AFGuide System to Support Personalized Management of Atrial Fibrillation

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Outline

• Motivation
• Existing Tools
• AFGuide
• Discussion
Motivation

• Atrial fibrillation (AF) constitutes a serious public health problem
  • Aging population [Chugh et al. 2014]

• Oral anticoagulant (OAC) therapy is sub-optimal [Cotte et al. 2014]
  • Vitamin K antagonists (VKAs), e.g. Warfarin

• Newly developed direct OACs (DOACs) are: [Giugliano et al. 2013]
  • Faster
  • More predictable and sustainable anticoagulation
  • Similar effectiveness as VKAs in stroke prevention
  • Lower bleeding and risk of death from CV causes
What’s The Problem?

• OAC management is suboptimal
  • Only 10% of AF patients with first acute stroke were therapeutically anti-coagulated at the time of admission [Gladstone et al., 2009]
  • A significant portion of primary care patients not treated according to AF CPGS [Valentinis et al. 2014]

Knowledge gap present for primary care physicians (PCPs)

Optimal OAC therapy can prevent approximately 80% of AF-related strokes
Barriers to Knowledge Uptake [Murray et al. 2011]

1. Lack of up-to-date knowledge about new therapies
2. Difficulty using clinical practice guidelines (CPGs) for multimorbidity
3. Lowered compliance due to lack of patients’ engagement

**AFGuide**

A clinical decision support system (CDSS) to educate and support PCPs in developing optimal OAC therapy to improve patient management
## Existing Tools

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<th>Multi-morbidity</th>
<th>Patient preferences and adherence</th>
<th>Automatically or semi-automatically executable</th>
<th>Mobile</th>
<th>Comparison of therapies</th>
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Proposed system being implemented
AFGuide – Medical & Patient Context

• Executable CPG
  • Canadian Cardiovascular Society’s (CCS) CPG for AF
  • Potential adverse events when managing a multimorbid patient
  • Represented as an actionable graph based on SDA*

• Patient Adherence-to-Therapy and Preference Models
  • Create baseline models using Generalized Regression with Intensities of Preference (GRIP) method [O’Sullivan et al. 2014]
    • Represented as additive value function
  • Capture and operationalize patient preferences [Michalowski et al. 2015]
  • Advanced evaluation of derived OAC therapies
AFGuide

Collection, retrieval and revision of patient data

- Patient context
  - Executable medical secondary knowledge
    - Risk-related operators
    - Mitigation-related operators
  - Executable medical primary knowledge
    - CCS AF guideline
- Stroke and bleeding risk assessor
  - Final risk assessment
- Therapy generator
  - A ranking of feasible OAC therapies
- Therapy explainer
  - Clinical evidence
- Model manager and learner
  - Baseline and customized patient models
    - Adherence-to-therapy models
    - Preference models

Monitoring of PCP-patient interactions and customization of patient models

Interactions between PCP and patient
Interactions between PCP and AFGuide system
Interactions within AFGuide system and between system and repositories with knowledge, models and evidence

AFGuide system component
Repository with primary knowledge
Repository with secondary knowledge
Repository with adherence-to-therapy or preference models
External repository with evidence
AFGuide - Stroke and Bleeding Risk Assessor

• Risk-related operators represented as a First-Order Logic (FOL) theory
• Compute stroke and bleeding risk scores based on patient data
  • Stroke risk (CHA₂DS₂-VASc)
  • Bleeding risk (HAS-BLED)
• Takes into account patient context for comprehensive assessment
• Used in therapy development
AFGuide - Therapy Generator and Explainer

• *Generator* Derives feasible OAC therapies using FOL [Wilk et al., 2016]
  • Theorem proving and model finding techniques
  • Mitigates any adverse interactions (multimorbidity)
  • Ranks recommended OAC therapies according to their confidence levels
    • Stroke and bleeding risk assessment
    • Scoring functions associated with adherence-to-therapy and preference models
  • PCP can select any therapy from the list
    • Revise the patient context

• *Explainer* On-request justification for each therapy in the ranked list
  • Reviews from the Cochrane Database of Systematic Reviews [O’Sullivan et al. 2010]
AFGuide - Model Manager and Learner

- **Management** Automatically selects the adherence-to-therapy and preference models for new patient
- **Learning** During PCP-patient encounter
  - Observes interactions and therapy choices
  - Customizes baseline adherence-to-therapy and preference models for a given patient using feedback loop
- Transforms population-based baseline models into customized patient-specific ones
AFGuide – Tools for Implementation
Discussion - Goals

• Narrow the knowledge gap among PCPs w.r.t. optimal OAC therapy for patients with AF

  1. Decision support for PCPs
    • Address the complexities of evidence-based OAC therapy development

  2. Derive an evidence-based OAC therapy
    • Patient-specific
    • Multimorbidity
    • Patient Preferences
    • PCP education
Discussion – Current Status

• Designed AFGuide
  • Developed: executable CPG, FOL models, therapy explainer and generator
  • Under development: model manager and learner, stroke and bleeding risk assessor

• Ongoing: Integration of all components

• Ongoing: Working with clinical partners to design the evaluation studies
Questions?
Thank you!

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MET Research:
http://www.mobiledss.uottawa.ca
References


• Cotte, F. E.; Benhaddi, H.; Duprat-Lomon, I.; Doble, A.; Marchant, N.; Letierce, A.; and Huguet, M. 2014. Vitamin k antagonist treatment in patients with atrial fibrillation and time in therapeutic range in four European countries. Clin Ther 36(9):1160–8


References


Designed Evaluation

• Two-phase evaluation study
  1. Usability study involving PCPs
     • Interact with AFGuide when deriving a therapy using clinical vignettes
     • System Usability Scale [U.S. Department of Health & Human Services 2016]
  2. Clinical validation
     • In collaboration with selected Canadian hospitals