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Reasons for omitting anticoagulant treatment in patients with atrial fibrillation: an audit of patient records in general practice

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Abstract

Background Anticoagulant treatment is recommended for most patients with atrial fibrillation. Yet, register studies show a persisting treatment gap, which may lead to preventable strokes. This study aimed to explore the reasons for omitting anticoagulant treatment in patients with atrial fibrillation.

Methods We performed a comprehensive audit of electronic patient records in Danish general practice, including 12 clinics served by 39 general practitioners. All patients with atrial fibrillation, prevalent on 1 January 2023 and receiving no anticoagulant treatment, were identified using data from nationwide health registers. Patient records were reviewed retrospectively, covering the period 1 January 2001-1 January 2023. Information on care trajectories, follow-up patterns, decisions on anticoagulant treatment and reasons for omission were extracted and summarised using descriptive statistics.

Results In a representative sample of patients with atrial fibrillation receiving no anticoagulant treatment ($n=166$), the absence of treatment was based on clinical decisions explicitly noted in the patient records in 93.4% of cases. In 34.3% of non-users, anticoagulants were deselected due to a low risk of stroke and no treatment indication, and 59.1% represented clinical decisions made in areas with no firm guideline recommendations. Reasons for anticoagulant treatment omission included minimal atrial fibrillation burden, left atrial appendage closure, palliative care, risk-benefit considerations and patient preference. However, in 6.6% of patients, the absence of treatment reflected unjustified or outdated decisions. For patients with atrial fibrillation receiving no anticoagulant treatment, care trajectories were characterised by contacts across healthcare sectors. For 64.4% of patients, the most recent contact for atrial fibrillation occurred in the hospital setting, while 30.7% had theirs in general practice. Most follow-up consultations were planned in general practice, but 59.0% had no follow-up plan. A decision on anticoagulant treatment was explicitly documented in the electronic patient record (at least once since diagnosis) for 94.6% of patients, with 22.3% revised in the past year.

Conclusion This study found that most anticoagulant treatment omissions in patients with atrial fibrillation were supported by documented clinical reasoning, suggesting that the extent of inappropriate undertreatment may be lower than expected. Nevertheless, optimising care pathways could facilitate timely anticoagulation for some patients with atrial fibrillation.

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Introduction

Atrial fibrillation (AF) is the most prevalent cardiac arrhythmia worldwide, with one in three individuals expected to develop AF during their lifetime [1, 2]. In AF management, oral anticoagulant (OAC) treatment is essential to reduce the risk of stroke [3–6]. Yet, OAC adherence remains a persistent challenge, with recent studies indicating that at least 20% of patients remain untreated across healthcare settings worldwide [7–9]. This suggests a gap between optimal guideline-directed care and real-world clinical practice, which may result in potentially preventable strokes. Various clinical, patient and systemic factors can influence OAC initiation and adherence in patients with AF [10, 11]. For clinicians, decisions on OAC treatment require careful balancing of risks and benefits of treatment, which can be challenging to navigate, particularly in complex patient cases [12–14]. For patients, OAC treatment can be burdensome, and they may prefer not to take the medication due to medication expenses, side effects or other personal preferences [15, 16]. Moreover, systemic factors, such as information loss during transitions between healthcare settings, time constraints faced by physicians or patients and the structure of follow-up regimes, can impact treatment initiation and persistence [17]. However, little is known about the reasons for treatment omission in everyday clinical practice. AF is a chronic condition requiring long-term follow-up. In Denmark, as in many other healthcare systems, general practice plays a key role in managing patients with AF. Danish general practitioners (GPs) prescribe approximately 90% of all OAC medications [18] and coordinate patient care across healthcare sectors [14, 19]. This positions general practice as an ideal setting to investigate potential gaps in OAC treatment among patients with AF.

Methods

Aim

This study aimed to examine why some patients with AF receive no OAC treatment and to estimate the relative prevalence of reasons for omission by exploring care trajectories, follow-up practices and clinical decision-making processes in general practice. Such pragmatic, real-world insights could inform the development of targeted interventions to ensure guideline-adherent treatment and improved prognosis of patients with AF.

Design

We conducted a retrospective audit of electronic patient records in general practice, focusing on patients with AF who had redeemed no prescriptions for OAC. Patients were identified based on data from nationwide Danish health registers, [20] while information to explore reasons for treatment omission was extracted from general practice records.

Setting

The study was conducted in the Central Denmark Region, one of five administrative regions in Denmark. On 1 January 2023, this region had a population of 1,358,879, representing 23% of the total population [21]. In Denmark, healthcare is predominantly publicly funded through a universal tax-based system, and all residents have free access to medical services [22]. General practice operates with a patient-listing system, where more than 98% of the population is registered with a specific general practice clinic. GPs serve as the primary entry point to the healthcare system and act as gatekeepers, as most specialised treatments require a referral [19]. This model makes the GP a key coordinator of patient care pathways with a central role in initiating and maintaining medical treatment, including OAC treatment for patients with AF.

Data sources for patient identification and characterisation

Register-based information on age, sex, place of residence, atrial fibrillation diagnosis, medication prescriptions, CHA_2DS_2-VASc score [23], HAS-BLED-score [24] and Charlson Comorbidity Index [25] was obtained from the Danish Atrial Fibrillation Registry [20]. The Central Denmark Region provided information about general practice clinics (list size, organisation), GPs (age and sex) and the linkage between patient identification number and general practice provider number. This linkage allowed for identifying AF patients not receiving OAC treatment in the clinics included in the study.

Study participants

Source population

We included all individuals registered with at least one AF diagnosis (ICD-10: DI48*, including all subdiagnoses) between 1 January 2016 and 1 January 2023 and residing in the Central Denmark Region on 1 January 2023. Patients were classified as either receiving or not receiving OAC treatment depending on whether they had reimbursed a prescription for OAC (warfarin, phenprocoumon, edoxaban, rivaroxaban, apixaban or dabigatran) within 180 days before 1 January 2023. We identified all general practice clinics in the Central Denmark Region with an active patient list on 1 January 2023.

Audit population

General practice clinics were recruited through professional networks and snowball sampling, aiming to achieve maximum variation across organisation form, size and geographical location of clinics. All patients listed in the included clinics who were registered with an AF diagnosis and not receiving OAC treatment were eligible for audit.

Development of an audit registration form

Audit content was inspired by the 2020 guideline recommendations by the European Society of Cardiology (ESC) [5]. These recommendations were supplemented by evaluating existing literature on barriers to anticoagulant treatment. Audit content included information on (1) basic patient characteristics, (2) arrhythmia presentation and data for calculating stroke risk as the main indicators for OAC treatment, (3) follow-up activities related to AF and incidents of recorded decisions on OAC treatment and (4) reasons for omitting OAC treatment. The objective was to develop a structured audit registration form for collecting data through the SurveyXact online platform (Ramboll Group A/S, Denmark, www.rambollxact.com/surveyxact). The audit registration form allowed for collection of categorical data and open-ended text to describe patient trajectories, including contextual information and clinical considerations regarding OAC treatment (Appendix 1).

Data extraction and analysis

The first author reviewed the electronic patient records covering the period from 1 January 2001 to 1 January 2023 and entered information using the audit registration form. The reviews were based on structured search strategies with predefined keywords combined with a comprehensive examination and analysis of the patient record to trace the patient's pathway from AF diagnosis to the current stage of disease and care. Data were extracted from consultation records, referrals, discharge summaries and records from outpatient hospital clinics and specialist practitioners.

Quantitative data were analysed using descriptive statistics to provide prevalence measures. The representativeness of the audit sample was assessed using chi-square tests for categorical variables and two-sample *t*-tests for continuous variables. Open-ended text was analysed to identify influential factors in anticoagulant therapy decisions, including the primary reason for the individual patient to receive no OAC treatment. Data analyses were performed in Stata, version 14 [26].

Results

Baseline characteristics from register data

On 1 January 2023, we identified 31,167 patients with AF in the Danish Atrial Fibrillation Registry, registered across 337 general practice clinics in the Central Denmark Region. Of these, 4,185 (13.4%) patients received no OAC treatment. In total, 12 general practice clinics, representing 39 general practitioners, were included in the audit. The characteristics of these clinics were comparable to other general practice clinics in the Central Denmark Region (Table 1a). In the clinics, 195 patients were identified as eligible for inclusion based on data obtained from the Danish Atrial Fibrillation Registry [20]. These patients were comparable to the source population in the Central Denmark Region (Table 1b).

Eligibility assessment and formation of the final audit cohort

Among the 195 patients identified as eligible for audit based on register data, 26 patients (13.3%) were excluded due to an invalid AF diagnosis. Reasons for misclassification included patients being registered with an AF diagnosis during a diagnostic work-up that revealed another arrhythmia (e.g. atrioventricular nodal reentrant tachycardia) or cases involving the rejection of suspected AF upon further examination (criteria for misclassification detailed in Appendix 2). Additionally, one patient was excluded due to treatment with parenteral anticoagulation (in the context of end-stage kidney disease), and two patients were excluded because their electronic patient records were unavailable for review in the general practice clinic. The final audit sample included 166 patients (Fig. 1).

Stroke risk and arrhythmia characteristics from audit data

In the audit, 49.4% of patients had a CHA_2DS_2-VASc score of ≥ 2, indicating a moderate to high risk of stroke, when calculated based on information available in the general practice patient record. Most patients had a low burden of arrhythmia: 70.5% had experienced only a single episode of AF, and 7.2% had paroxysmal AF. A total of 13.3% of the patients had persistent or permanent AF, and 7.8% had atrial flutter and no episodes of AF (Table 1).

Decisions about anticoagulant treatment

For 94.6% of patients, a decision about OAC treatment was explicitly documented in the patient record at least once since diagnosis. Treatment decisions were not necessarily made in the general practice setting, but decisions were documented in the general practice patient records. For 22.3% of patients, the decision had been renewed and documented within the past year (Table 1).

Table 1 a and b: Characteristics of general practice clinics and patients not receiving oral anticoagulant treatment

a: Clinics	**Audit (n = 12)**	**Reference (n = 325)**	**P-value***
List size - n (%)			
<2,000 patients	2 (16.7)	96 (29.6)	0.399
2–4,000 patients	3 (25.0)	101 (31.1)	
>4,000 patients	7 (58.3)	128 (39.4)	
GPs in clinic - n (%)			
1	2 (16.7)	98 (30.2)	0.544
2	3 (25.0)	83 (25.6)	
≥3	7 (58.3)	144 (44.3)	
GP age (years) Mean (sd)	48.8 (7.7)	50.0 (10.3)	0.472
GP sex– n (%)			
Female	23 (59.0)	479 (59.2)	0.977
Number of patients per GP Mean (sd)	1,587 (197)	1,582 (322)	0.962
Number of AF patients per GP Mean (sd)	51.4 (25.5)	48.8 (24.0)	0.708
AF patients– n (%) OAC treatment	1,208 (86.1)	25,774 (86.6)	0.596
No OAC treatment	195 (13.9)	3,990 (13.4)	
b: Patients	**Audit (n = 195)**	**Reference (n = 3, 990)**	**P-value***
Age (years) Mean (sd)	64.5 (15.4)	64.2 (15.0)	0.802
Sex– n (%) Female	66 (33.9)	1,339 (33.6)	0.934
Time since AF diagnosis (years)			
Mean (sd)	5.9 (3.9)	5.5 (4.0)	0.224
CHA_2DS_2-VASc score– n (%)**			
0	86 (44.1)	1,753 (43.9)	0.735
1	28 (14.4)	668 (16.7)	
≥2	70 (35.9)	1,315 (33.0)	
Unspecified	11 (5.6)	254 (6.4)	
HAS-BLED score– n (%)**			
0	63 (32.3)	1,237 (31.0)	0.684
1	45 (23.1)	1,057 (26.5)	
≥2	76 (39.0)	1,442 (36.1)	
Unspecified	11 (5.6)	254 (6.4)	
Charlson Comorbidity Index– n (%)**			
0	110 (56.4)	2,413 (60.5)	0.651
1–2	59 (30.3)	1,129 (28.3)	
3–4	18 (9.2)	295 (7.4)	
≥5	8 (4.1)	153 (3.8)	

Abbreviations AF: atrial fibrillation; OAC: oral anticoagulant; GP: general practitioner; sd: standard deviation

Notes Table 1a describes the general practice clinics in the audit sample compared to all general practice clinics in the Central Denmark Region (reference), including AF combined with no OAC treatment in the audit sample compared to all AF patients receiving no OAC treatment in the Central Denmark Region (reference). Table 1b describes the patient characteristics in the audit sample compared to all untreated patients in the Cental Denmark region. Data presented are based on information obtained from the Danish Atrial Fibrillation Registry

*To assess differences between the groups, chi-square tests were applied to compare categorical variables and two-sample t-test continuous variables

** Based on patient history on 1 January 2023

AF patient care pathways

The care pathways for patients with AF and no OAC treatment were characterised by transitions between general practice, hospital outpatient clinics, private practice cardiologists and hospital admissions. A total of 37.6% of patients had experienced a healthcare contact within the past year where AF was mentioned in the patient record, implying that for the remaining 62.4%, the most recent recorded reference to AF occurred more than one year ago. When reviewing patient records retrospectively from 1 January 2023, the most recent contact related to AF was recorded in the hospital setting for 64.4% of patients: 56.0% in a hospital outpatient clinic and 8.4% during an admission. A total of 30.7% had their most recent AF-related contact in general practice. For 41.0%, a follow-up consultation was planned: 33.7% were scheduled in general practice and 7.2% in a hospital outpatient clinic. However, 59.0% had no planned AF follow-up (Table 1).

Reasons for no anticoagulant treatment

We divided reasons for receiving no OAC treatment (despite AF) into five groups based on OAC treatment indication:

Anticoagulant treatment not indicated according to guidelines

True low risk Patients with a CHA_2DS_2-VASc score of 0 for men and 1 for women were not eligible for OAC treatment according to guidelines [5, 6].

Anticoagulant treatment indication not acknowledged in the clinical context

For some patients, OAC treatment should be considered according to guidelines, but clinical assessment determined that the arrhythmia episodes did not justify anticoagulation or follow-up. *Minimal atrial fibrillation*: Patients with short episodes of device-recorded AF or trigger-induced AF, i.e. single episodes of AF during cardiac surgery, non-cardiac surgery, hospitalisation with severe infectious disease or thyrotoxicosis. *Atrial flutter with no recent symptoms*: Patients presenting with few self-limiting episodes of atrial flutter or no recurrence after radiofrequency ablation (RFA) for atrial flutter and no episodes of AF.

Anticoagulant treatment indication acknowledged, but other or no treatment preferred

OAC treatment indication was established, but treatment was deliberately omitted. *Left atrial appendage closure (LAAC)*: Patients not prescribed OAC treatment due to LAAC procedure. For most patients, LAAC was performed as an alternative to OAC treatment due to bleeding complications or a high risk of bleeding.

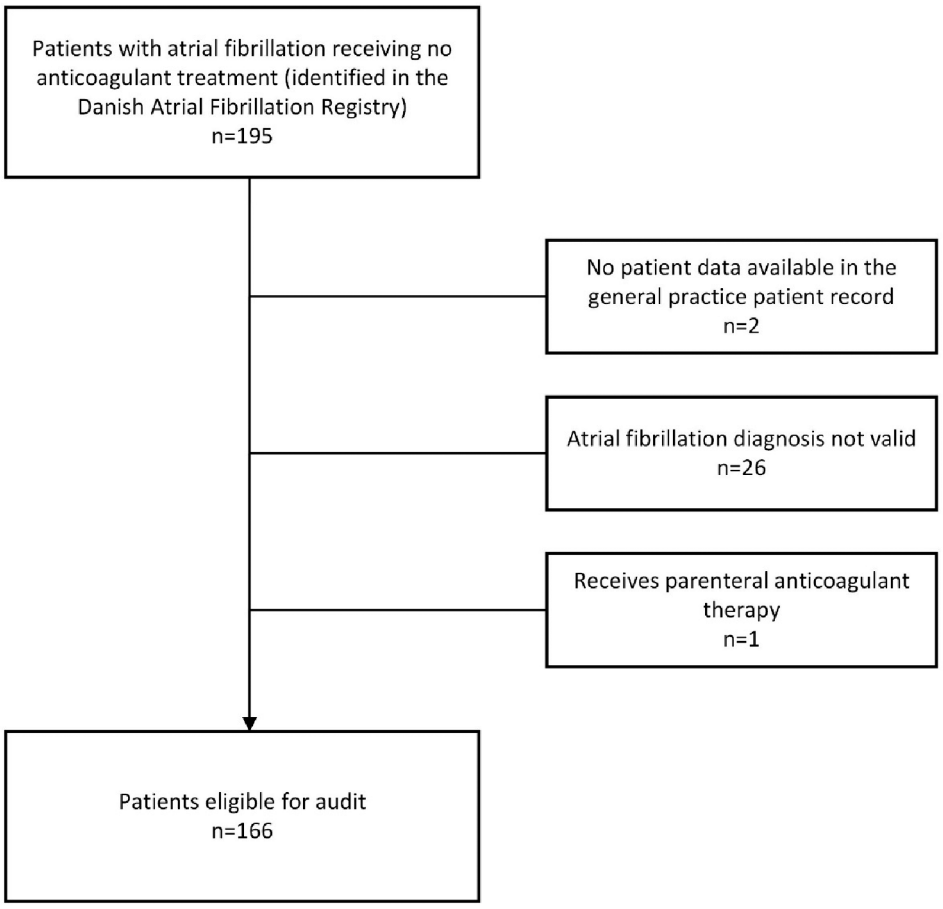

Fig. 1 Flowchart of patient eligibility for audit

Some patients underwent LAAC as part of clinical trials. *Palliative care*: Patients with end-stage disease in palliative treatment. *Patient preference*: Patients who declined OAC treatment despite healthcare providers' recommendations.

Anticoagulant treatment indication considered, but rejected after balancing risks and benefits

In this group, the decision to use no OAC was based on an assessed balance between the risks and benefits of treatment. These patients generally had a low arrhythmia burden (one or a few episodes or had undergone PV-RFA with no recurrent symptomatic or recorded AF episodes). Some engaged in daily activities entailing an increased risk of bleeding, such as karate. For one patient, excessive alcohol consumption was a contributing factor. The decision on OAC treatment was documented in the patient record; patient preference was often highlighted as the decisive factor.

Anticoagulant treatment indication evaluation not updated, inaccurately assessed or never performed

Healthcare system factors: This group included patients with no updated, well-founded decision on OAC treatment. *Inaccurate risk score*: The risk of stroke (CHA_2DS_2-VASc score) had increased since the most recent decision on OAC treatment or was underestimated due to incomplete data. *Fragmented care*: Some patients did not complete the diagnostic work-up or the assessment of treatment needs due to transitions between healthcare sectors (e.g. referral between primary and secondary care). This category included patients with little or no AF information in the general practice patient record.

Prevalence of reasons for no anticoagulant treatment

Table 2 outlines the prevalence of identified reasons for no OAC treatment. In 34.3% of patients, treatment was not indicated due to a low risk of stroke. In 21.7%, the arrhythmia occurrence was considered not to justify treatment. In 24.7%, treatment was indicated, but an alternative to OAC treatment or no treatment was preferred. In 12.7%, treatment was considered but not initiated following a risk-benefit assessment. In 11 patients

Table 2 Patient characteristics, care pathways and decisions on anticoagulant treatment

Participant characteristics	
Participants included in audit– n	166
Age (years)– mean (sd)	63.4 (14.8)
Female sex– n (%)	54 (32.5)
CHA_2DS_2-VASc score*– n (%)	
0	48 (28.9)
1	36 (21.7)
≥2	82 (49.4)
Classification of arrythmia– n (%)	
Single-episode AF	117 (70.5)
Paroxysmal AF	12 (7.2)
Persistent/permanent AF	22 (13.3)
Atrial flutter, no AF	13 (7.8)
Not classifiable based on available data	2 (1.2)
Decisions on OAC treatment recorded in the patient record	
Ever**– n (%)	157 (94.6)
During the past year***– n (%)	37 (22.3)
AF patient care pathway	
Follow-up of AF during the past year***– n (%)	62 (37.6)
Setting of most recent contact concerning AF– n (%)	
General practice	51 (30.7)
Hospital outpatient clinic	93 (56.0)
Hospital admission	14 (8.4)
Specialist practitioner	7 (4.2)
No contacts concerning AF	1 (0.6)
Setting of planned follow-up– n (%)	
General practice	56 (33.7)
Hospital outpatient clinic	12 (7.2)
No planned follow-up	97 (59.0)

Abbreviations: AF: Atrial fibrillation; OAC: oral anticoagulant; sd: standard deviation

* Based on patient history on 1 January 2023. Calculated using information available in general practice records

** Between 1 January 2001 and 1 January 2023

***Between 1 January 2022 and 1 January 2023

(6.6%), no up-to-date or adequately supported decision on OAC treatment was available.

Discussion

We conducted a comprehensive audit of electronic patient records in general practice, using data from nationwide registers to identify eligible patients. The method proved feasible: patients could be successfully identified in general practice records, and detailed data were available to provide deeper insights to explain why some patients were not receiving treatment. Of the patients identified with AF and no OAC treatment based on register data, 13.3% were excluded following record review due to misclassification. Among the 166 patients included in the audit, reasons for OAC treatment omission were explicitly documented in over 90% of cases. In 34.3%, treatment was not indicated due to a low risk of stroke, while in 59.1% it was omitted based on clinical judgement within guideline grey zone areas. In the remaining 6.6%, the absence of treatment was either undocumented, inadequately justified, or based on outdated risk profiles. Documented reasons for no OAC treatment included minimal AF burden, left atrial appendage closure, palliative care, risk-benefit considerations, and patient preference. Care pathways for patients with AF were characterised by transitions between healthcare sectors. The most recent contact for AF management occurred in the hospital setting for approximately two-thirds of patients compared to one-third in general practice. A revised treatment decision within the past year was explicitly documented for only one fifth of patients, and 59.1% had no documented follow-up plan for AF.

Clinical significance of undertreatment

This study indicates that the omission of OAC treatment is based on clinical decisions explicitly noted in the patient record in more than 90% of patients with AF. These findings suggest that a significant proportion of the non-adherence reported in recent studies [7–9] may be clinically justified; this emphasises the importance of integrating patient-specific contextual data into large population-based assessments to enhance our understanding of the clinical implications. Furthermore, a misclassification rate of 13% was observed among patients with a register-based AF diagnosis and no OAC treatment. Previous validation studies have reported positive predictive values for register-based AF diagnoses of 93% [27] and 95% [28], corresponding to misclassification rates of approximately 5–7%. As individuals without a validated AF diagnosis are less likely to be prescribed OAC, misclassification is more likely to occur in the untreated group. A higher misclassification rate is therefore expected in this population, making a 13% rate plausible and consistent with earlier findings. Nevertheless, this underscores the potential overestimation of non-adherence when relying on register-based data.

Guideline grey areas

For many patients, the reason for receiving no OAC treatment fell within areas with no firm guideline recommendations. The association between even minimal AF burden and elevated stroke risk is widely accepted [5, 6, 29, 30]. Guidelines emphasise that the clinical pattern of AF should not condition the indication for OAC treatment [5, 6]. A strict interpretation of these recommendations would imply that OAC treatment indication in patients with trigger-induced or minimal AF depended solely on stroke risk assessment. However, our study found that single episodes of trigger-induced AF were rarely considered sufficient to warrant treatment or follow-up in the clinical context; this indicates

Table 3 Reasons for patients with atrial fibrillation to receive no anticoagulant treatment

Reason	Frequency *n* (%)	Subcategory	Frequency *n* (%)
Anticoagulant treatment not indicated according to guidelines due to low risk of stroke			
CHA_2DS_2-VASc score 0 (men)/1 (women)	57 (34.3)		
Anticoagulant treatment indication not acknowledged in the clinical context			
Minimal atrial fibrillation	28 (16.9)	AF during cardiac surgery	12 (7.2)
		AF during non-cardiac surgery	2 (1.2)
		AF during severe infectious disease	9 (5.4)
		AF during thyrotoxicosis	3 (1.8)
		AF recorded in less than 30 s	2 (1.2)
RFA-treated atrial flutter	8 (4.8)		
Anticoagulant treatment indication acknowledged, but other or no treatment preferred			
Left atrial appendage closure	30 (18.1)		
Palliative care	5 (3.0)		
Patient preferences	6 (3.6)		
Anticoagulant treatment indication considered, but rejected after balancing risks and benefits			
Balancing risk and benefit	21 (12.7)	Low AF burden	7 (4.2)
		Bleeding risk	3 (1.8)
		Combination	10 (6.0)
		Excessive alcohol consumption	1 (0.6)
Anticoagulant treatment indication evaluation not updated, inaccurately assessed or never performed			
Healthcare system factors	11 (6.6)	Inaccurate CHA_2DS_2-VASc score	9 (5.4)
		Fragmented care	2 (1.2)

Abbreviations AF: Atrial fibrillation; OAC: oral anticoagulant; RFA: radiofrequency ablation

a need to further clarify the role of OAC treatment in this population. The efficacy and safety of OAC treatment in AF triggered by non-cardiac surgery are currently being evaluated in an ongoing study (ASPIRE-AF, NCT03968393). Furthermore, the role of OAC treatment in device-detected AF remains debatable [30]. Recent studies have suggested that arrhythmia episodes shorter than 5.5 [31] to 24 [29] hours may not be associated with a clinically significant increase in stroke risk to justify OAC treatment. This supports a cautious approach to treatment in cases of minimal AF. Another example of treatment decisions in guideline grey areas is the role of LAAC as a stand-alone preventive measure of thrombosis. In alignment with guideline recommendations [5, 6] our study found that LAAC was offered as a treatment alternative to patients with contraindications to oral anticoagulation. However, it was also regarded as a substitute for OAC treatment in patients without contraindications who had undergone LAAC in conjunction with other cardiac interventions. The frequent need to navigate such guideline grey areas in clinical decision-making reflects the underlying complexity of OAC management in AF. Guidelines cannot encompass the full spectrum of individual patient presentations, and guideline deviations are an inevitable aspect of clinical practice. In this study, we suggest that deselecting treatment in these grey areas constitutes appropriate care when such deselection is based on well-documented decisions, even if it does not strictly adhere to guidelines. Consequently, this study suggests that most patients with AF receive appropriate anticoagulant care. However, it also reveals the necessity of further research to support treatment decisions in areas where clinical uncertainty remains.

Patient care pathways

AF often progresses over time. Stroke risk increases alongside age and emerging comorbidities [32] and patient preferences may also shift with changes in life circumstances. Consequently, treatment needs should be viewed as dynamic rather than static [5, 6].

Traditionally, the response to such a challenge is to recommend more frequent follow-up for all patients [33–35]. The 2020 ESC guidelines [5] recommend all patients with AF to undergo at least one annual reassessment. However, in a healthcare system facing financial and labour shortages, increasing follow-up for all patients may not be an optimal solution [36]. Our study proposes that despite low rates of AF-related follow-up (37.6%) and OAC treatment reassessment (22.3%) in the year preceding 1 January 2023, treatment decisions remained consistent with the patient's risk profile in 93.4% of cases. These findings suggest that less frequent follow-up could be sufficient to support appropriate treatment in selected patients. This aligns with the 2024 ESC guidelines, [6] which places less emphasis on fixed time intervals and recommends personalised and dynamic follow-up tailored to individual clinical circumstances.

However, in 6.6% of patients in our study, decisions on OAC treatment were unjustified or outdated (mostly due to changes in their risk profile since the most recently documented treatment decision). This highlights the need to develop AF follow-up models that facilitate timely detection of changes in risk profile or patient preferences while ensuring efficient and meaningful use of healthcare and patient resources. A one-size-fits-all approach is unlikely to achieve this balance. Future studies could assess the safety of non-frequent, individualised follow-up in patients with minimal AF. Such an approach might be guided by symptom recurrence rather than planned contacts. Furthermore, exploring the potential role of automated data-driven solutions would be valuable to optimise patient pathways and ensure timely personalised care.

Strengths and limitations

The relatively small sample size may limit the generalisability of the results to more extensive or diverse populations. However, the representativeness of the audit sample was assessed using register-based data and found to be comparable to the broader population in the Central Denmark Region in terms of AF patient demographics and the characteristics of general practice clinics. The uniform organisation and accessibility of healthcare in Denmark suggest that the results may also be applicable at a national level. Although the findings might be relevant in international contexts, healthcare systems differ considerably, and the underlying reasons for OAC treatment omission may vary. In settings with lower OAC treatment coverage, including low-income countries, additional or alternative reasons for treatment omission are likely to exist.

A key limitation of the study is the risk of selection bias. Inclusion was based on hospital-based diagnoses from national health registers, which requires that all patients are seen within the hospital system. In the Danish healthcare system, it is standard practice for all patients with a new AF diagnosis in primary care to be referred to a cardiologist for further evaluation. These assessments are predominantly conducted in hospital settings, thus supporting a high degree of completeness in hospital-based diagnostic data. Moreover, patients receiving no OAC treatment were identified through the redemption of an OAC prescription within the past 180 days. This approach may exclude individuals who have filled prescriptions but have not used the medication or have used it inconsistently, and may introduce bias, as this group could have distinct reasons for non-adherence. An additional concern is the possible inclusion of individuals with subclinical, device-detected AF, for whom the indication for OAC therapy remains uncertain [30] Device-detected AF was not a predefined category in the audit registration form; consequently, this information was not systematically collected from patient records, although it could have provided clinically relevant insights.

The study is based on information from electronic patient records in general practice. As key patient care coordinators, GPs receive information about their listed patients from hospitals and municipal healthcare providers, which is integrated into the patient records. Therefore, these records contain comprehensive patient-centred data that reflect real-world care processes. A key strength of our study is the utilisation of this data source, including unstructured information from text notes and analyses of patient trajectories. Still, many reflections and decisions on patient care are not documented in patient records and cannot be captured in this study design. Additionally, the patient record serves as a work tool in healthcare and reflects the clinician's perspective rather than the patient's.

Conclusion

This study suggests that most cases of OAC treatment omission in patients with AF are supported by clinical reasoning explicitly documented in general practice records. The observed gap between guideline recommendations and clinical practice was primarily explained by misclassification and non-use based on clinical decisions that carefully weighed the risks and benefits of treatment. These findings suggest that undertreatment is less prevalent than anticipated, thus reducing the need for extensive quality improvement interventions. However, changes in risk profiles went undetected for some patients, indicating the importance of reassessment. Future research should aim to develop dynamic and personalised follow-up models ensuring effective monitoring without unnecessary use of patient and healthcare resources.

Abbreviations

AF	Atrial fibrillation
GP	General practitioner
LAAC	Left atrial appendage closure
OAC	Oral anticoagulant

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12875-025-02852-8.

Supplementary Material 1

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Author contributions

IGL, ELG, FB and AM designed the study and developed the audit registration form. IGL reviewed the electronic patient records and extracted the data.

IGL undertook the statistical analyses. All authors contributed to the analysis and interpretation of data. IGL drafted the first version of the manuscript. All authors revised and contributed to the editing of the manuscript. All authors read and approved the final version.

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Data availability
Due to their sensitive nature, the datasets generated and analysed during this study are not publicly available. The data and other study materials are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent
The study was conducted in accordance with the general ethical principles of good clinical research practice as outlined by the World Medical Association in the Declaration of Helsinki. The Central Denmark Region authorised the use of data from electronic patient records in general practice under Sect. 46(2) of the Danish Health Act, thereby waiving the requirement for written patient consent (file no.: 1-45-70-29-22). Before data collection, a data processing agreement was signed with each included general practice clinic.

Competing interests
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References

1. Lippi G, Sanchis-Gomar F, Cervellin G. Global epidemiology of atrial fibrillation: an increasing epidemic and public health challenge. Int J Stroke. 2021;16(2):217–21. https://doi.org/10.1177/1747493019897870.
2. Vinter N, Cordsen P, Johnsen SP, et al. Temporal trends in lifetime risks of atrial fibrillation and its complications between 2000 and 2022: Danish, nationwide, population based cohort study. BMJ. 2024;385:e077209. https://doi.org/10.1136/bmj-2023-077209.
3. Wolf PA, Abbott RD, Kannel WB. Atrial fibrillation as an independent risk factor for stroke: the Framingham Study. Stroke. 1991;22(8):983-8. https://doi.org/10.1161/01.str.22.8.983
4. Hart RG, Pearce LA, Aguilar MI. Meta-analysis: antithrombotic therapy to prevent stroke in patients who have nonvalvular atrial fibrillation. Ann Intern Med. 2007;146(12):857–67. https://doi.org/10.7326/0003-4819-146-12-200706190-00007.
5. 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): the task force for the diagnosis and management of atrial fibrillation of the European society of cardiology (ESC) developed with the special contribution of the European heart rhythm association (EHRA) of the ESC. Eur Heart J. 2021;42(5):373–498. https://doi.org/10.1093/eurheartj/ehaa612.
6. Van Gelder IC, Rienstra M, Bunting KV, et al. 2024 ESC guidelines for the management of atrial fibrillation developed in collaboration with the European association for Cardio-Thoracic surgery (EACTS). Eur Heart J. 2024;45(36):3314–414. https://doi.org/10.1093/eurheartj/ehae176.
7. Salmasi S, Loewen PS, Tandun R, et al. Adherence to oral anticoagulants among patients with atrial fibrillation: a systematic review and meta-analysis of observational studies. BMJ Open. 2020;10(4):e034778. https://doi.org/10.1136/bmjopen-2019-034778.
8. Grymonprez M, Simoens C, Steurbaut S, et al. Worldwide trends in oral anticoagulant use in patients with atrial fibrillation from 2010 to 2018: a systematic review and meta-analysis. Europace. 2022;24(6):887–98. https://doi.org/10.1093/europace/euab303.
9. Komen JJ, Pottegård A, Mantel-Teeuwisse AK, et al. Persistence and adherence to non-vitamin K antagonist oral anticoagulant treatment in patients with atrial fibrillation across five Western European countries. Europace. 2021;23(11):1722–30. https://doi.org/10.1093/europace/euab091.
10. Farinha JM, Jones ID, Lip GYH. Optimizing adherence and persistence to non-vitamin K antagonist oral anticoagulant therapy in atrial fibrillation. Eur Heart J Supplements. 2022;24(SupplementA):A42–55. https://doi.org/10.1093/eurheartj/suab152.
11. Bhat A, Karthikeyan S, Chen HHL, et al. Barriers to Guideline-Directed anticoagulation in patients with atrial fibrillation: new approaches to an old problem. Can J Cardiol. 2023;39(5):625–36. https://doi.org/10.1016/j.cjca.2023.01.020.
12. Mulder BA, Ten Berg J, Ten Cate H, et al. Complex clinical scenarios with the use of direct oral anticoagulants in patients with atrial fibrillation: a multidisciplinary expert advisory board. Neth Heart J. 2020;28(10):504–13. https://doi.org/10.1007/s12471-020-01424-y.
13. Gebreyohannes EA, Salter SM, Chalmers L, et al. Reasons for non-adherence to thromboprophylaxis prescribing guidelines in atrial fibrillation in Western Australia: A qualitative descriptive study of general practitioners' views. Thromb Res. 2021;208:83–91. https://doi.org/10.1016/j.thromres.2021.10.025.
14. Pokorney SD, Bloom D, Granger CB, et al. Exploring patient-provider decision-making for use of anticoagulation for stroke prevention in atrial fibrillation: results of the INFORM-AF study. Eur J Cardiovasc Nurs. 2019;18(4):280–88. https://doi.org/10.1177/1474515118812252.
15. van de Steeg BJW, Esselink AC, de Wit H, et al. Medication adherence to direct oral anticoagulants: extent and impact of side effects. Patient Prefer Adherence. 2024;18:1779–88. https://doi.org/10.2147/ppa.S463164.
16. Pandya EY, Bajorek B. Factors affecting patients' perception on, and adherence to, anticoagulant therapy: anticipating the role of direct oral anticoagulants. Patient. 2017;10(2):163–85. https://doi.org/10.1007/s40271-016-0180-1.
17. Rush KL, Burton L, Ollivier R, et al. Transitions in atrial fibrillation care: A systematic review. Heart Lung Circ. 2020;29(7):1000–14. https://doi.org/10.1016/j.hlc.2019.11.022.
18. Pottegård A, Olesen M, Christensen B, et al. Who prescribes drugs to patients: A Danish register-based study. Br J Clin Pharmacol. 2021;87(7):2982–87. https://doi.org/10.1111/bcp.14691.
19. Pedersen KM, Andersen JS, Søndergaard J. General practice and primary health care in Denmark. J Am Board Fam Med. 2012;25(Suppl 1):S34–8. https://doi.org/10.3122/jabfm.2012.02.110216.
20. Frost L, Joensen AM, Dam-Schmidt U, et al. The Danish atrial fibrillation registry: A multidisciplinary National pragmatic initiative for monitoring and supporting quality of care based on data retrieved from administrative registries. Clin Epidemiol. 2023;15:1259–72. https://doi.org/10.2147/clep.S443473.
21. Population Figures: Statistics Denmark. 2024 [Available from: accessed 16 December 2024]. https://www.dst.dk/en/Statistik/emner/borgere/befolkning/befolkningstal
22. Christiansen T. Organization and financing of the Danish health care system. Health Policy. 2002;59(2):107–18. https://doi.org/10.1016/s0168-8510(01)00201-9.
23. Lip GY, Nieuwlaat R, Pisters R, et al. Refining clinical risk stratification for predicting stroke and thromboembolism in atrial fibrillation using a novel risk factor-based approach: the Euro heart survey on atrial fibrillation. Chest. 2010;137(2):263–72. https://doi.org/10.1378/chest.09-1584.
24. Pisters R, Lane DA, Nieuwlaat R, et al. A novel user-friendly score (HAS-BLED) to assess 1-year risk of major bleeding in patients with atrial fibrillation: the Euro heart survey. Chest. 2010;138(5):1093–100. https://doi.org/10.1378/chest.10-0134.

25. Charlson ME, Pompei P, Ales KL, et al. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chronic Dis. 1987;40(5):373–83. https://doi.org/10.1016/0021-9681(87)90171-8.
26. Stata Statistical Software. Release 14. [program]. College Station, TX: StataCorp LP; 2015.
27. Rix TA, Riahi S, Overvad K, et al. Validity of the diagnoses atrial fibrillation and atrial flutter in a Danish patient registry. Scand Cardiovasc J. 2012;46(3):149–53. https://doi.org/10.3109/14017431.2012.673728.
28. Sundbøll J, Adelborg K, Munch T, et al. Positive predictive value of cardiovascular diagnoses in the Danish National patient registry: a validation study. BMJ Open. 2016;6(11):e012832. https://doi.org/10.1136/bmjopen-2016-012832.
29. Van Gelder IC, Healey JS, Crijns H, et al. Duration of device-detected subclinical atrial fibrillation and occurrence of stroke in ASSERT. Eur Heart J. 2017;38(17):1339–44. https://doi.org/10.1093/eurheartj/ehx042.
30. De Sio V, Gragnano F, Capolongo A, et al. Antithrombotic therapy in patients with atrial high-rate episodes (AHREs): current evidence and open questions. Int J Cardiol. 2024;422:132921. https://doi.org/10.1016/j.ijcard.2024.132921.
31. Peigh G, Koehler J, Majumder S, et al. Associations between changes in maximum daily atrial fibrillation duration, ischemic stroke, and mortality. JACC Clin Electrophysiol. 2024;10(11):2394–406. https://doi.org/10.1016/j.jacep.2024.06.020.
32. Pisters R, Lane DA, Marin F, et al. Stroke and thromboembolism in atrial fibrillation. Circ J. 2012;76(10):2289–304. https://doi.org/10.1253/circj.cj-12-1036.
33. Bezabhe WM, Bereznicki LR, Radford J, et al. Stroke risk reassessment and oral anticoagulant initiation in primary care patients with atrial fibrillation: A ten-year follow-up. Eur J Clin Invest. 2021;51(6):e13489. https://doi.org/10.1111/eci.13489
34. Wirbka L, Ruff C, Haefeli WE, et al. A prediction model for nonpersistence or nonadherence to direct oral anticoagulants in hospitalized patients with atrial fibrillation. J Manag Care Spec Pharm. 2022;28(10):1161–72. https://doi.org/10.18553/jmcp.2022.28.10.1161.
35. van der Horst SFB, de Vries TAC, Chu G, et al. Prevalence and predictors of nonadherence to direct oral anticoagulant treatment in patients with atrial fibrillation. TH Open. 2023;7(3):e270–79. https://doi.org/10.1055/a-2161-0928.
36. Johansson M, Guyatt G, Montori V. Guidelines should consider clinicians' time needed to treat. BMJ. 2023;380:e072953. https://doi.org/10.1136/bmj-2022-072953.

Publisher's note

Ina Grønkjaer Laugesen is a medical doctor and general practice trainee with clinical experience in both hospital and primary care settings. This background has provided essential context for evaluating care pathways across sectors and identifying contributing factors to deselection of anticoagulant treatment during the review process.