Development of a Taxonomy of Setting-Specific Factors for Adaptation of Clinical Decision Support Rules

David Yauch[1]; Pamela H. Kum, MA[2]; Samson W. Tu, MS[3]; Peter Haug, MD[4]; Nathan Hulse, PhD[4]; Emory A. Fry, MD[5]; Robert A. Greenes, MD, PhD[1,6]; Davide Sottara, PhD[1]; Mary K. Goldstein, MD, MS[2,3]

[1]Arizona State University, Scottsdale, AZ; [2]VA Palo Alto Health Care System, Palo Alto, CA; [3]Stanford University, Palo Alto, CA; [4]Intermountain Healthcare, Salt Lake City, UT; [5]Naval Health Research Center, San Diego, CA; [6]Mayo Clinic, Scottsdale, AZ

Abstract

This research examines how a general clinical decision support (CDS) rule can be incrementally customized to take into account setting-specific factors. We classify the kinds of adaptations that are used in several examined practice settings and generalize these findings. This work serves as an underpinning for the design of an Implementer's Workbench, a tool that will facilitate adaptation of best practice rules by non-information technology (IT) specialist users for their settings

Introduction

Clinical decision support (CDS) rules that are written generically for use in any health care setting require customization when implemented by a particular practice or health care system (HCS). This process has been found typically to require considerable time and effort, as well as IT expertise and is an obstacle to wider sharing and use of best practice clinical knowledge. This is particularly true for smaller non-academic practices or HCSs. For example, each HCS must indicate when a rule should trigger, the method by which health professionals are alerted when it triggers, with whom a rule should interact when data are needed, any modifications of thresholds, timing for alerting, and nature and form of transmission of advice or actions as a result of the rule firing. We call such considerations setting-specific factors (SSFs), and consider the customization of a rule using SSFs as stage 3 in a 4-stage rule refinement model, which was originally developed as part of the Morningside Initiative [1].

Stage	Description
1	Evidence-based medicine statement in which key information is organized into high-level sections. (ex. Who? What? When?) Headers are structured and content is unstructured.
2	Refined version of stage 1 with structured content. Rule is structured and setting-independent.
3	Stage 2 rule refined using SSFs. Fully structured, setting-specific rule. This stage is iterative.
4	Stage 3 rule converted (semi)automatically to code, a (business) rules language, or other locally actionable format.

This project aims to facilitate the process that will allow HCSs to adapt general CDS rules using SSFs pertaining to their environment, (1) by refinement of a taxonomy of SSFs through examination of existing installed rule bases in several leading healthcare institutions; and (2) by examining workflow considerations and desiderata of several practices. The taxonomy is also informed by previous research efforts, namely, the NQF CDS Taxonomy [2] and the Structuring Care Recommendations for Clinical Decision Support "Implementation Considerations" (also known as "e-Recommendations") report [3].

Methods

Initial Taxonomy Construction

- Used "Implementation Considerations" list from SCRCDS effort as a starting point. Project team members also had been on that project.
- A mapping from this list to elements of the NQF CDS Taxonomy was completed as part of that project; therefore, the NQF CDS taxonomy was leveraged implicitly.

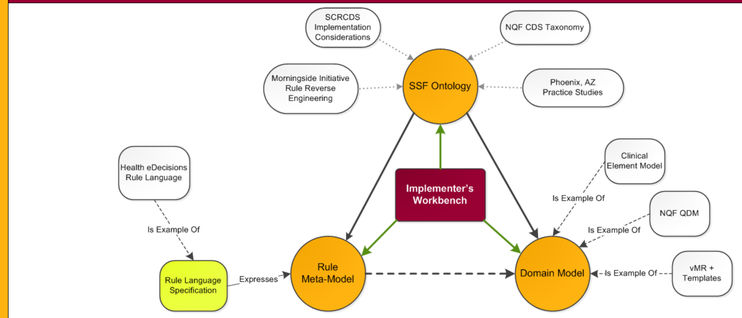
Refinement Through Analysis of Existing Rules

- CDS rules gathered from the Morningside Initiative for diabetes management were used in a "reverse engineering" evaluation.
- A standard form was developed to guide the process of distilling a starting expression and set of SSFs from each implemented rule.
- A clinician evaluated each rule and documented the adaptations used in each healthcare setting.
- The resulting adaptations were merged into the existing taxonomy.

Refinement Through Direct Observation of Medical Practices

- Three practices in the Phoenix, Arizona, metropolitan area were studied through direct observation and interviews.*
- Practices ranged from a single-site, single-provider family practice to a multi-site, multi-specialty practice.
- Each practice also used a different commercially-available EHR.
- The inclusion of individual provider offices in this research revealed an important insight that had not been noted in the other sources: business considerations also impacted rules, e.g., insurance coverage may influence the recommended treatment by including or excluding coverage of certain procedures (for instance, at least one plan accepted at all three sites does not cover diabetic foot exams).

Design of Implementer's Workbench: A Semantically Constrained Knowledge Editor



Rule Refinement Process (Stage 2 → Stage 3)

Our focus was on the process of creating a stage-3 rule, starting with a stage-2 rule in our 4-stage rule-refinement model. This consisted of iterative evolution of the stage-3 rule by selecting and incorporating SSFs.

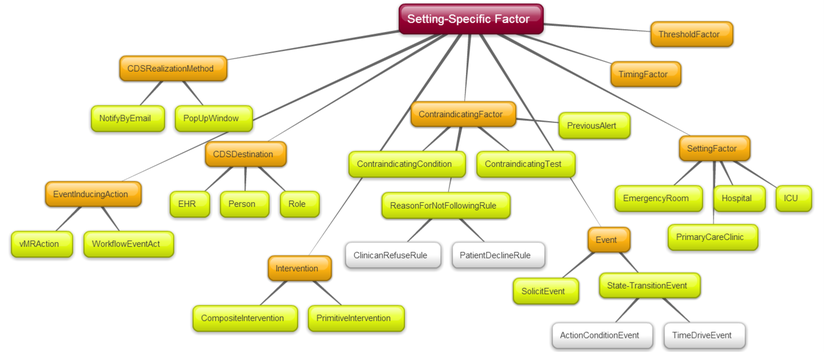
Notes: An *ad hoc* syntax is used in the table for describing the refinements and presenting the evolving rule to enhance readability.

In the Implementer's Workbench, graphical metaphors are under development to enable authoring by subject matter experts without extensive training in logic formalisms.

The rules are exported in a standard format such as the emerging Health eDecisions rule syntax, which can be later converted to a host language.

Description (Site-Specific Difference)	Post-Editing Expression
Initial expression:	**If Diabetes_Present and exist Last_HgA1C and Last_HgA1C Occurred after 6 months ago**
Add inclusion criteria: Last HgA1c before 5 months ago.	If Diabetes_Present and exist Last_HgA1C and Last_HgA1C Occurred after 6 months ago ***and Last_HgA1c Occurred before 5 months ago***
Specify Intervention: Recommend HgA1c	Logic: If Diabetes_Present and exist Last_HgA1C and Last_HgA1C Occurred after 6 months ago and Last_HgA1c Occurred before 5 months ago ***Intervention: Recommend HgA1c***
Specify Intervention: Display message "Pt. Almost due for HgA1c"	Logic: If Diabetes_Present and exist Last_HgA1C and Last_HgA1C Occurred after 6 months ago and Last_HgA1c Occurred before 5 months ago Intervention: Order HgA1c ***and display message "Pt. Almost due for HgA1c"***
Add Trigger: On chart open by attending physician	***Trigger: OnChartOpen (User:=AttendingPhysician)*** Logic: If Diabetes_Present and exist Last_HgA1C and Last_HgA1C Occurred after 6 months ago and Last_HgA1c Occurred before 5 months ago Intervention: Order HgA1c and display message "Pt. Almost due for HgA1c"
Specify Setting: Inpatient Status and NOT ICU_Inpatient	Trigger: OnChartOpen (User:=AttendingPhysician) ***Setting: Pt.Status.Type = Inpatient and NOT Pt.Status.Location = ICU*** Logic: If Diabetes_Present and exist Last_HgA1C and Last_HgA1C Occurred after 6 months ago and Last_HgA1c Occurred before 5 months ago Intervention: Order HgA1c and display message "Pt. Almost due for HgA1c"

Draft Taxonomy



Summary/Future Work

Summary

- A taxonomy was developed to capture the types of variations introduced in rules as they are deployed to a specific setting.
- Synthesis of prior research and novel data collection were used to create and expand the taxonomy.
- The taxonomy will be used in rule authoring/refinement software (the Implementer's Workbench) being developed for subject matter experts.

Future Work

- Currently constructing a software tool (the Implementer's Workbench) to allow users to create and customize CDS rules.
- Active participation in the ONC Health eDecisions initiative to support robust knowledge authoring standards.
- Validation of the SSF taxonomy through Implementer's Workbench user testing.
- Expansion of the SSF taxonomy into a full ontology to enhance the rule authoring and validation process.

Notes and References

[1] Greenes R, Bloomrosen M, Brown-Connolly NE, et al. The Morningside Initiative: collaborative development of a knowledge repository to accelerate adoption of clinical decision support. The open medical informatics journal 2010;4:278-290.

[2] National Quality Forum (NQF), *Driving Quality and Performance Measurement—A Foundation for Clinical Decision Support: A Consensus Report, Washington, DC: NQF; 2010.*

[3] Raetzman SO, Osheroff J, Greenes RA, et al. Structuring Care Recommendations for Clinical Decision Support: Final Report. (Prepared by Thomson Reuters under Contract No. HHSA 290- 2009-00022I.) AHRQ Publication No. 11-0025-2-EF. Rockville, MD: Agency for Healthcare Research and Quality. September 2011.

Disclaimer: Views expressed are those of the authors and not necessarily those of the organizations with which the authors are affiliated, including the Department of Veterans Affairs.

Support for this project (known as Project 2B): DHHS ONC SHARPC (www.sharpc.org), by subcontract from the University of Texas Houston.

*The ASU IRB Board determined that this study did not constitute human subjects research.