Implementation of a computer algorithm in the electronic health record to identify inpatients with untreated atrial fibrillation to optimise stroke prevention

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Background

- **Atrial fibrillation (AF)** is the most common arrhythmia worldwide and is associated with a **5-fold increased risk of stroke.**
- Appropriate use of **anticoagulants reduces the relative risk** of stroke by approximately **64%**.
- Despite overwhelming evidence in favour of anticoagulation, **up to 40% of AF patients are not anticoagulated**.
- **Decision support systems** have shown promise in increasing guideline adherence to capture undertreatment.

Aim:

- *To develop and validate a **highly sensitive and specific advanced computerized screening algorithm** to accurately identify untreated AF inpatients to improve stroke prevention.*

Table 1. *Stepwise decision process of the computerized algorithm and the associated data in EHR*

Screening criteria	Data in EHR
STEP 1) establishing AF diagnosis	
AF or atrial flutter	Care program AF
	ECG reports
	Holter monitoring reports
	Presence of AF as natural language in medical records
STEP 2) calculating the CHA_2DS_2-VASc-score	
(C) Congestive heart failure	Care program heart failure
	Left ventricular ejection fraction < 40%
	Therapy with ivabradine
	Therapy with sacubitril-valsartan
(H) Hypertension	Care program hypertension
	Therapy with cardiovascular medication*
(A_2) Age ≥ 75 y	Demographics
(D) Diabetes mellitus	Care program diabetes mellitus
	Diabetes mellitus convention
	HbA1c ≥ 6.5%
	Therapy with antidiabetic drugs
(S_2) Stroke	Care program stroke or transient ischemic attack
	Therapy with dipyridamole-acetylsalicylic acid
(V) Vascular disease	Care program coronary or peripheral artery disease
	Surgical procedure percutaneous coronary intervention
	Therapy with organic nitrates
	Therapy with molsidomine
	Therapy with clopidogrel / ticagrelor / prasugrel
(A) Age 65-74 y	Demographics
(Sc) Sex (female gender)	Demographics
STEP 3) determining whether anticoagulant treatment is prescribed	
Oral anticoagulants	Therapy with VKA or NOAC
Parenteral anticoagulants	Therapy with heparins

VKA: vitamin K antagonist, NOAC: non-vitamin K oral anticoagulant
**Cardiovascular medication: diuretics, beta blocking agents, calcium channel blockers and agents acting on the renin-angiotensin system*

Table 2. *Calculating the priority score*

Sex category	CHA_2DS_2-VASc	Anticoagulants in pre-admission therapy	Anticoagulants during hospitalization	Priority score
♂ / ♀	< 2	Not applicable	Not applicable	0
♂ / ♀	≥ 2	Oral anticoagulants	Oral anticoagulants	0
♂ / ♀	≥ 2	Heparins	Heparins	0
♂ / ♀	≥ 2	/	Oral anticoagulants	0
♂ / ♀	≥ 2	Oral anticoagulants	Heparins	1
♂ / ♀	≥ 2	/	Heparins	2
♂ / ♀	≥ 2	Oral anticoagulants or heparins	/	3
♀	2	/	/	4
♀	≥ 3	/	/	5
♂	≥ 2	/	/	5

Methods

- A computerized screening algorithm was developed integrating pre-specified **data from the electronic health record (EHR):** demographics, care program allocation, laboratory values, medication data, ECG reports, medical and surgical records.
- A decision process was applied, consisting of **1) establishing AF or atrial flutter diagnosis, 2) calculating the CHA_2DS_2-VASc-score and 3) determining whether anticoagulants were present during hospitalization and/or in the pre-admission therapy** (Table 1). Subsequently, based on these three steps, **a priority score** was assigned to the patient, ranging from 0 (no risk) to 5 (highest risk of undertreatment) (Table 2).
- To assess the accuracy of this algorithm, a **cross-sectional study** was performed, comparing the results of the algorithm with a manual check of the EHR.
- Two datasets were defined: A) for **400 patients, admitted on the cardiology and geriatric ward,** the correct identification of the AF diagnosis was evaluated; and B) **400 patients assigned by the algorithm as having AF** and for whom a priority score was calculated, were included and reviewed to evaluate the individual screening criteria and the overall priority score.
- Criterion and algorithm validity were ascertained by determining **sensitivity and specificity.** Consistency regarding the priority score was determined by estimating **Cohen's kappa**.

Results

Dataset A (n = 400):

- AF was manually detected in 183 patients (45.8%), of which 180 patients were identified by the screening algorithm.
- **Sensitivity and specificity** of the screening algorithm for **AF diagnosis** were 98.4% and 87.6%, respectively.

Dataset B (n = 400):

- AF was manually confirmed in 362 patients (PPV 90.5%).
- A high risk for stroke ($CHA_2DS_2VASc \geq 2$) was found in 313 patients (86.5%) of which **45 patients (12.4%) did not receive anticoagulation therapy**.
- Overall **sensitivity and specificity** for identification of AF patients with a **CHA_2DS_2-VASc ≥ 2** was 97.7% and 72.7%.
- **Sensitivity and specificity** to determine the **presence of anticoagulant treatment** was at least 87.8% and 97.1%.
- There was **good agreement between the overall priority score** obtained by the researchers after EHR review and the one generated by the screening algorithm (κ 0.74).

Discussion

- Our hospital-wide computerized screening algorithm was able to **identify untreated AF inpatients reliably and with a high sensitivity**. Nearly no patients were missed by our novel approach.
- To further improve specificity, future investigations might focus on **better digital structuring** of patient data.
- Our future goal is to **implement** the AF-screening algorithm in **clinical practice** to improve the use of preventative therapy and **reduce the significant burden of stroke**.