

S84: Expanding a First-Order Logic Mitigation Framework to Handle Multimorbid Patient Preferences



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Disclosure

- Dr. Wojtek Michalowski discloses that he has no relationships with commercial interests

Learning Objectives

- After participating in this activity, the learner should be better able to:
 - Understand the importance of mitigating adverse interactions when concurrently applying multiple clinical practice guidelines (CPGs) to a multimorbid patient
 - Understand how patient preferences might be elicited and encoded
 - Understand the interplay between CPGs, secondary knowledge, and patient preferences when developing therapeutic scenarios for multimorbid patients

Outline

- Motivation
- Related Work
- Proposed Framework
- Illustrative Clinical Scenario
- Discussion

Motivation

- Patient preferences – *the desirability of a health-related outcome, process, or treatment option* [Krahn & Naglie 2008]
- Preferences together with evidence and clinical experience are the components of evidence-based medicine [McCormack & Loewen 2007]
- Difficulty with concurrent use of multiple CPGs for multimorbid patients is “major shortcoming of CPG uptake in clinical practice” [Peleg 2013]
- Representation of CPGs, secondary knowledge, and patient information have been formalized [Latoszek-Berendsen et al. 2010]

Related Work

- Patient decision aid tools [van der Weijden et al. 2012; Stacey et al. 2014]
- Embedding patient preferences in CDSS [Sacchi et al. 2013; Garcia-Saez et al. 2014]
- Eliciting preferences [van der Weijden et al 2010, 2012]

Proposed Framework: Background

- Mitigates adverse interactions in multiple CPGs applied to a multimorbid patient [Wilk et al. 2013, 2014; Michalowski et al. 2013, 2014]
- Grounded in first order logic (FOL) paradigm
- Uses revision operators to codify secondary medical knowledge
- Applies theorem proving and model finding techniques to propose therapeutic scenario

Proposed Framework: Steps

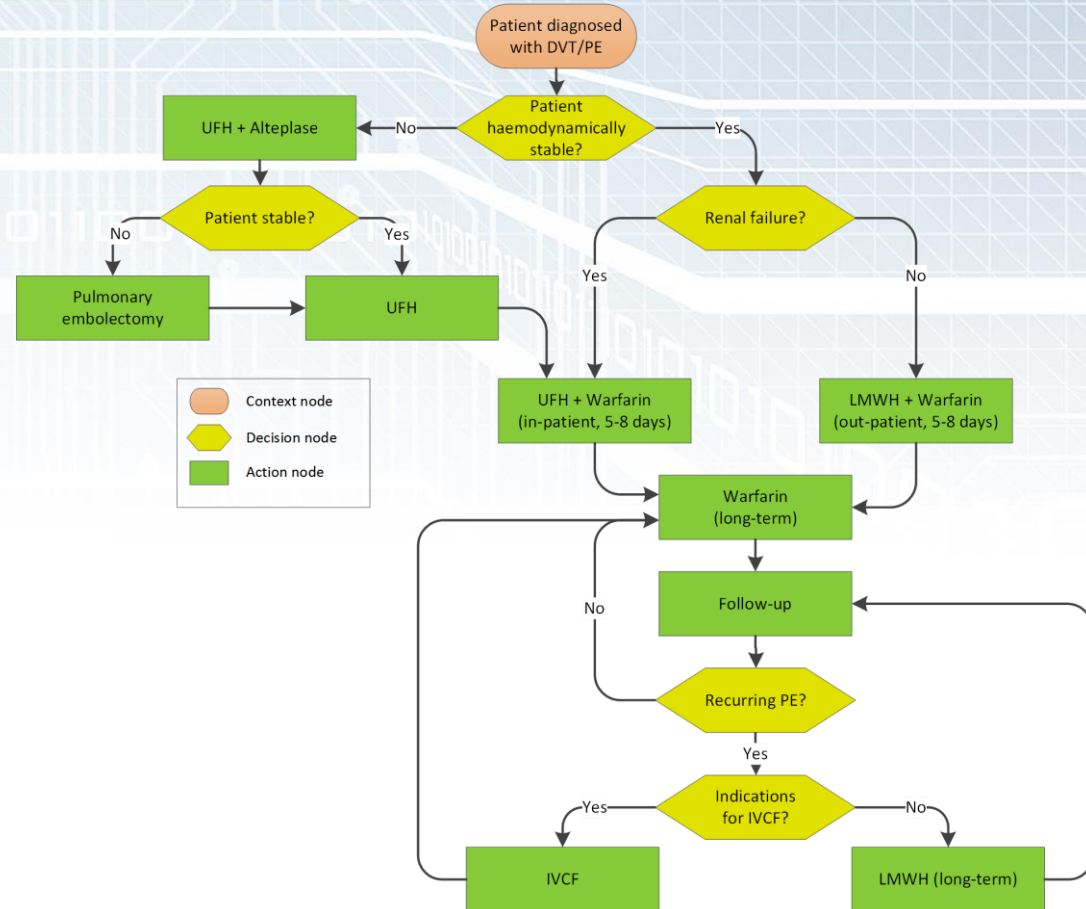
1. Elicit patient preferences (pairwise comparison, GRIP method [O'Sullivan et al. 2014])
2. Translate elicited preferences into preference-related revision operators
3. Apply extended mitigation algorithm with preference-related and interaction-related revision operators
4. Find consistent (and preferred) therapeutic scenario

Extended Mitigation Algorithm

- 1 Order preference-related revision operators according to their decreasing priorities
- 2 For each revision operator do
- 3 If the revision operator is applicable to CPGs and patient data, then
 - 4 Temporarily revise CPGs using the operator
 - 5 Mitigate adverse interactions in revised CPGS
 - 6 If mitigation is successful then
 - 7 Accept introduced revisions
 - Else
 - 8 Reject introduced revisions
- 9 Develop therapeutic scenario from CPGs and patient data

Illustrative Clinical Scenario

Patient with stable coronary artery disease (SCAD) complains about swelling and tenderness in left leg. An ultrasound and D-dimer test confirm DVT/PE (deep vein thrombosis/pulmonary embolism). Management of DVT/PE follows a guideline.



Illustrative Clinical Scenario: Treatment Options

- Development of novel oral anticoagulants (NOACs) opens new treatment options
- DVT/PE management may involve:
 - LMWH + warfarin (requires blood work) → default treatment indicated by the CPG
 - LMWH (injection) for 5 days followed by NOAC (dabigatram) twice daily (no blood work)
 - NOAC - rivaroxaban once a day or apixaban twice a day (no blood work)

Illustrative Clinical Scenario: Patient Preferences

- Pairwise comparison of hypothetical treatments
- Development of a preference model (codified and formalized preferences)
- Translation of a model into a preference-related revision operator

	RO ²
α^2 : applicability condition	<i>diagnosed(DVT/PE) \wedge executed(LMWH) \wedge executed(warfarin)</i>
Op^2 : revisions	<i><executed(LMWH) \wedge executed(warfarin), executed(rivaroxaban)></i>

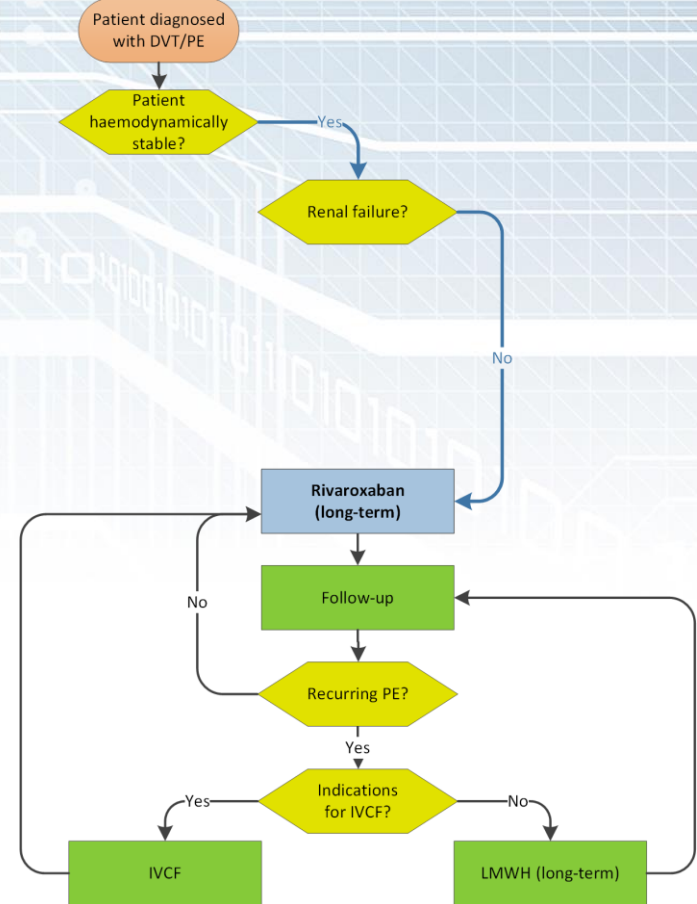
Illustrative Clinical Scenario:

Applying Mitigation Framework

- SCAD and DVT/PE patient is haemodynamically stable with renal failure ruled out
- Entailment identifies applicability of preference-related revision operator (RO^2)
- Relevant fragment of DVT/PE CPG (represented as logical theory) is modified
- Therapeutic scenario now includes rivaroxaban instead of LMWH + warfarin

Illustrative Clinical Scenario: Revised CPG for DVT/PE

Components of a CPG that do not match patient data are excluded from analysis and processing



Discussion

- Unified representation of patient preferences and secondary medical knowledge
- Extended mitigation framework seamlessly checks for applicability of the preferences
- Future work involves temporal interactions and development of an interactive CDSS implementing the framework



Questions?
Thank you!

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