Open-Source Clinical Decision Support Models

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NHGRI Workshop on Characterizing and Displaying Genetic Variants for Clinical Action, Gaithersburg, Maryland

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Disclosures

- I am or have recently been a consultant to Partners HealthCare, Inflexxion, and RAND Corporation.
- I was formerly a consultant for Religent, Inc. and formerly a co-owner and consultant for Clinica Software, Inc.
- I have no financial competing interests related to OpenCDS.

Presentation Objectives

- Describe clinical decision support (CDS) and how it could help bridge the translation gap for personalized medicine
- Identify requirements for scaling CDS for personalized medicine (PM) on a national scale
- Describe an open-source, standards-based CDS platform (OpenCDS) that could enable CDS for PM at scale

Clinical Decision Support (CDS)

- Definition
  - The provision of pertinent knowledge and/or person-specific information to clinical decision makers to enhance health and health care (Osheroff et al., *JAMIA*, 2006)
- Supports translation of evidence into practice
  - CDS systems that provide patient-specific care recommendations automatically and within clinical workflows have significantly improved care quality in >90% of RCTs (Kawamoto et al., *BMJ*, 2005)

CDS Example: Disease Mgmt. Dashboard

https://clinapp6.duhs.duke.edu:8081 - Patient Summary for [redacted] - Microsoft Internet Explorer

Allergies/ADE | Problems | Medications | Medications From Notes | Vitals | Cautions | Disease Mgmt. | Print | Send Feedback | Close

All | Health Maintenance | Diabetes* | Hypertension*

Re-Evaluate | Input Observations | Last evaluated Mon Jan 12 21:09:31 EST 2009

Diabetes — Remove from Diabetes List

Focus	Status	Relevant Data	Last Done	Guidelines
Height	Not Due	Height: **154.9cm (61.0in)**	12/15/08(age 61y 3m)	*21+yo: once after age 21*
Weight/BMI	DUE NOW	Weight: **77.1kg (170.0lb)** BMI: **32.1**	01/08/09 (0m 4d ago)	*21+yo: q visit.* *Goal: BMI <25*
B.P.	DUE NOW	BP: **120/69 mm Hg** *Patient has diabetes or GFR <60*	01/08/09 (0m 4d ago)	*18+yo: annual; if diabetic or HTN q visit.* *Goal <140/90, 130/80 if diabetic or GFR <60.*
Alcohol Screen	Not Due	**Abstains**	01/08/09 (0m 4d ago)	*10+yo: check alcohol use yearly* *(excessive: males >2/d, females >1/d)*
Visual Foot Exam	DUE NOW		01/08/09 (0m 4d ago)	*q visit*
Foot Monofilament	Not Due		01/08/09 (0m 4d ago)	*annual*
HgbA1C	Not Due	HgbA1C: **6.2%**	01/08/09 (0m 4d ago)	*21+yo: q6mo if <7%, q3mo if >= 7%. Goal: <7%.*
Urine Micro alb/cr	Not Due	alb/cr ratio: * **mg/g**	10/08/08 (3m 4d ago)	*10+yo: annual*
Total Chol.	Not Due	Total-C: **151 mg/dL**	12/15/08 (0m 28d ago)	*annual, goal <200*
LDL Chol.	Not Due	LDL-C: **94 mg/dL**	12/15/08 (0m 28d ago)	*annual, goal <100*
Eye Exam	DUE NOW	*Intervention considered but not delivered on 01/08/09.* *Reason: Scheduled*		*10+yo: annual*
Flu Vacc.	CONSIDER		>2y ago	*annual, unless egg allergic*
Pneum. Vacc.	Not due		01/01/06 (3y 0m ago)	*once; revacc if >=65 and last 5+ yrs ago when <65*
ASA (81 mg)	Not Due	Not known to be allergic to aspirin Aspirin listed as prescribed		*40+yo: no contraindications*
Education	Not Due	**Completed**	01/08/09 (0m 4d ago)	*once; repeat annually if HgbA1C >=7%*

Source: Lobach DF, Kawamoto K, et al. Medinfo. 2007;861-5.

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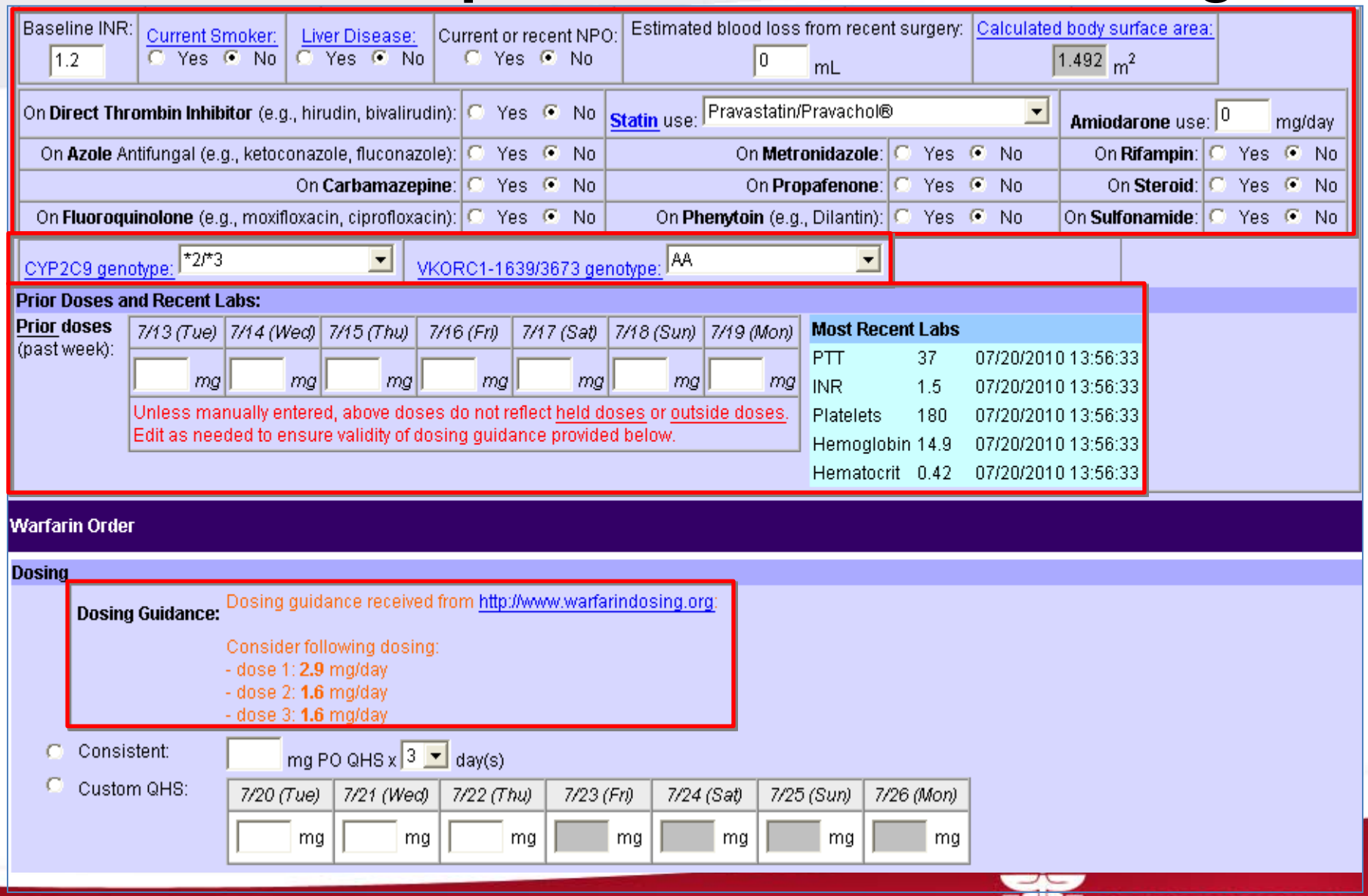
Potential CDS Applications Areas for PM

- Test ordering
  - Recommend indicated test
  - Recommend against test with dubious clinical utility
- Personalized test interpretation
  - Combine genetic test result with clinical data to provide personalized risk assessment and care guidance
- Family history analysis
  - Tailor preventive care guidance based on family history
- Therapy
  - Provide genetically-informed drug therapy guidance

CDS Example: Warfarin PGx Dosing



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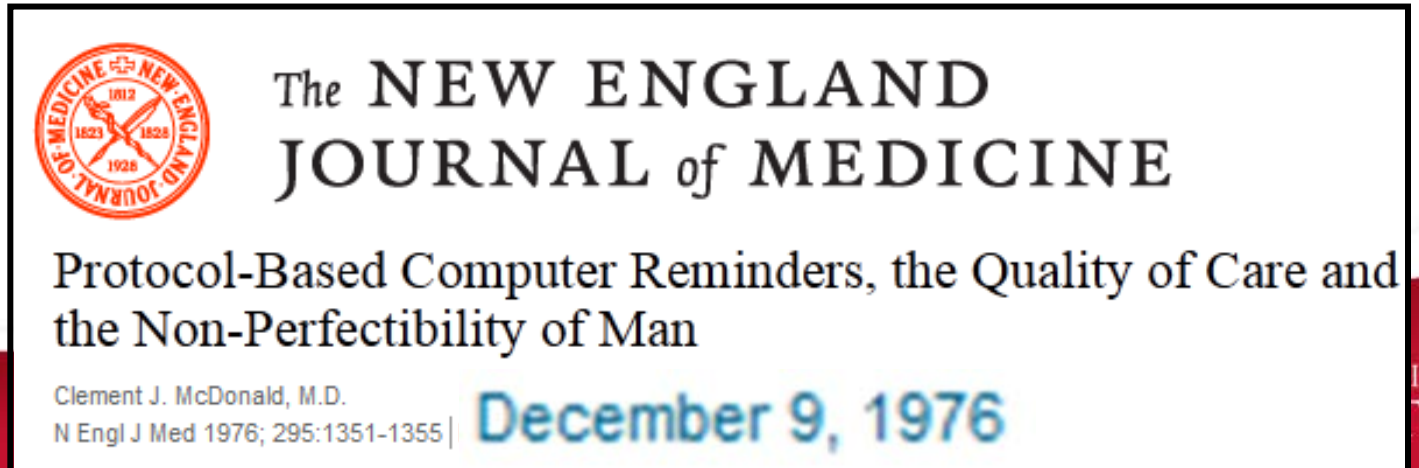
Achilles' Heel of CDS: Limited Scalability

- Despite demonstrated effectiveness, CDS is not widely available
  - Most CDS capabilities only work within specific institutions and health IT systems
- We are still trying to scale up "traditional" CDS capabilities that have been validated for decades
  - Unless we focus on scalability, CDS will have a limited impact on PM for decades to come



What is Needed to Scale CDS for PM?

- Standardized representation of relevant patient data
- Centrally managed repositories of high-quality, computer-processable medical knowledge
- Standard approaches for leveraging the encoded knowledge to provide patient-specific advice

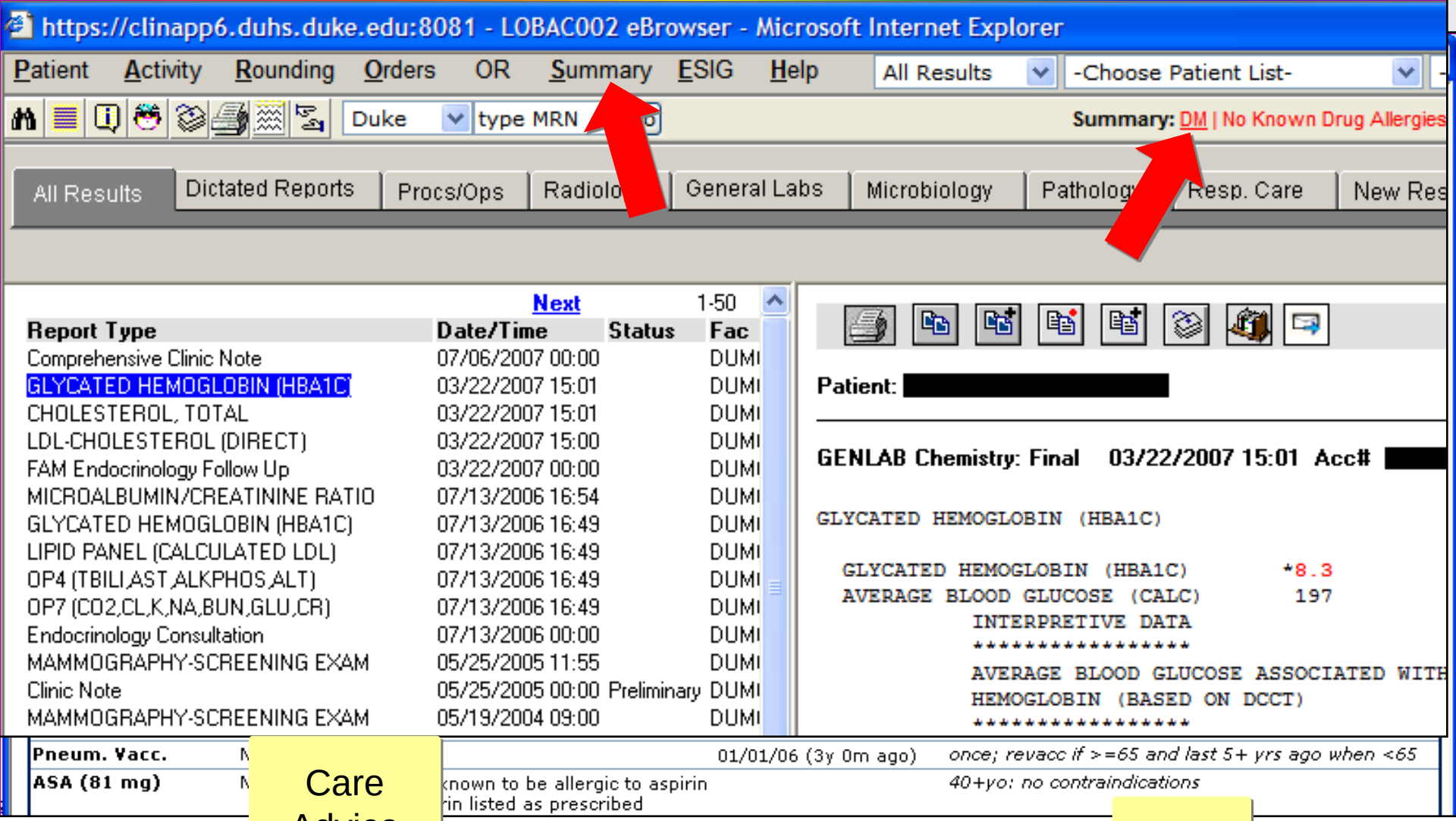
Kawamoto K, Lobach DF, Willard HF, Ginsburg GS. A national CDS infrastructure to enable the widespread and consistent practice of genomic and personalized medicine. *BMC Medical Informatics and Decision Making*, 2009, 9:17.

OpenCDS

- An open-source, standards-based CDS platform designed to enable CDS at scale
- Addresses core requirements of a national CDS infrastructure for PM
  - Uses standard data models
  - Can leverage various knowledge resources, both externally and internally developed
  - Provides a standard approach for EHR systems to leverage CDS resources over the Internet to obtain patient-specific advice

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


https://clinapp6.duhs.duke.edu:8081 - LOBAC002 eBrowser - Microsoft Internet Explorer
Patient Activity Rounding Orders OR Summary ESIG Help
All Results
-Choose Patient List-
Duke
type MRN
Summary: DM | No Known Drug Allergies
All Results
Dictated Reports
Procs/Ops
Radiolo
General Labs
Microbiology
Pathology
Resp. Care
New Res
Next
1-50
Report Type
Date/Time
Status
Fac
Comprehensive Clinic Note 07/06/2007 00:00 DUMI
GLYCATED HEMOGLOBIN (HBA1C) 03/22/2007 15:01 DUMI
CHOLESTEROL, TOTAL 03/22/2007 15:01 DUMI
LDL-CHOLESTEROL (DIRECT) 03/22/2007 15:00 DUMI
FAM Endocrinology Follow Up 03/22/2007 00:00 DUMI
MICROALBUMIN/CREATININE RATIO 07/13/2006 16:54 DUMI
GLYCATED HEMOGLOBIN (HBA1C) 07/13/2006 16:49 DUMI
LIPID PANEL (CALCULATED LDL) 07/13/2006 16:49 DUMI
OP4 (TBILI,AST,ALKPHOS,ALT) 07/13/2006 16:49 DUMI
OP7 (CO2,CL,K,NA,BUN,GLU,CR) 07/13/2006 16:49 DUMI
Endocrinology Consultation 07/13/2006 00:00 DUMI
MAMMOGRAPHY-SCREENING EXAM 05/25/2005 11:55 DUMI
Clinic Note 05/25/2005 00:00 Preliminary DUMI
MAMMOGRAPHY-SCREENING EXAM 05/19/2004 09:00 DUMI
Patient: [redacted]
GENLAB Chemistry: Final 03/22/2007 15:01 Acc# [redacted]
GLYCATED HEMOGLOBIN (HBA1C)
GLYCATED HEMOGLOBIN (HBA1C) *8.3
AVERAGE BLOOD GLUCOSE (CALC) 197
INTERPRETIVE DATA
AVERAGE BLOOD GLUCOSE ASSOCIATED WITH
HEMOGLOBIN (BASED ON DCCT)
Pneum. Vacc. 01/01/06 (3y 0m ago) once; revacc if >=65 and last 5+ yrs ago when <65
ASA (81 mg) known to be allergic to aspirin 40+yo: no contraindications
rin listed as prescribed
Care Advice
OpenCDS Care Guidance Service
EHR System
Pt data
Patient Data Sources

WARFARINDOSING

www.WarfarinDosing.org

- Warfarin Dosing
- Clinical Trial
- Outcomes
- Hemorrhage Risk
- Patient Education
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User:
Patient:
Version 2.34
Build : Oct 30, 2011

Required Patient Information

Age: | **Sex:** -Select- **Ethnicity:** -Select-

Race: -Select-

Weight: lbs **or** kgs

Height: (feet and inches) **or** (cms)

Smokes: -Select- **Liver Disease:** -Select-

Indication: -Select-

Baseline INR: **Target INR:** Randomize & Blind

Amiodarone/Cordarone® Dose: mg/day

Statin/HMG CoA Reductase Inhibitor: -Select-

Any azole (eg. Fluconazole): -Select-

Sulfamethoxazole/Septra/Bactrim/Cotrim/Sulfatrim: -Select-

Genetic Information

VKORC1-1639/3673: Not available/pending

CYP4F2 V433M: Not available/pending

GGCX rs11676382: Not available/pending

CYP2C9*2: Not available/pending

CYP2C9*3: Not available/pending

CYP2C9*5: Not available/pending

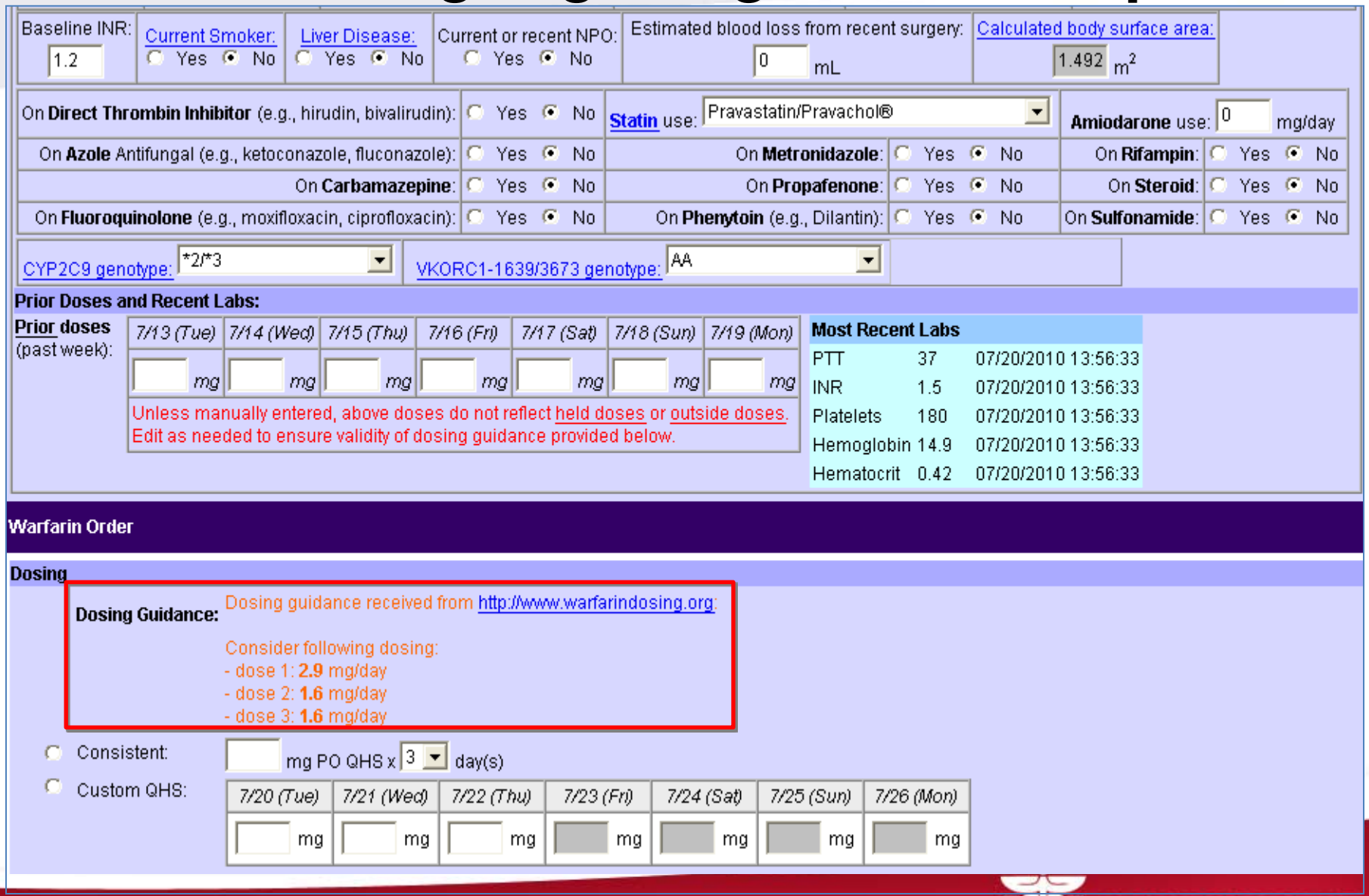
CYP2C9*6: Not available/pending

Accept Terms of Use

> ESTIMATE WARFARIN DOSE

OF UTAH
CARE

WarfarinDosing.org Integration via OpenCDS



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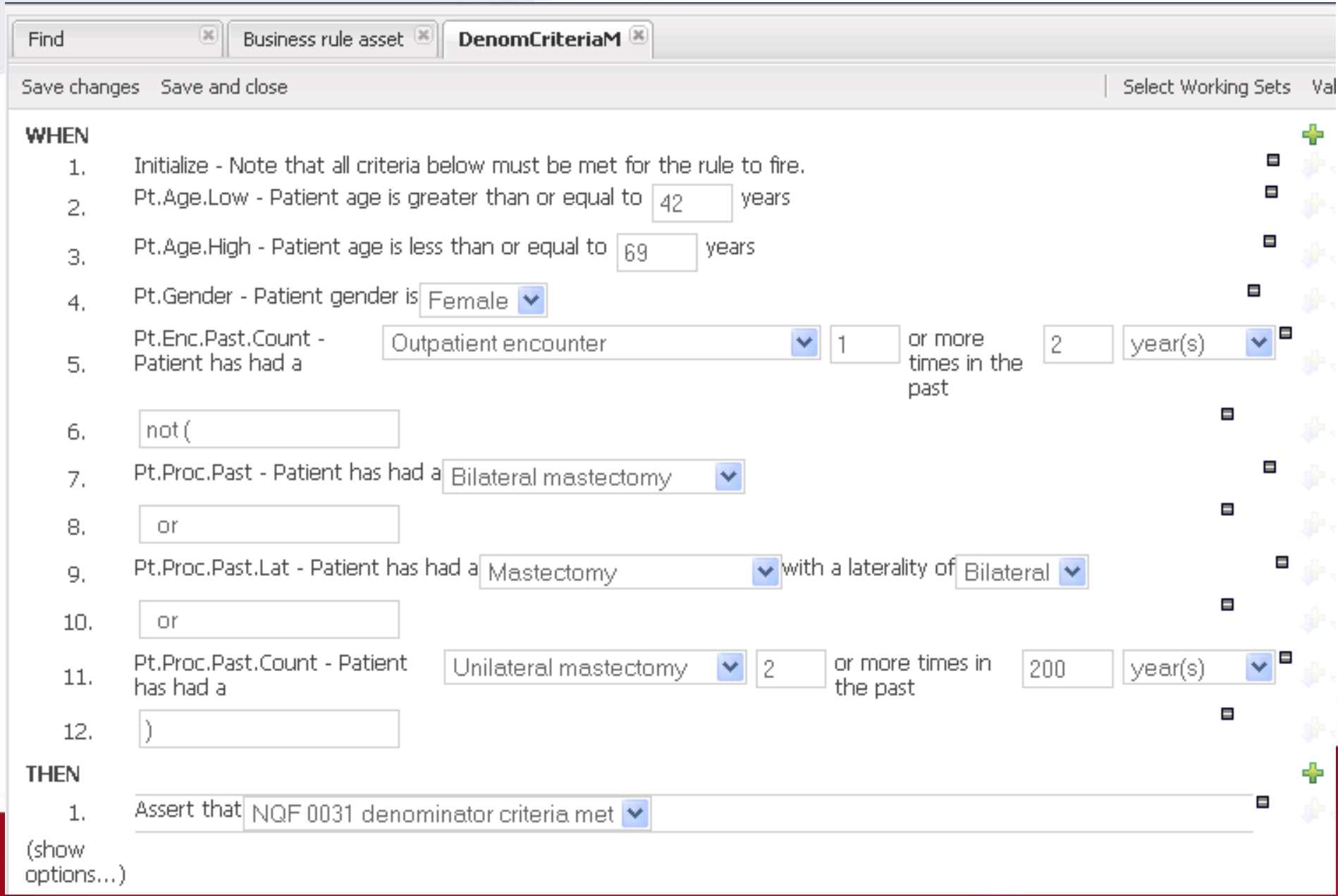
Web-based Authoring – Decision Rules

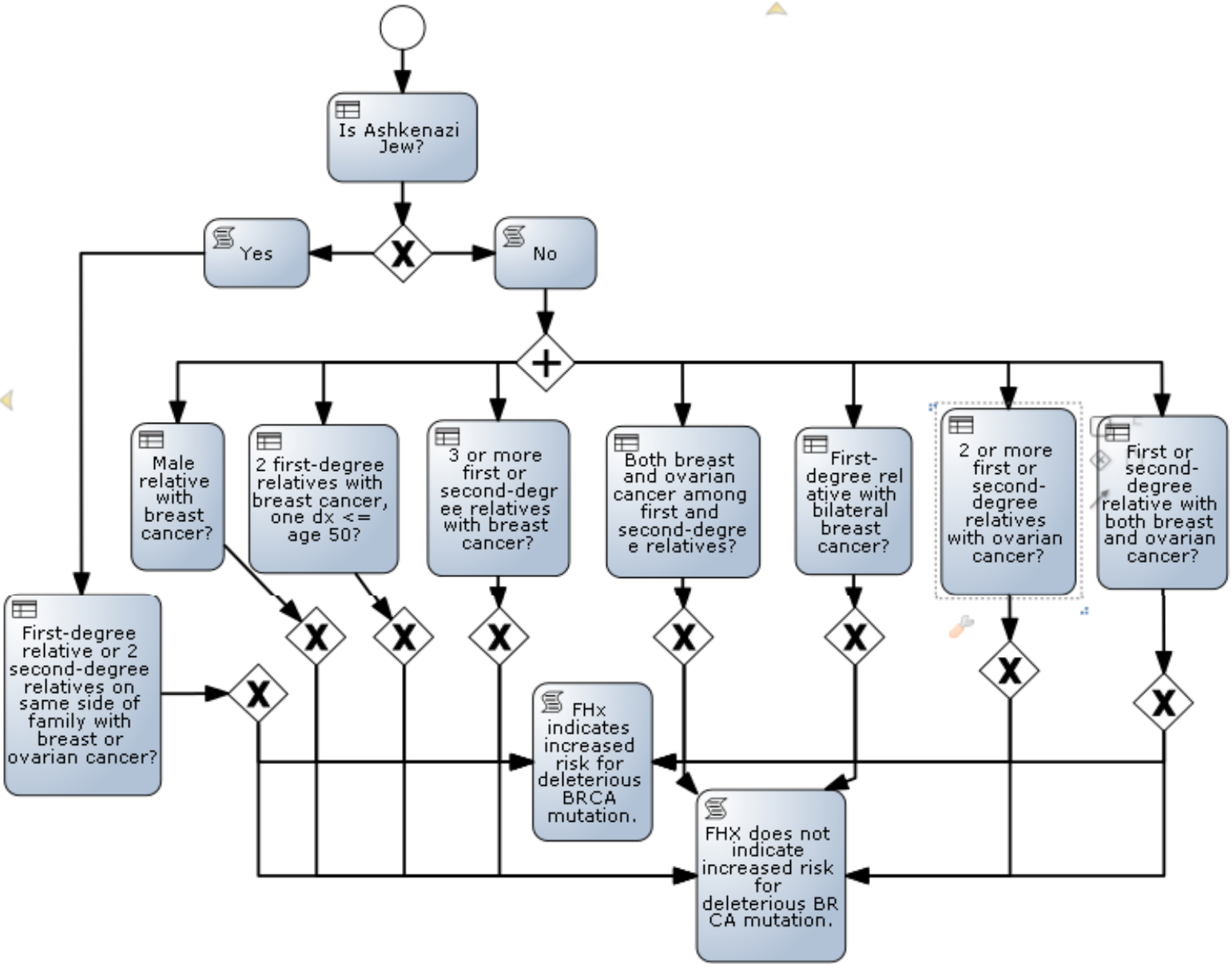


Web-Based Authoring – Decision Table

Decision table

#	Desc	Vaccine	Gender	Dose #	Min Age	Units1	Max Age	Units2	Index Dose #	Min Interval	Units3	Rec Interval	Units4
1		HPV	Female	1	9	Yr	26	Yr					
2				2					1	24	Day	61	Day
3				3					2	80		121	
4									1	164		182	
5			Male	1	11								
6				2					1	24	Day	61	Day
7				3					2	80		121	
8									1	164		182	

Web-Based Authoring – Decision Diagram



OpenCDS Status

- 1.0 release scheduled December 2011
- Multiple ongoing initiatives within University of Utah and partner organizations

Recommendations

- Make CDS a core component of the PM vision
- Consider and prioritize scalability for CDS
- Leverage relevant resources
  - OpenCDS
  - Multiple CDS efforts focused on “traditional” medicine
- Align with, and influence, EHR Meaningful Use regulations
- Start building national CDS infrastructure now
  - Divergent, incompatible approaches will develop without coordination and standardization

Acknowledgements

- Financial support
  - NHGRI K01 HG004645 (PI: K. Kawamoto)
  - University of Utah Dept. of Biomedical Informatics
  - ONC Beacon Community Program subcontract (PI: Bruce Bray)
- Numerous OpenCDS collaborators
  - https://sites.google.com/site/opencdspublic/collaborators

www.opencds.org

OpenCDS

Search this site

Home | Collaborators | Architecture | Key Components | Screenshots | References | Acknowledgments | Alpha Release | Join OpenCDS

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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.

Breaking News

OpenCDS Alpha Release Available An alpha release of OpenCDS is now available to collaborators. Please see the Alpha Release tab for more information.
Posted Apr 26, 2011 9:51 AM by Kensaku Kawamoto

EBSCO Joins as OpenCDS Collaborator The OpenCDS team is very excited to announce that EBSCO, one of the leading knowledge content providers in healthcare, has joined OpenCDS as a collaborator. The OpenCDS team will be ...
Posted Apr 26, 2011 9:51 AM by Kensaku Kawamoto

OpenCDS at AMIA 2010 OpenCDS collaborators will be discussing OpenCDS and/or its component technologies at the following sessions of the 2010 American Medical Informatics Association (AMIA) Fall Symposium, which will be held in ...
Posted Apr 26, 2011 9:50 AM by Kensaku Kawamoto

Thank You!

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