



Advancing Clinical Decision Support: Initiatives and Implications for Next Generation EHRs

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Acknowledgments

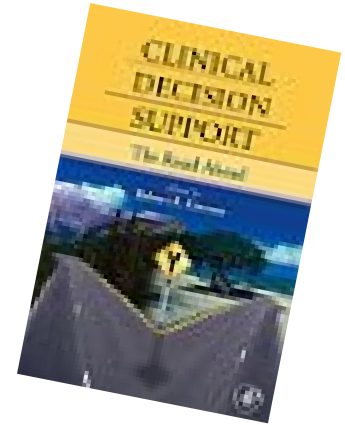
- ▶ **Key project participants**
 - **Davide Sottara, PhD** ASU/Mayo, Scottsdale, AZ
 - **Peter J. Haug, MD, PhD, Matthew Ebert, BS**
Intermountain Healthcare, Salt Lake City, UT
- ▶ **Project original scope included:**
 - **Mary Goldstein, MD**, Palo Alto VA
 - **Samson Tu, PhD**, Stanford Univ.
 - **Emory Fry, MD**, US Navy Research Center, San Diego, and then Cognitive Medical Systems, Inc.
 - Other participants at Intermountain Health and ASU

The Landscape of CDS

- ▶ Much work over a 50-year history
- ▶ Large body of evidence of effectiveness
- ▶ Yet limited and spotty uptake
- ▶ Focus up to a decade ago largely on:
 - Orders, alerts/reminders, doc templates, infobuttons
- ▶ Greatly expanding focus now
 - Broader range of CDS potential:
 - Precision medicine, personal sensors, patient self-management, NLP progress, big data/analytics, visualization/cognitive support, app interfaces and CDS as a service
 - Expanded focus on need for CDS:
 - Emphasis on wellness/prevention, pay for value, quality measurement and reporting, meaningful use incentives

To illustrate:

- ▶ *CDS: The Road Ahead* (2007), 544 pgs
- ▶ *CDS: The Road to Broad Adoption* (May 2014), 926 pgs, 8 new chapters
 - Reflecting growth and broadening of the topic from social, health care finance, legal, organizational, and technical perspectives



Initial issues addressed by project 2B

- ▶ Difficulty sharing of CDS knowledge
 - Lack of an interlingua
 - A dialectic: Level of specificity vs. ease of sharing
- ▶ Enterprise issues
 - Time-consuming nature of site-specific, workflow-specific adaptation
 - Difficulties managing and updating CDS knowledge artifacts
 - Lack of an “implementation science” – ability to capture and utilize experience of what works and what doesn’t
 - Particular challenges for small practices without IT staff
- ▶ Disconnect between artifacts and readability
 - Can UI be created that hides the technical details and facilitates SME viewing – and authoring?

Original Goals of Project 2B

- ▶ Create model of how decision rules are adapted to local workflow, setting, and preferences
 - An ontology of Setting-Specific Factors (SSFs)
 - Authoring tools for adaptation process
- ▶ Build on abstracted model of rules plus adaptations, as basis for:
 - Sharing
 - Capturing of implementation decisions
 - Framework for knowledge management
- ▶ Demonstrate ability to convert to host-specific representation

Revised Goals of Project 2B

(as of July, 2012)

- ▶ Tied to initiation of ONC's Health eDecisions (HeD) Initiative:
 - Part of the ONC's Standards and Interoperability Framework
 - Confluence HL7 ORG
 - Two main use cases:
 1. CDS Artifact Sharing
 - Computable representations for rules, order sets, and documentation templates
 2. CDS Guidance Service
 - Service model for delivery of CDS

- Wiki Home
- Recent Changes
- Pages and Files
- Members

- Calendar
- Contact

General Information

- Introduction & Overview
- Processes & Guidelines
- Committed Members
- Getting Started as a Participant
- Community Enabling Toolkit (CET)
- April Face-to-Face (F2F) Info
- FAQs
- Wiki User Guide

Initiatives

- Community-Led Initiatives
 - Public Health Reporting
 - Longitudinal Coordination of Care
- Cross-Initiative Functions
 - Standards Development Support
 - Model-Driven Health Tools

Health eDecisions Homepage

- Initiative Home
- Join the Initiative
- Charter & Members
- S&I Phases
- Materials

Announcements

- **We just finished our HeD Pilots Virtual OPEN HOUSE....A SHOWCASE FOR USE CASE 1 PILOTS!! Take a look at what we have done....**

open house _final_v2.pptx

[Details](#) [Download](#) 1 MB

- **View a recording:** <https://vimeo.com/70201880>
- On June 6 we presented at an AMIA webinar. This presentation included an introduction to the S&I framework as well as a description of our methodology. We also presented a brief history of HeD as well as the work we have done and are continuing to do with Use Case 1, Use Case 2, and our pilots. Thank you to all who contributed! The presentation material can be seen [here](#).
- **Consensus was achieved on the HeD CDS Guidance Service Use Case (Use Case 2) on April 4, 2013!** Congratulations and thank you to everyone who participated in the Use Case development process. To review the Implementation Guide and Consensus Statement votes, see the [HeD Consensus Page](#).
- Use Case 1 Pilots has started!!! To participate as a pilot for Use Case 1 please complete the [Pilots Survey](#). If you are interested in partnering with another organization be sure to complete the entire survey including the "Areas of Potential Partnership" question.
- We submitted our HL7 Ballot. To see what was submitted see the HL7 Ballot Section of the Reference wiki: [HL7 Ballot](#).
- The Health eDecisions Schema can be seen [HERE](#) (in our HeD Google Code Repository).

Weekly Meetings

Mondays	Tuesdays	Wednesdays	Thursdays
HeD UC 1 Pilots meetings are now	HL7 CDS/Hed Joint Meeting	HeD Use Case 2 Standards Sub	All Hands Community Meeting
			Monday, August 5

Quick Links

- [Meetings and Announcements](#)
- [Use Cases](#)
- [Harmonization](#)
- [Pilots](#)
- [Project Charter](#)
- [Consensus Statement](#)
- [Contact Us](#)

Harmonization SWGs

- [Use Case 2 Standards SWG](#)
- [Artifact Schema SWG](#)
- [Clinical Data and Actions SWG](#)
- [Expressions SWG](#)
- [Metadata and Supporting Elements SWG](#)
- [Model Methodology SWG](#)
- [Terminologies and Value Sets SWG](#)

Meeting Schedule

Today ◀ ▶ **Tuesday, July 30**

Tuesday, July 30

- 3:00pm HL7 CQI (vMR/QDM harr
- 4:00pm HeD - Terminologies and '

Wednesday, July 31

- 1:00pm HeD Use Case 2 Standar

Thursday, August 1

- 11:00am Health eDecisions WG M

Our revised goals for Project 2B

- 1. Create (with HeD working group) a model-based specification for the knowledge artifacts**
 - Having an XML specification – as well as a formal model basis
 - To be a standard (balloted by HL7 successfully in Jan 2013, and updates)
 - To be required as an interlingua for knowledge distribution and incorporation in EHRs in MU stage 3 (use case 1)
 - To be used as basis for model for CDS Guidance Service (use case 2)

Our revised goals for Project 2B

2. Create a model-driven CDS authoring tool

- Unified model supporting different views
 - Different levels of abstraction/granularity
 - Views for SME vs. KE vs. technical code-level
- Reference state-of-the-art data models and terminology systems
- Convertible to existing CDS languages, data models, and standards
- Focus on declarative knowledge, not SSF adaptations

Our revised goals for Project 2B

3. Explore approaches for ongoing refinement and extension

- To be distributed as open–source resource
 - Seek to establish user/developer community
- Extensions for enterprise knowledge management and workflow/setting localization and adaptation
- Incorporation of QM authoring
- Possible value to knowledge content vendors

HeD Semantic Model

- ▶ Companion to the HeD schema
 - Abstracts the content delivered by the syntax
 - HeD schema available at:
<https://code.google.com/p/health-e-decisions/>
- ▶ Defined using a modular OWL ontology
 - Standards-based
 - Set in the context of well-known upper ontologies
 - Mirrors the HeD schema modules
 - Model component subontologies include:
 - metadata, information model, events, expressions, conditions, actions

HeD / model mapping

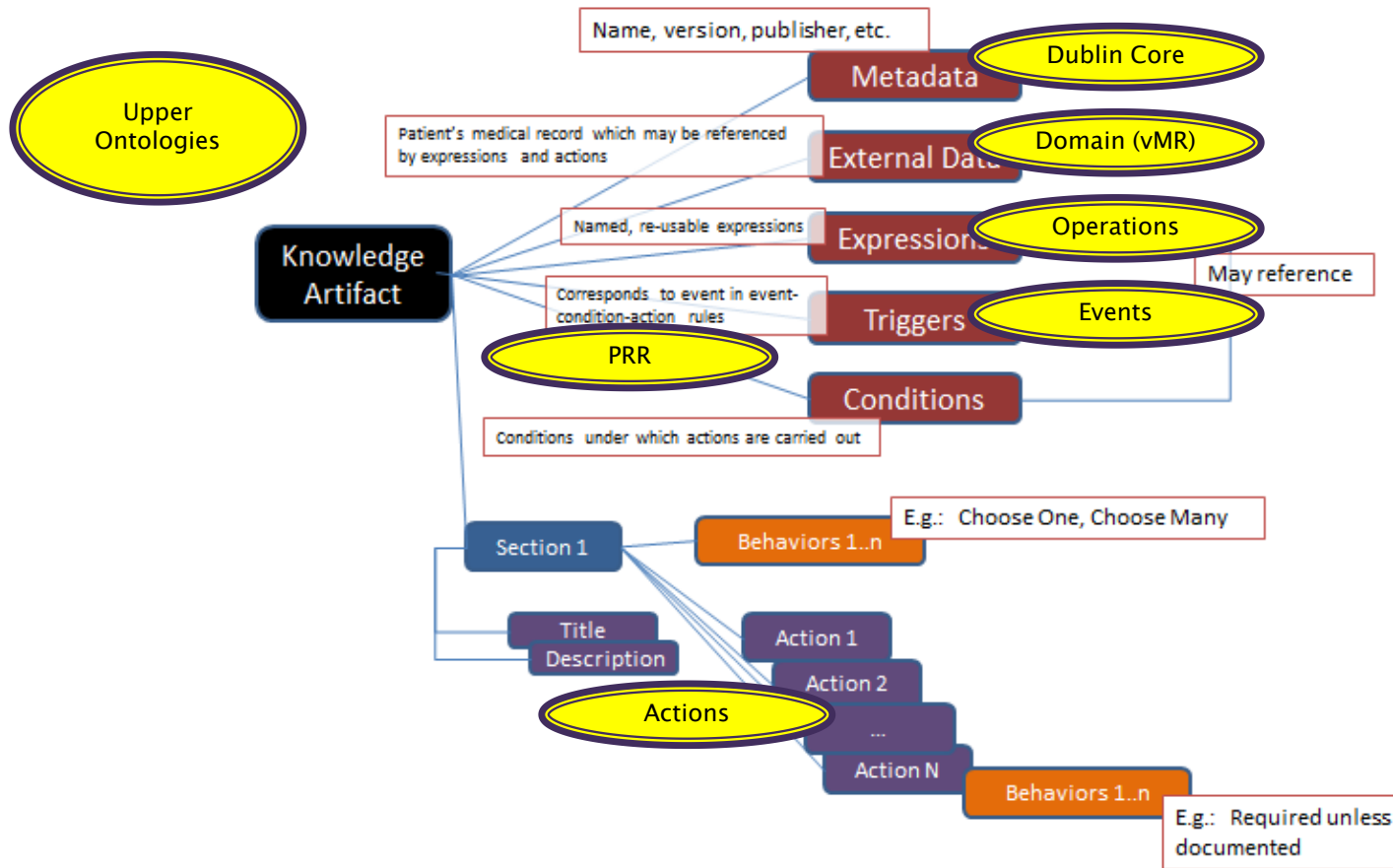


Image taken from HeD Implementation Guide v0.8, available from the HeD google code repository

Model-based editor

▶ First version

- Can edit elements in HeD model
- For rules, order sets, and documentation templates
- (Simplified) meta-data access
- Custom Expressions
- Main logic elements:
 - Triggers
 - Rule-clause types
 - Actions

Rule Logic

Define Rule Logic

Welcome, SHARP
Log Out

Background Information Create Expressions Select Trigger Define Logic Choose Action Review & Export

Write a logic clause about:

Select an option below (a new window will open)

MEDICATION

- Patient on MEDICATION with DOSAGE
- Patient on MEDICATION

All of the items on the grey area may be dragged in to the canvas on the right

Remember, you may drop anything in a container (including other containers), but nothing may go inside a clause.

Conditions

- All must be true
- Exists
- Not
- (Condition Expression...)

Clause

add clauses

- Clause
- Clause
- Clause

Conditions

- All must be true
 - isAdult
 - Exists nonGestationalDiabetesMellitus
 - Exists highHGbA1cLast6Months

Rule Actions



Choose Actions to be Executed

Welcome, SHARP
Log Out

Background Information Create Expressions Select Trigger Define Logic Choose Action Review & Export

Begin by choosing an action type from the list below.

search

ALERTS

Send REMINDER to Patient

Available actions on the grey area may be dragged in to the canvas on the right

Perform all
Documentation
Condition

Create
Documentation
Condition
Action Sentence

Documentation

(Condition Expression...)

(Sentence Expression...)

Perform all
Documentation
Condition

Perform exactly one
Documentation
Condition isAllergic
Create
Documentation
Action Sentence aProcedureProposal
Create
Documentation
Condition
Action Sentence anotherProcedureProposal

Create
Documentation
Condition
Action Sentence Reminder



SME-oriented editor

- ▶ **Initiated**
 - Will need to be furthered by open source community and other extensions/follow-ons of HeD and project 2B work
- ▶ **Main features**
 - Palettes of primitives and templates for common components
 - Trigger types, action types, expression clause types
 - Can select type of artifact
 - Primitives guide and constrain entries
 - Or can start creating it
 - Wizard recognizes possible primitives intended, enables selection
 - Output in HeD model format, with metatags based on
 - Metadata, problem domain, types and domains of primitives used, workflow (e.g., trigger, actions) choices
 - Use of descriptors that are more user-friendly
 - e.g., “diabetes present” or “HbA1c exceeds threshold” as labels that can be shown rather than formal logic that represents it
- ▶ **Still to be done**
 - Usability design/refinement
 - Evaluation of degree to which implementation detail can be captured without need for KE tweaking

Templates



Background Information Create Express

Write a logic clause about:

Select an option below (a new window will open)

PROB

Prob with EVALUATED_PERSON_ID and CONDITION_CODE and CONDITION_EFFECTIVE_TIME and AGE_AT_ONSET and CRITICALITY and CONTRIBUTED_TO_DEATH and WAS_CAUSE_OF_DEATH and CONDITION_STATUS

Prob with CONDITION_CODE and CONDITION_EFFECTIVE_TIME and CRITICALITY and CONDITION_STATUS

Prob with CONDITION_CODE

Prob with DIAGNOSTIC_EVENT_TIME and PRIORITY_IN_ENCOUNTER and CONDITION_CODE

Prob with CONDITION_CODE and CONDITION_EFFECTIVE_TIME and DIAGNOSTIC_EVENT_TIME and AFFECTED_BODY_SITE and CRITICALITY and PRIORITY_IN_ENCOUNTER and CONDITION_STATUS

Prob with CONDITION_CODE and CONDITION_EFFECTIVE_TIME

SUBS ADMIN

PROC

ENC

Enc with RELATED_ENTITY and RELATED_ENTITY and RELATED_ENTITY and RELATED_CLINICAL_STATEMENT and ENCOUNTER_TYPE and ENCOUNTER_EVENT_TIME

Enc with ENCOUNTER_TYPE and ENCOUNTER_EVENT_TIME

AE

GOALS

SUPPLY

OBS

COMM

ENT

All of the items on the grey area may be dragged in to the canvas on the right

Remember, you may drop anything in a container (including other containers), but nothing may go inside a clause.

- ▶ Parametric expression templates
 - Derived from HeD templates
 - Extensible collection

Templates

The image displays two overlapping screenshots from a software interface titled "Define Rule Logic".

The top screenshot shows a dialog box with the following elements:

- Header: "You have selected: Patient on MEDICATION with DOSAGE"
- Field: "Nickname:" with an empty text box and a question mark icon.
- Text: "Patient on MEDICATION with DOSAGE" (where "MEDICATION" and "DOSAGE" are highlighted in blue).
- Buttons: "Verify" (with a checkmark icon), "Confirm and Save" (with a floppy disk icon), and "Cancel" (with a close icon).

An orange oval highlights the text "MEDICATION with DOSAGE" in the top dialog, with an orange arrow pointing to the bottom screenshot.

The bottom screenshot shows a "MEDICATION" configuration dialog box with the following elements:

- Radio buttons: "Literal" (selected) and "Expression".
- Coding System: "RxNorm" (selected) and "NDC".
- Code Value: A text box containing "metformin".
- Buttons: "Save" (with a floppy disk icon) and "Cancel" (with a close icon).

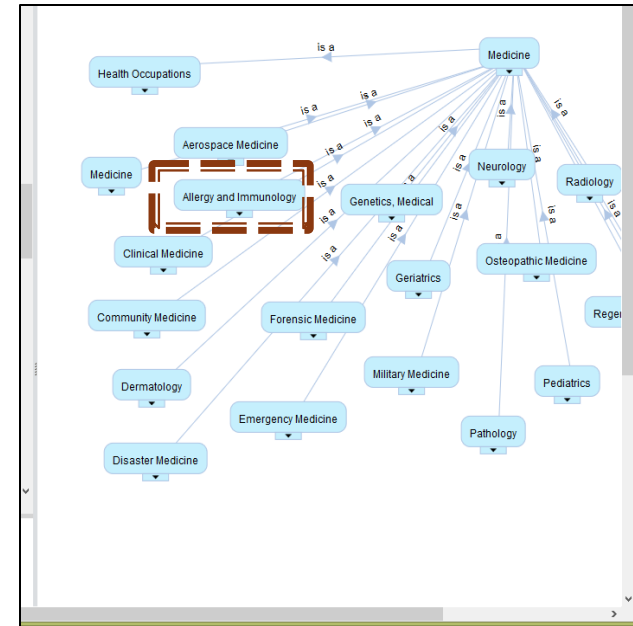
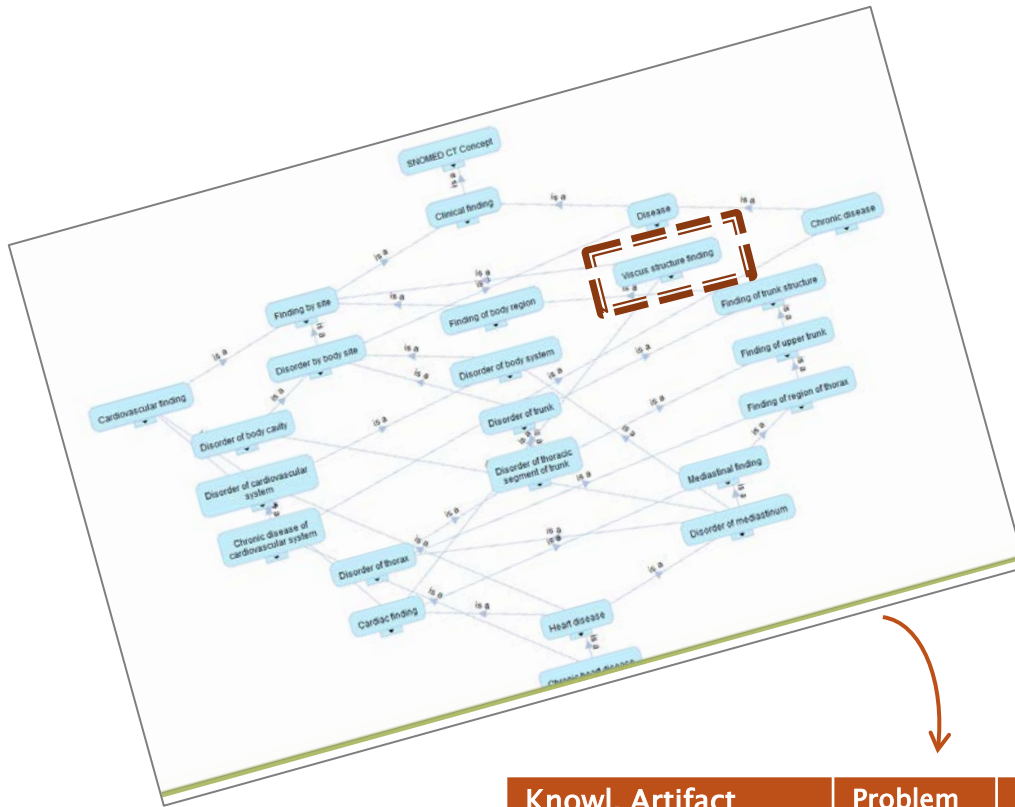
Beyond-SHARP possible directions

- ▶ Dependency on creation of demand for interlingua
 - Meaningful Use Stage 3
 - National or commercial best-practice KBs available in this form
- ▶ Enterprise needs
 - Knowledge repositories
 - Versioning
 - Independence of vendor (e.g., in multi-vendor settings)
 - Organize by any model components
 - e.g., meta-tags, encounter/setting types, provider types, user types, problem foci, logic clause types/primitives, workflow trigger types, action types
- ▶ Development of adapters
 - To EHR rule authoring and execution environments
 - To EHR data models
 - For service-based execution

Other implications of model-based representation of knowledge

- ▶ Ability to find all related knowledge for a situation
 - Enables situation-aware, context-aware knowledge access
 - Could lead to new ways of providing guidance

Model-based knowledge repository uses



Knowl. Artifact	Problem	Setting	Provider type	Workflow step	Action
IF THEN	XXXXX	YYYY	ZZZZ	N33	ABC
If THEN	XXXXXX	YYYY	ZZZZ	N27	DEF
ORDER SET	XXXXXX	YYYY	ZZZZ	N118	GHI
IJNFBUTTON	XXXXXX	YYYY	ZZZZ	N6	JKL
DOC TEMPLATE	XXXXXX	YYYY	ZZZZ	N20	MNO

A perspective re: next generation

- ▶ KM has challenge of core knowledge but multiple possible deployments
 - Shareability is limited once customized/adapted
- ▶ But if we can create model-based descriptions of settings – *clinical problem, state, venue, user, activity* – then:
 - Can index all knowledge by these attributes
 - Can identify gaps, resolve conflicts
 - Can find knowledge artifacts suited to a particular setting
- ▶ Also forms basis for an “implementation science”
 - Tags define characteristics of settings
 - Can associate with indicators of success, usage, overrides, etc.
 - Can find settings similar to “my own” and select approach that is most successful

Thank you!

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