Electronic Health Record-Based Clinical Decision Support for Stroke Prevention in Atrial Fibrillation (CDS-AF)

Magnus Janzon
Senior Consultant, Cardiologist, Head of Cardiology Department, Associate Professor
University Hospital Linköping, Region Östergötland
Faculty of Medicine and Health Sciences, Linköping University
DEVELOPMENT OF CLINICAL DECISION SUPPORT AND THE NECESSARY REQUIREMENTS FOR INTEROPERABILITY AND OPEN SYSTEMS

• HIMSS Nordic e-Health exchange at HIMSS Orlando 2017
• Date and time: 21\textsuperscript{th} February. 12:00 AM–1:00 PM
• Location: Orange County Convention Centre, 110B (The Nordic Community Room)
The problem
How big is the problem, in Sweden?

Prevalence of atrial fibrillation (AF) in the general population in relation to age and sex.

More than 300,000 patients in Sweden!

Prevalence 3.2%
How big is the problem?

- 30 000 strokes/year (totally in Sweden)
- Stroke leads to disability
- Impair the patient's quality of life and even for the relatives

- If 20% of all strokes is caused by atrial fibrillation, the cost of hospitalisation and care is US$ 560.000.000!
- US$ 67.300 – The cost of rehabilitation first year after a stroke

Ref: Björck et al. Stroke 2013;44:3103-3108
How big is the problem, in United States?

Prevalence 2.3 %

More than 7,5 million patients in United States!

Ref: Am J Cardiol 2013;112:1142e1147
2016 ESC Guidelines for the management of atrial fibrillation
Cardiovascular morbidity and mortality associated with atrial fibrillation

<table>
<thead>
<tr>
<th>Event</th>
<th>Association with AF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death</td>
<td>Increased mortality, especially cardiovascular mortality due to sudden death, heart failure or stroke.</td>
</tr>
<tr>
<td>Stroke</td>
<td>20–30% of all strokes are due to AF. A growing number of patients with stroke are diagnosed with ‘silent’, paroxysmal AF.</td>
</tr>
<tr>
<td>Hospitalizations</td>
<td>10–40% of AF patients are hospitalized every year.</td>
</tr>
<tr>
<td>Quality of life</td>
<td>Quality of life is impaired in AF patients independent of other cardiovascular conditions.</td>
</tr>
<tr>
<td>Left ventricular dysfunction and heart failure</td>
<td>Left ventricular dysfunction is found in 20–30% of all AF patients. AF causes or aggravates LV dysfunction in many AF patients, while others have completely preserved LV function despite long-standing AF.</td>
</tr>
<tr>
<td>Cognitive decline and vascular dementia</td>
<td>Cognitive decline and vascular dementia can develop even in anticoagulated AF patients. Brain white matter lesions are more common in AF patients than in patients without AF.</td>
</tr>
</tbody>
</table>
The solution

Pradaxa® (Dabigatran)

Eliquis® (Apixaban)

Lixiana® (Edoxaban)

Waran® (Warfarin)

Xarelto® (Rivaroxaban)

Left atrial appendage occlusion
The solution

- Congestive heart failure
- Hypertension
- Age $\geq 75$
- Diabetes mellitus
- Stroke/thromboembolism
- Vascular disease
- Age $> 65$
- Sex category

$\text{CHA}_2\text{DS}_2\text{VASc} \geq 1 = \text{Anticoagulant treatment}$

# Prediction of stroke and bleeding risk

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>The CHA$_2$DS$_2$-VASc score is recommended for stroke risk prediction in patients with AF.</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>Bleeding risk scores should be considered in AF patients on oral anticoagulation to identify modifiable risk factors for major bleeding.</td>
<td>IIa</td>
<td>B</td>
</tr>
<tr>
<td>Biomarkers such as high-sensitivity troponin and natriuretic peptide may be considered to further refine stroke and bleeding risk in AF patients.</td>
<td>IIb</td>
<td>B</td>
</tr>
</tbody>
</table>
Clinical risk factors for stroke, transient ischaemic attack, and systemic embolism

<table>
<thead>
<tr>
<th>CHA₂DS₂-VASc risk factor</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congestive heart failure</td>
<td>1</td>
</tr>
<tr>
<td>Signs/symptoms of heart failure or objective evidence of reduced left-ventricular ejection fraction</td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>1</td>
</tr>
<tr>
<td>Resting blood pressure &gt;140/90 mmHg on at least two occasions or current antihypertensive treatment</td>
<td></td>
</tr>
<tr>
<td>Age 75 years or older</td>
<td>2</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1</td>
</tr>
<tr>
<td>Fasting glucose &gt;125 mg/dL (7 mmol/L) or treatment with oral hypoglycaemic agent and/or insulin</td>
<td></td>
</tr>
<tr>
<td>Previous stroke, transient ischaemic attack, or thromboembolism</td>
<td>2</td>
</tr>
<tr>
<td>Vascular disease</td>
<td>1</td>
</tr>
<tr>
<td>Previous myocardial infarction, peripheral artery disease, or aortic plaque</td>
<td></td>
</tr>
<tr>
<td>Age 65–74 years</td>
<td>1</td>
</tr>
<tr>
<td>Sex category (female)</td>
<td>1</td>
</tr>
</tbody>
</table>
## Stroke prevention in patients with atrial fibrillation (1)

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral anticoagulation therapy to prevent thromboembolism is recommended for all male AF patients with a CHA(_2)DS(_2)-VASc score of 2 or more.</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>Oral anticoagulation therapy to prevent thromboembolism is recommended in all female AF patients with a CHA(_2)DS(_2)-VASc score of 3 or more.</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>Oral anticoagulation therapy to prevent thromboembolism should be considered in male AF patients with a CHA(_2)DS(_2)-VASc score of 1, considering individual characteristics and patient preferences.</td>
<td>IIa</td>
<td>B</td>
</tr>
<tr>
<td>Oral anticoagulation therapy to prevent thromboembolism should be considered in female AF patients with a CHA(_2)DS(_2)-VASc score of 2, considering individual characteristics and patient preferences.</td>
<td>IIa</td>
<td>B</td>
</tr>
<tr>
<td>Vitamin K antagonist therapy (INR 2.0–3.0 or higher) is recommended for stroke prevention in AF patients with moderate-to-severe mitral stenosis or mechanical heart valves.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>When oral anticoagulation is initiated in a patient with AF who is eligible for a NOAC (apixaban, dabigatran, edoxaban, or rivaroxaban), a NOAC is recommended in preference to a Vitamin K antagonist.</td>
<td>I</td>
<td>A</td>
</tr>
</tbody>
</table>
The problem with the solution

Most AF patients do not receive anticoagulation!

Warfarin use among 307,476 Swedish AF patients

Warfarin use decreased as the risk of stroke increased!

42 %

Friberg et al, Journal of Internal Medicine 2013
But... the use of anticoagulant treatment is slowly increasing

Ref: Swedish Patientregister, Open Comparisons in Sweden 2015

- CHA$_2$DS$_2$VASc ≥ 2
- Hospitalized patients
The Case:
The County of Östergötland
County of Östergötland January 1, 2016

- Population: 444,347
- Number of patients with atrial fibrillation: 13,379
- Prevalence atrial fibrillation: 3.0%
- Patients treated according to guidelines: 70%
Variation among 43 Primary Care Centers 2016

The Swedish National Board of Health and Welfare, National Guidelines: Goal 80%

Uptake is suboptimal!
What to be done?

• Information/Education
• New pharmaceuticals/device
• Screening

• Clinical decision tools – the CDS?
The patient is non-compliant with the ESC guidelines for stroke prevention in Atrial Fibrillation because there is no anticoagulation medication(s) prescribed.
**CHADS2-VASc Score**

<table>
<thead>
<tr>
<th>Category</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congestive Heart failure</td>
<td>1</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1</td>
</tr>
<tr>
<td>Age ≥ 75</td>
<td>1</td>
</tr>
<tr>
<td>Diabetes</td>
<td>1</td>
</tr>
<tr>
<td>Stroke/TIA/Thromboembolism</td>
<td>1</td>
</tr>
<tr>
<td>Vascular disease</td>
<td>1</td>
</tr>
<tr>
<td>Age between 65 and 74</td>
<td>1</td>
</tr>
<tr>
<td>Sex female</td>
<td>1</td>
</tr>
<tr>
<td>Total score</td>
<td>7</td>
</tr>
</tbody>
</table>

**Stroke Prevention CDS App**

- **Diagnosis**
  - Atrial fibrillation
  - Congestive heart failure
  - Hypertension
  - Diabetes
  - Stroke/TIA/Thromboembolism
  - Vascular disease

- **Clinical assessment**
  - Present
  - Absent

- **Not-compliant with ESC guidelines**

- **Recommended treatment based on CHADS2-VASc**
  - NOAC or VKA
  - Anti-coagulation medication absent

- **Reference**
  - Socialstyrelsen: Nationella riktlinjer för hjärtsjukvård 2015 – Vetenskaplig underlag

**Prescription**

- **Medication list**: 

**Medical Decision**

- Make a decision now
- Postpone the decision for 

**Additional comment**
<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Clinical assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrial fibrillation</td>
<td>○ Present ○ Absent</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>○ Present ○ Absent</td>
</tr>
<tr>
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<td>○ Present ○ Absent</td>
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<td>○ Present ○ Absent</td>
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<tr>
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<td>○ Present ○ Absent</td>
</tr>
<tr>
<td>Vascular disease</td>
<td>○ Present ○ Absent</td>
</tr>
</tbody>
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**CHA₂DS₂-VASc Score**

<table>
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<tr>
<th>Category</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>C Congestive heart failure</td>
<td>0</td>
</tr>
<tr>
<td>H Hypertension</td>
<td>1</td>
</tr>
<tr>
<td>A₂ Age ≥ 75</td>
<td>0</td>
</tr>
<tr>
<td>D Diabetes</td>
<td>1</td>
</tr>
<tr>
<td>S₂ Stroke/TIA/Thromboembolism</td>
<td>0</td>
</tr>
<tr>
<td>V Vascular disease</td>
<td>1</td>
</tr>
<tr>
<td>A Age between 65 and 74</td>
<td>1</td>
</tr>
<tr>
<td>Sc Sex female</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total score</strong></td>
<td><strong>4</strong></td>
</tr>
</tbody>
</table>
Not-compliant with ESC guidelines

CHA(2)DS(2)-VASC Score 4

Stroke risk: 4.8%

Recommended treatment based on CHA(2)DS(2)-VASC: NOAC or VKA

Anti-coagulation medication absent

Reference: Socialstyrelsen: Nationella riktlinjer för hälso- och sjukvård 2015 – Vetenskapsrådet underlag

Prescription:

Medication list: 

Note: NOACs should not be given in atrial fibrillation with simultaneous mitral stenosis, or mechanical heart valve.

Medical Decision:

- Make a decision now
- Postpone the decision for

Additional comment:

Stroke Prevention CDS App
Anticoagulant treatment should be considered according to National Guidelines.

Non-compliant with ESC guidelines

CHA₂DS₂-VASc Score: 4

Stroke risk: **4.0%**

Recommended treatment based on CHA₂DS₂-VASc: NOAC or VKA

Anti-coagulation medication absent

Reference: Socialstyrelsen: Nationella riktlinjer för hjärtsjukvård 2015 – Vetenskapligt underlag

Prescription

Medication list: ▼

Note: NOACs should not be given in atrial fibrillation with simultaneous mitral stenosis, or mechanical heart valve.

Medical Decision

- Make a decision now
- Postpone the decision for ▼

Additional comment: ▼
Generated documentation and decision

Documentation automated generated by CDS application

Documentation entered by clinician
Pilot Study

• September-November 2014

• Five units:
  • Department of Acute Medicine, University Hospital
  • Department of Internal Medicine, Motala
  • Three Primary Care Centers (Kärna, Vikbolandet, Åby)

• Totally 113 different users = Physicians
Results from the Pilot Study

• All physicians got a 30 minutes education regarding the CDS within the Electronic Health Record system before activation of the system

• Outcomes:
  • User friendly system, 89 % of the users found it easy
  • Some recommendations regarding pop-up windows, text flow captured by questionnaires and interviews
  • Better compliance to guidelines

• Modifications performed
The Dental and Pharmaceutical Benefits Agency, TLV

Health economic evaluation of computerized decision support tool for stroke prevention

Summary: A tool that increases adherence to treatment guidelines for patients with atrial fibrillation and increased stroke risk has great potential to provide health benefits and to be cost-effective

Published December 2014, www.tlv.se
Rationale for the CDS-AF Study

• Different applications are underway

• Weak scientific basis
  • Alert fatigue?
  • Shift of attention?
  • Bleeding?
  • False safety?
AURAS-AF (Automated Risk Assessment for Stroke in Atrial Fibrillation)

Online 24th January 2017:

Stroke. 2017;48:00-00. DOI: 10.1161/STROKEAHA.116.015468.
AURAS-AF

• 570 practices identified as potentially eligible, 70 expressions of interest
• 47 practices were randomized
• Screen reminders appeared each time the electronic health records of an eligible patient was accessed until a decision had been taken over OAC treatment
• No statistical significant change in OAC prescribing occurred after 6 months
• Reduction of borderline significance in strokes of all types (P=0.06) and of hemorrhage (P=0.054) at 12 months
• No adverse effects of the software were reported

Stroke. 2017;48:00-00. DOI: 10.1161/STROKEAHA.116.015468.
Rationale for the CDS-AF Study

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• Weak scientific basis
  • Alert fatigue?
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The CDS-AF Study

- Approval from Ethical Committee, autumn 2015
- Educational meetings for all primary care centers, autumn 2015
- Randomization/stratification by statisticians Forum Östergötland
- Technical education at all randomised primary care centers, autumn 2015
- Study start January 11, 2016
- Registered at www.clinicaltrials.gov
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February 2017 accepted for publication in American Heart Journal
The main objectives of the study are as follows, to investigate:

- Whether a clinical decision support system for stroke prevention in AF can increase adherence to guidelines in the primary care setting compared to standard care.
- Whether a clinical decision support system can reduce the incidence of stroke and thromboembolism compared to standard care.
- The impact on health economics of a clinical decision support system in patients with AF.
- The physician’s experiences of the clinical usage of our CDS.
- The reasons for deviation from guidelines regarding anticoagulant therapy in patients with AF.
All primary care centers in the County of Östergötland (n=43)

CDS (n=22)

Adherence to guidelines 12 months

Control group (n=21)

Adherence to guidelines 12 months

February 2017 accepted for publication in American Heart Journal
Secondary endpoints

• Clinical events thromboembolism/bleeding
• Health Economic evaluation
• User analysis in collaboration with Department of Computer Science, Linköping University
• Analysis of prescriptions picked-up of patients through linkages with the Medical Register
• Analysis regarding reasons for deviation from guidelines

• Safety analysis by Data Safety and Monitoring Board

February 2017 accepted for publication in American Heart Journal
Collaboration

• Dept of Cardiology, University Hospital
• Dept of Computer Science, Linköping University

• Technicians, Region Östergötland
• Cambio Cosmic
Summary

• Significant low treatment with anticoagulation in patients with atrial fibrillation
• Slow improvement
• The Swedish National Board of Health and Welfare, goal: 80 %
• The CDS in the pilot study – promising results
• Large scientific CDS-AF Study of all primary care units in the County of Östergötland is ongoing
• Results expected to be presented Q3 2017, ESC 2017 in Barcelona

• Other exciting areas for CDS?
• To find and treat patients with high levels of cholesterol – Familial hypercholesterolemia
Clinical decision support for stroke prevention in atrial fibrillation (CDS-AF): Rationale and design of a cluster randomized trial in the primary care setting

• 11th February 2017:
• Accepted for publication in American Heart Journal
Thank you!
Magnus Janzon, Senior Consultant, Cardiologist, Head of Cardiology Department, Associate Professor
University Hospital Linköping, Region Östergötland
Faculty of Medicine and Health Sciences, Linköping University
magnus.janzon@regionostergotland.se
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