrial fibrillation and heart failure: the CASTLE-AF trial. *J Interv Card Electrophysiol*. 2021;61(3):609-615. doi:10.1007/s10840-020-00856-1
13. Balsam P, Peller M, Borodzicz S, et al. In-hospital heart rate reduction and its relation to outcomes of heart failure patients with sinus rhythm: results from the polish part of the European society of cardiology heart failure pilot and long-term registries. *Cardiol J*. 2020;27(1):25-37.
14. Forslund T, Komen JJ, Andersen M, et al. Improved stroke prevention in atrial fibrillation after the introduction of non–vitamin K antagonist Oral anticoagulants. *Stroke*. 2018;49(9):2122-2128.
15. Van Ganse E, Danchin N, Mahé I, et al. Comparative safety and effectiveness of Oral anticoagulants in nonvalvular atrial fibrillation. *Stroke*. 2020;51(7):2066-2075.
16. Briasoulis A, Gao Y, Inampudi C, et al. Characteristics and outcomes in patients with atrial fibrillation receiving direct oral anticoagulants in off-label doses. *BMC Cardiovasc Disord*. 2020;20(1):42.
17. Eschler CM, Antelo A, Funk GC, Exadaktylos AK, Lindner G. High fluctuation between anticoagulants, frequent off-label dosing, and No difference concerning outcomes: results of a real-life cohort study. *Am J Med*. 2021;134(3):e165-e170.
18. Díaz-Guzmán J, Freixa-Pamias R, García-Alegría J, et al. Epidemiology of atrial fibrillation-related ischemic stroke and its association with DOAC uptake in Spain: first national population-based study 2005 to 2018. *Rev Esp Cardiol*. 2021;75(6):496-505.

## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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