Sustaining a Community CDS Resource when External Funding Ends: Perspectives from the OpenCDS Experience

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From Demonstration to Standard Practice: Developing Sustainable Tools and Processes for CDS
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Disclosures

• I am or have recently been a consultant to Partners HealthCare and RAND Corporation for the ONC Advancing CDS Task Order, which is related to the AHRQ CDSC effort.

• I was formerly a consultant for Religent, Inc. and formerly a co-owner and consultant for Clinica Software, Inc., which holds IP rights to a CDS technology known as SEBASTIAN.

• I have no financial competing interests related to OpenCDS.
Agenda

• OpenCDS background and journey
• Lessons learned
• Recommendations
• Discussion
OpenCDS: the 10,000-feet View

• Multi-institutional, collaborative effort to develop scalable, open-source CDS tools and resources

• Primary deliverables:
  – For CDS consumers: CDS services with HL7 Decision Support Service (DSS) interface (~CDSC rules service)
  – For CDS developers: fully-featured, open-source knowledge authoring platform
  – For CDS developers with existing knowledge resources: open-source “wrappers” to share capabilities via HL7 DSS interface
OpenCDS: History

• Early 2000s to 2009: focus on OpenCDS predecessor (SEBASTIAN)
  – Due to commercialization efforts, became difficult to collaborate and scale

• Late 2009: initiation of OpenCDS effort
  – Funding via NHGRI K01 Career Development Award

• Nov 2010: alpha release at AMIA 2010; rapid accrual of collaborators

• Apr 2011: internal funding begins (Univ. of Utah)

• Aug 2011: external funding ends

• Dec 2011: 1.0 release (scheduled)
Collaborators

- University of Utah
- HP Advanced Federal Healthcare Innovation Lab
- HLN Consulting, LLC
- Apelon, Inc.
- Intermountain Healthcare
- New York Citywide Immunization Registry
- Alabama Department of Public Health
- Veterans Health Administration
- Wolters Kluwer Health
- EBSCO
- Univ. of NC at Chapel Hill
- Main Line Health
- Hospital Universitario Virgen del Rocío, Spain
- Keona Health
- Mass. General Hospital
- Stanford University
- MaRS Innovation, Canada
- SmartCare, Africa
- Emetra AS, Norway
- Visumpoint, LLC
- Genesys, LLC
- df8health
- IsoDynamic, Inc.
- Calcudos.com, Inc.
- CogniTech Corporation
OpenCDS – Architectural Overview

Standard Interface:
HL7/OMG Decision Support Service Standard
(http://hssp-dss.wikispaces.com)

Standard Data Models:
HL7 Virtual Medical Record (vMR) Standard
Support for Multiple Knowl. Rep. Approaches

DSS Client

Patient data ↓ Patient-specific care advice

OpenCDS DSS Interface

OpenCDS Adapter X

OpenCDS XML Knowledge Authoring Platform

Apelon Distributed Terminology System (DTS)

CDS Engine/Service X (e.g., SEBASTIAN, EON, WarfarinDosing.org)

OpenCDS Internal Adapter

OpenCDS Drools Engine

OpenCDS Drools Knowledge Authoring Platform

[Diagram showing relationships between different components and processes related to the support of multiple knowledge representation approaches in a decision support system.]
WarfarinDosing.org Integration

DSS Client

Patient data \[\Rightarrow\] Patient-specific care advice

OpenCDS DSS Interface

WarfarinDosing.org

OpenCDS Adapter
## WarfarinDosing.org Integration via OpenCDS

<table>
<thead>
<tr>
<th>Baseline INR</th>
<th>Current Smoker</th>
<th>Liver Disease</th>
<th>Current or recent NPO</th>
<th>Estimated blood loss from recent surgery</th>
<th>Calculated body surface area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>0 mL</td>
<td>1.492 m²</td>
</tr>
</tbody>
</table>

- **On Direct Thrombin Inhibitor** (e.g., hirudin, bivalirudin): Yes/No
- **Statin use** (eg, Pravastatin/Pravachol®): [Select]
- **Amiodarone use** (mg/day): 0
- **On Azole Antifungal** (e.g., ketoconazole, fluconazole): Yes/No
- **On Metronidazole**: Yes/No
- **On Rifampin**: Yes/No
- **On Carbamazepine**: Yes/No
- **On Propafenone**: Yes/No
- **On Steroid**: Yes/No
- **On Fluoroquinolone** (e.g., moxifloxacin, ciprofloxacin): Yes/No
- **On Phenytoin** (eg., Dilantin): Yes/No
- **On Sulfonamide**: Yes/No

- **CYP2C9 genotype**: *2/*3
- **VKORC1-1639/3873 genotype**: AA

### Prior Doses and Recent Labs

<table>
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<th>Prior doses (past week):</th>
<th>7/13 (Tue)</th>
<th>7/14 (Wed)</th>
<th>7/15 (Thu)</th>
<th>7/16 (Fri)</th>
<th>7/17 (Sat)</th>
<th>7/18 (Sun)</th>
<th>7/19 (Mon)</th>
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<tr>
<td>mg</td>
<td></td>
<td></td>
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</table>

Unless manually entered, above doses do not reflect held doses or outside doses. Edit as needed to ensure validity of dosing guidance provided below.

### Most Recent Labs

- **PTT**: 37 07/20/2010 13:56:33
- **INR**: 1.5 07/20/2010 13:56:33
- **Platelets**: 180 07/20/2010 13:56:33
- **Hemoglobin**: 14.9 07/20/2010 13:56:33
- **Hematocrit**: 0.42 07/20/2010 13:56:33

### Warfarin Order

#### Dosing Guidance:

Dosing guidance received from [http://www.warfarindosing.org](http://www.warfarindosing.org).

- Consider following dosing:
  - dose 1: 2.9 mg/day
  - dose 2: 1.6 mg/day
  - dose 3: 1.6 mg/day

- **Consistent**: mg PO QHS x 3 day(s)
- **Custom QHS**:
  - 7/20 (Tue) mg
  - 7/21 (Wed) mg
  - 7/22 (Thu) mg
  - 7/23 (Fri) mg
  - 7/24 (Sat) mg
  - 7/25 (Sun) mg
  - 7/26 (Mon) mg
OpenCDS Knowledge Workbench

DSS Client

Patient data

Patient-specific care advice

OpenCDS DSS Interface

Apelon Distributed Terminology System (DTS)

OpenCDS Internal Adapter

OpenCDS Drools Engine

OpenCDS Drools Knowledge Authoring Platform
Web-based Authoring – Decision Rules

When

1. Initialize - Note that all criteria below must be met for the rule to fire.
2. Pt.Age.Low - Patient age is greater than or equal to 42 years
3. Pt.Age.High - Patient age is less than or equal to 69 years
4. Pt.Gender - Patient gender is Female
5. Pt.Enc.Past.Count - Patient has had a
   - Outpatient encounter one or more times in the past 2 years
6. not ( )
7. Pt.Proc.Past - Patient has had a
   - Bilateral mastectomy
8. or
9. Pt.Proc.Past.Lat - Patient has had a
   - Mastectomy with a laterality of Bilateral
10. or
11. Pt.Proc.Past.Count - Patient has had a
    - Unilateral mastectomy two or more times in the past 200 years
12. )

Then

1. Assert that NQF 0031 denominator criteria met
OpenCDS Implement. – Underlying Details
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<th>#</th>
<th>Desc</th>
<th>Vaccine</th>
<th>Gender</th>
<th>Dose #</th>
<th>Min Age</th>
<th>Units1</th>
<th>Max Age</th>
<th>Units2</th>
<th>Index Dose #</th>
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<th>Rec Interval</th>
<th>Units4</th>
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<td></td>
<td>HPV</td>
<td>Female</td>
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<td>9</td>
<td>Yr</td>
<td>26</td>
<td>Yr</td>
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<td>24</td>
<td>Day</td>
<td>61</td>
<td>Day</td>
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<tr>
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<td>11</td>
<td>Male</td>
<td>164</td>
<td>Day</td>
<td>1</td>
<td>24</td>
<td>Day</td>
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<td>182</td>
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Web-based Testing Environment
Web-based Batch Regression Testing
OpenCDS Status

• Alpha release available
• 1.0 preview available to collaborators
• 1.0 release scheduled December 2011
• Multiple ongoing initiatives
Sample Initiatives

• Vaccine forecasting
  – Contributors
    • HLN Consulting, New York Citywide Immunization Registry, Alabama Department of Public Health, University of Utah
  – Developing next-generation immunization CDS knowledge management and delivery platform

• Personalized medicine
  – Contributors
    • Intermountain Healthcare, Washington University, IsoDynamic, University of Utah, potentially others
  – Implementing family history-informed risk assessment algorithms
Sample Initiatives (cont’d)

• Patient-centered medication CDS
  – Contributors
    • HP Advanced Federal Healthcare Innovation Lab, Apelon, University of Utah
  – Developed prototype medication CDS platform for smartphones within a simulated VHA environment

• Enterprise analytics and population health management
  – Contributors
    • University of Utah, others in discussion
  – Part of enterprise Knowledge Management & Mobilization (KMM) initiative
Current Staffing of Core Team

• University of Utah
  – Project director (~0.5 FTE)
  – Senior informaticist (full-time)
  – Senior data warehouse architect (part-time)
  – Multiple graduate students

• HLN Consulting
  – 2 senior software engineers (full-time)
  – Business analyst (part-time)
OpenCDS Funding Sources

- (completed) NHGRI K01 HG004645
- University of Utah Health Care
  - Using OpenCDS to meet institutional business needs
  - Key to sustainability
- University of Utah Dept. of Biomedical Informatics
  - Investing in OpenCDS as platform for future funding
- ONC Beacon Community program
  - Using OpenCDS for public health reporting
- In-kind contributions of various collaborators
Key Lessons Learned

• Local operational support is essential
  – Meeting internal institutional needs must be #1 priority
  – Collaborators may make significant in-kind contributions but are generally reluctant to pay for services

• Grant/contract funding is still very important
  – Significantly strengthens business case for developing a CDS infrastructure that scales beyond local institution
  – Necessary to provide sufficient attention to needs of the community (vs. needs of the local institution)

• An open-source, freely available technology stack significantly facilitates adoption
Key Lessons Learned (cont’d)

• Ask not what the community can do for you; ask what you can do for the community
  – Contributions generally arise because (i) the CDS resource targets an important business need and (ii) the collaborator must enhance the CDS resource to meet its own business need

• Most CDS implementers with established knowledge representation approaches are very reluctant to adopt a new approach
  – Conversely, they are very interested in having their resource made accessible to a wider audience through an open-source, standard service “wrapper”
Key Lessons Learned (cont’d)

• Many organizations are exploring alternate CDS approaches but are reluctant to go “all-in” with any given effort because of multiple competing approaches
  – Collaboration is likely in everybody’s interest, especially if external funders can foster such collaboration

• It is incredibly fulfilling to work with like-minded collaborators to establish a community CDS resource
Recommendations

• Ensure local operational support
• Continue to identify and meet community needs
• Move towards low-cost, open-source technology stack
• Support stakeholders who utilize different approaches to knowledge representation
• Coordinate (merge?) efforts with other like-minded initiatives (e.g., OpenCDS)
• Federal agencies: support coordination and further development of community CDS resources
Home

What is OpenCDS?

OpenCDS is a multi-institutional, collaborative effort to develop open-source, standards-based clinical decision support (CDS) tools and resources that can be widely adopted to enable CDS at scale.

Who is Involved?

OpenCDS was founded by Dr. Kensaku Kawamoto, MD, PhD, who is a faculty member at the Duke Center for Health Informatics and a co-chair of the HL7 CDS Work Group. OpenCDS collaborators include the University of Utah, Intermountain Healthcare, the Veterans Health Administration, the University of North Carolina at Chapel Hill, and Apelon, Inc.
Thank You!

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