

From Guidelines to Clinical Decision Support: a Unified Approach to Translating and Implementing Knowledge

AMIA 2012 Fall Symposium, Chicago, IL

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Associate Director, Yale Center for Medical Informatics

❖❖❖ Introductions and Lineup

- Doug Rosendale, DO, FACOS, FACS (Moderator)
 - Senior Physician Advisor, Clinical Informatics, Office of Health Information, Veterans Health Administration, Washington, D.C.
- Richard Shiffman, MD, MCIS
 - Professor and Associate Director, Yale Center for Medical Informatics
 - P.I., GLIDES
- Kensaku Kawamoto, MD, PhD
 - Director, Knowledge Management & Mobilization, Univ. of Utah
 - P.I., OpenCDS
- Blackford Middleton, MD, MPH, MSc
 - Director, Clinical Informatics R&D, Partners HealthCare
 - P.I., CDS Consortium
- Jacob Reider, MD
 - Acting Chief Medical Officer, Office of the National Coordinator (ONC)
 - HHS/ONC perspective

Setting the Stage: WHY Clinical Decision Support (CDS)?

- Knowledge is Power – how do we harness information and knowledge to improve care?
- Health Complexity and Information Overload
- Various Potential Modalities
 - Alerts and reminders, Infobuttons, documentation templates, order sets, etc.
- Computational Science
- Learning Cycle of Knowledge Improvement
- Challenges
 - Including lack of unified model for CDS



Achieving Health IT Adoption and Effective Use: Approaches to Knowledge Sharing from the *CDS Consortium*

Blackford Middleton,

MD, MPH, MSc, FACP, FACMI, FHIMSS

Partners Healthcare System – Harvard Medical School

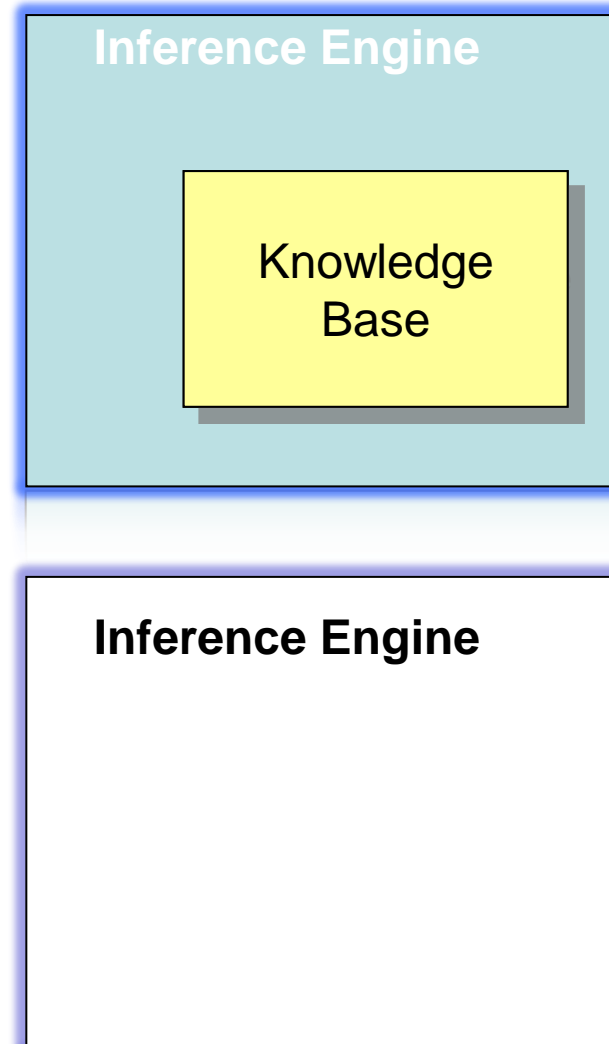
AMIA Fall Symposium, Nov. 4-7, 2012

Chicago, IL

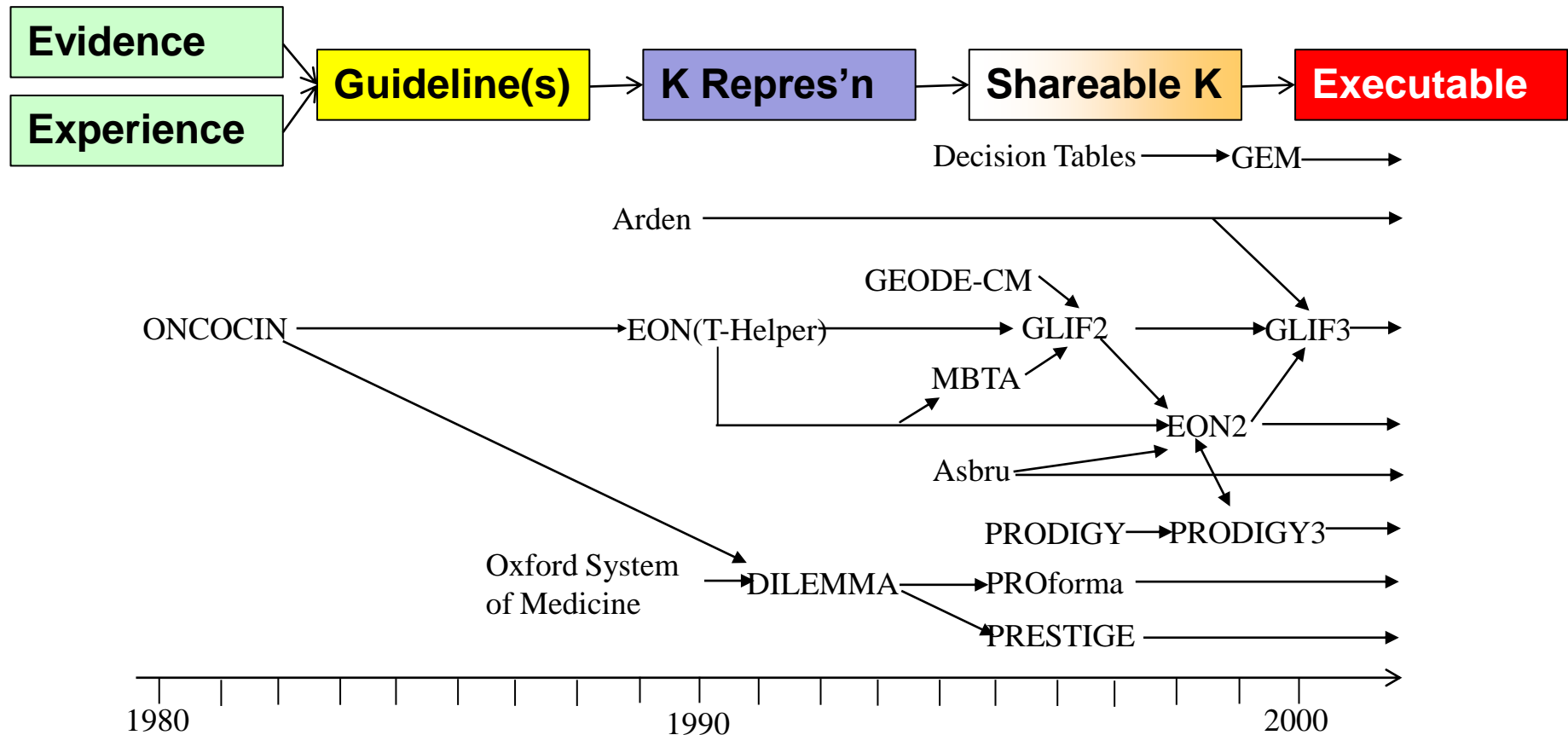


Inference Methods Used in Expert Systems

- Algorithmic
- Statistical
- Pattern Matching
- Rule-based (Heuristic)
- Fuzzy sets
- Neural nets
- Bayesian
- TBD...



Knowledge Translation and Specification



P. L. Elkin, M. Peleg, R. Lacson, E. Bernstam, S. Tu, A. Boxwala, R. Greenes, & E. H. Shortliffe.
Toward Standardization of Electronic Guidelines. *MD Computing* 17(6):39-44, 2000

A perfect storm for Clinical Decision Support?



- Lots of clinical data going online
- Lots of genetic data coming
- Lots of personal/social data coming
- Lots of geospacial data coming
- More data exchange and interoperability
- Inexorable rise of Healthcare costs...
- Healthcare Reform

CDS Consortium: Goal and Significance

- **Goal:** To assess, define, demonstrate, and evaluate best practices for knowledge management and clinical decision support in healthcare information technology at scale – across multiple ambulatory care settings and EHR technology platforms.
- **Significance:** The CDS Consortium will carry out a variety of activities to improve knowledge about decision support, with the ultimate goal of supporting and enabling widespread sharing and adoption of clinical decision support.

1. Knowledge Management Life Cycle		
2. Knowledge Specification	3. Knowledge Portal and Repository	4. CDS Public Services and Content
5. Evaluation Process for each CDS Assessment and Research Area		
6. Dissemination Process for each Assessment and Research Area		



MAYO CLINIC



UTHealth
The University of Texas
Health Science Center at Houston



UMDNJ
UNIVERSITY OF MEDICINE &
DENTISTRY OF NEW JERSEY



NEXTGEN
HEALTHCARE

SIEMENS

MITRE

UC San Diego



GE Healthcare



einance

Mount Sinai
MEDICAL CENTER



The University of Utah
Health Sciences



DUODECIM
Medical Publications Ltd.

PHILIPS

sense and simplicity



Wolters Kluwer
Health

accenture



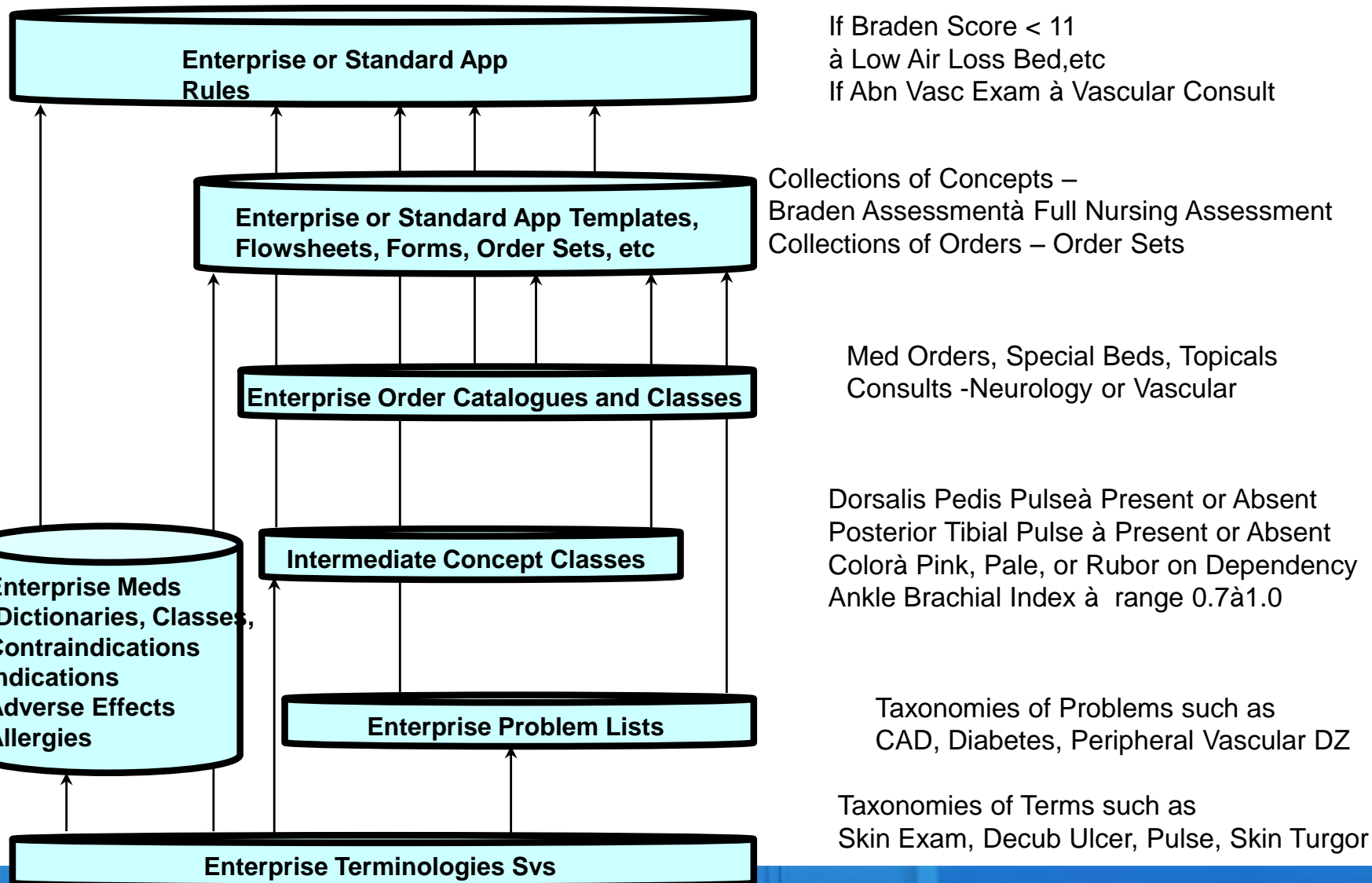
newMentor

GEISINGER

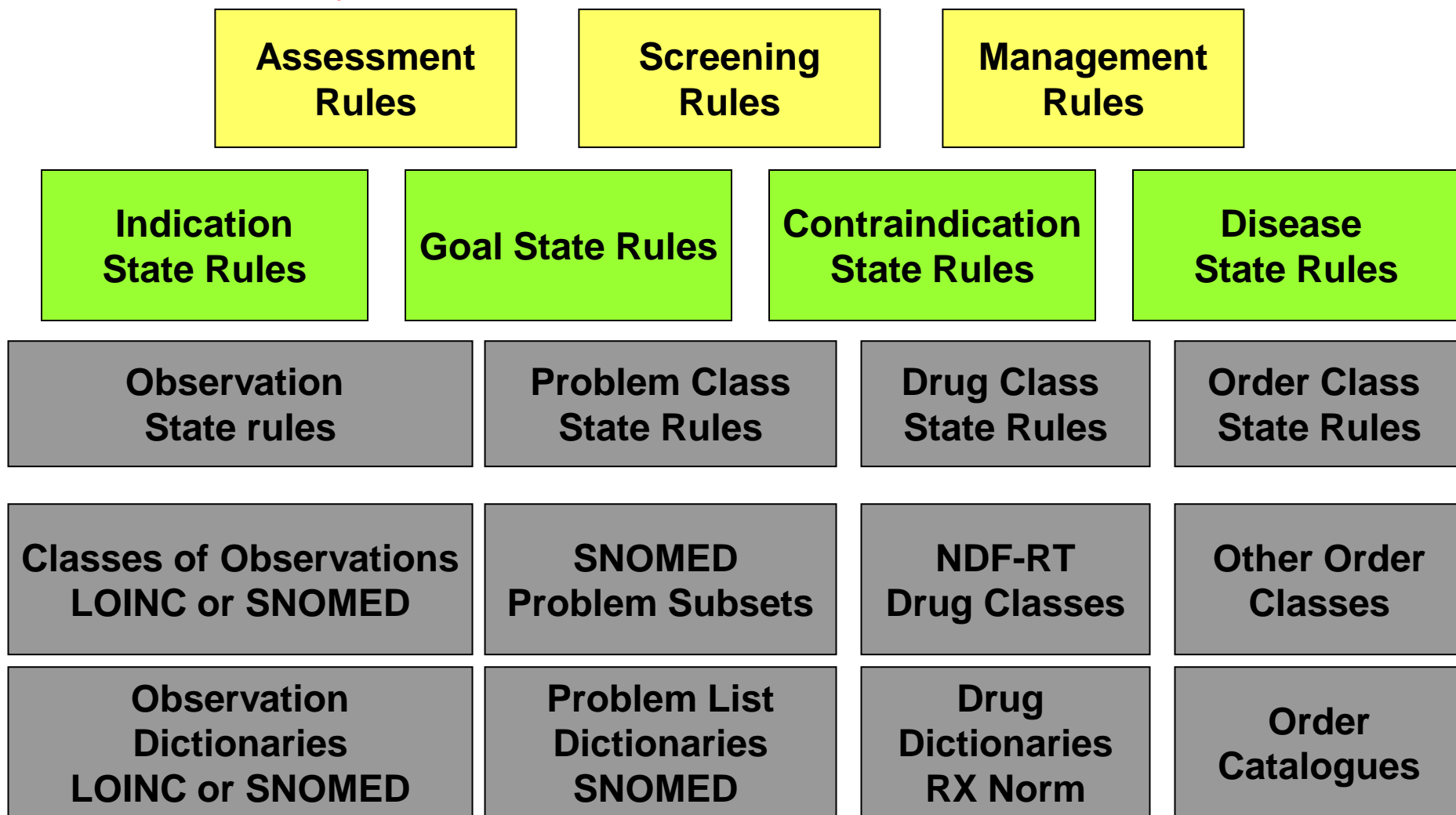


KAISER PERMANENTE®

Knowledge is Like a Cake-Stack

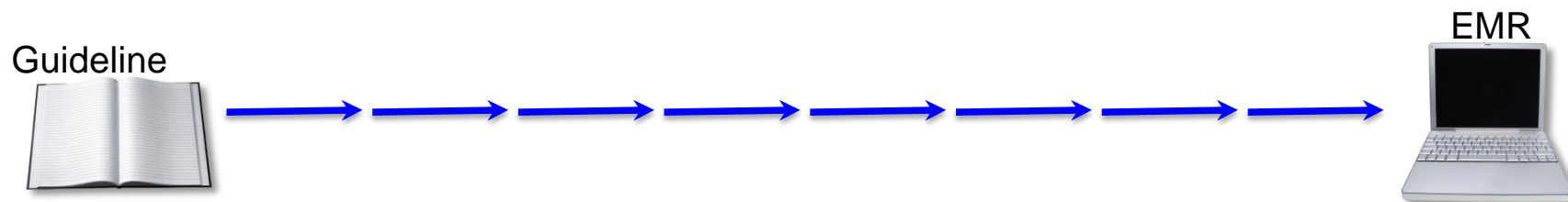


Building Blocks For Rule Modularity and Reusability

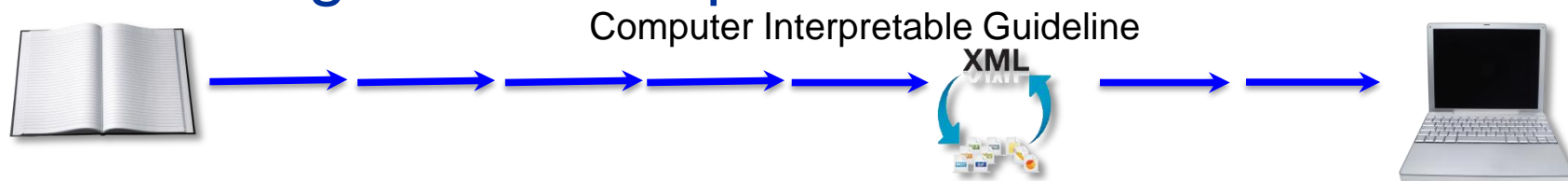


Three Models to Accelerate Knowledge -> Practice

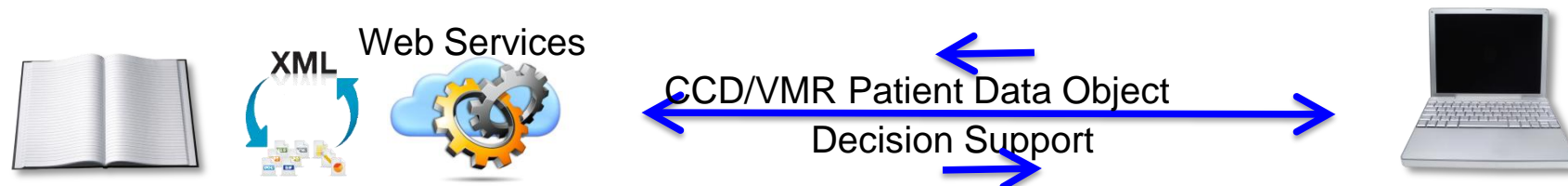
- Current paper-based approach



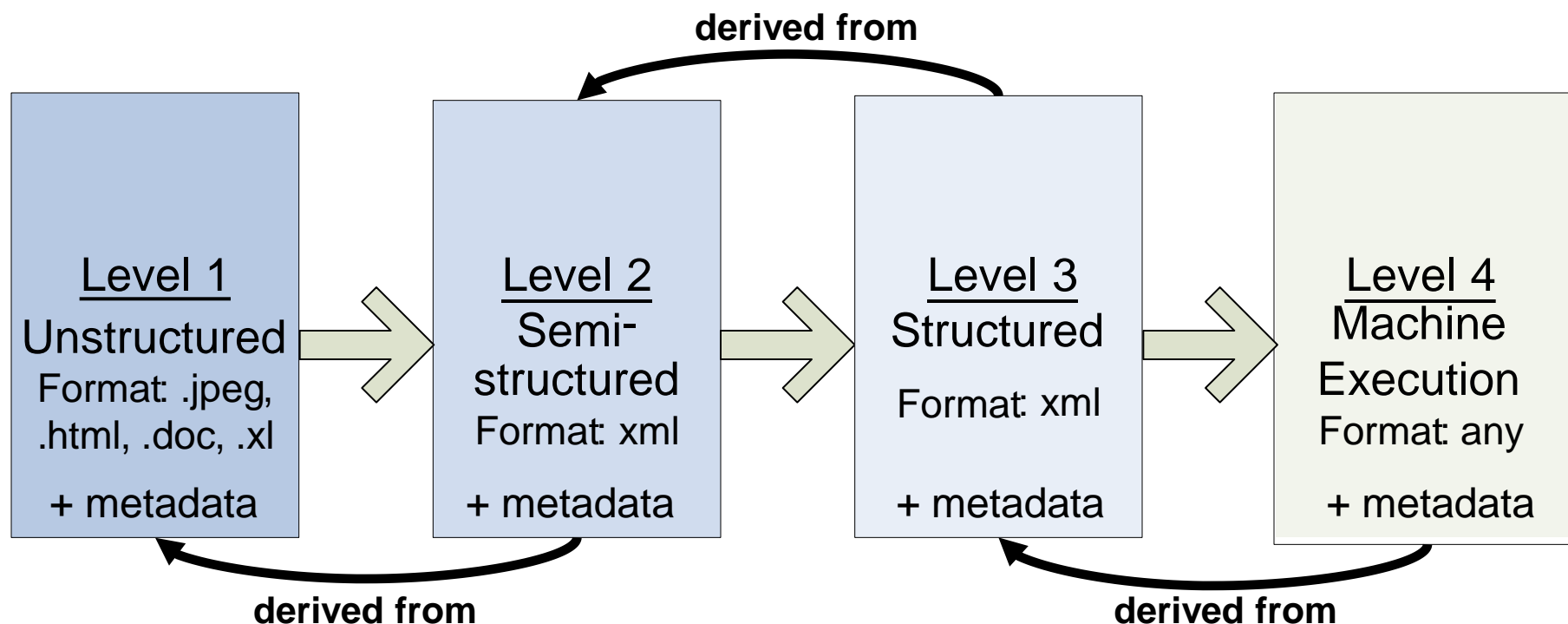
- Knowledge artifact import into EMR



- Cloud-based clinical decision support services



Knowledge Translation and Specification: Four-Layer Model



Initial evaluation results: Structured recommendation (L3) was considered *more implementable* than the semi-structured recommendation (L2).

CDSC Knowledge Authoring Tool

Guideline Entry Form- Structured Model v 0.2 of

Diabetes guideline for AHRQ CDSC pilot (Level 2)

Rules for managing outpatient adult diabetic patients

expand/collapse

codes

classification table

New

Save As...

Navigation

- Structured Guideline
 - Metadata
 - Scenario: **EVOKEs**
 - Module
 - Rec 1: OverdueA1c
 - Rec 2: HighA1cMonitoring
 - Module
 - Rec 1: Overdue Eye Exam
 - Rec 2: Overdue Foot Exam
 - Rec 3: Overdue microalbuminuria
 - Module
 - Rec 1: HighA1c.StartOralAgentOrInsulin
 - Rec 2: HighA1c.StartMetformin
 - Rec 3: OralAgent
 - Rec 4: Insulin
 - Rec 5: Nephropathy.NotOnARBorACEI

Guideline

- Metadata

-Identity title: **Diabetes guideline for AHRQ CDSC pilot**

Rules for managing outpatient adult diabetic patients

Developer: PHS

- Coverage (includes 3)

adult (coverage type: **patient**)

diabetes mellitus (coverage type: **clinicalFocus**)

outpatient (coverage type: **careSetting**)

- Applies to: **EVOKEs**

description:

Definition of adult patient: patient 18 years or older

- Module **ASSESS**

description: **Rules for monitoring HgbA1c**

- Recommendation 1: (**OverdueA1c**)

HgbA1c should be monitored biannually

+ **Applies to:** **OverdueA1c**

description: **Order HgbA1c now**

+ **Recommendation 2:** (**HighA1cMonitoring**)

+ Module **SCREEN**

**Facilitates import
GEM marked up
Guideline, too**



Inspect

Clear

Console

HTML

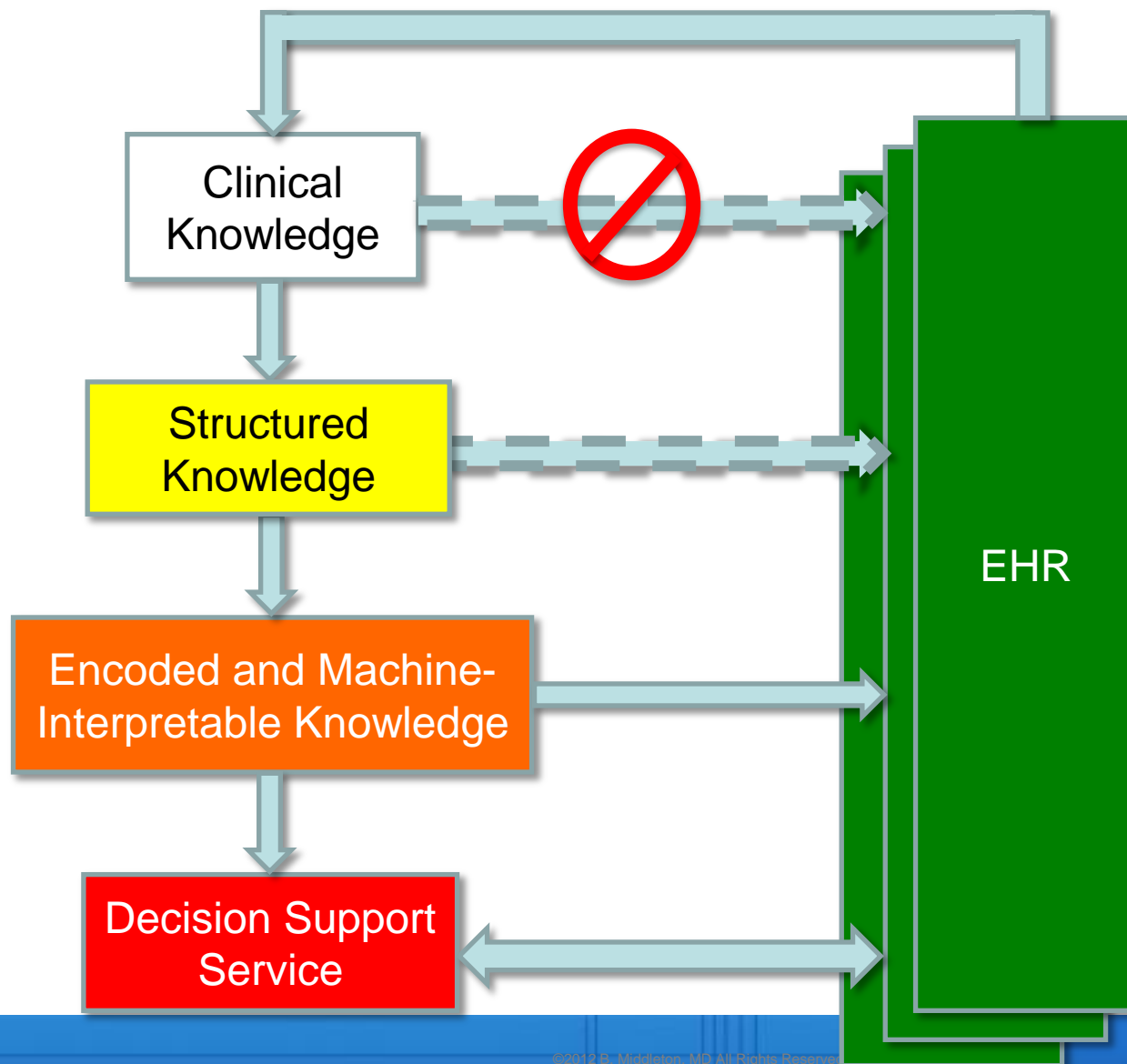
CSS

Script

DOM

XHR

A Unified Theory for CDS



An external repository of clinical content with web-based viewer



Keyword Search:

Search Criteria

Content Type...

Specialty

All Clinical Disciplines
Anesthesiology/Perioperative Medicine
Behavioral Medicine

Entity :
All Entities
es - PC

are
es
ory Care

Patient Safety :

Alerts and Notification
All Patient Safety
Consequent Order/Lab Display

Age Group :

Adult
All Patient Age Groups
Geriatric

Disease Management :

ADHD
All Disease Management
Asthma

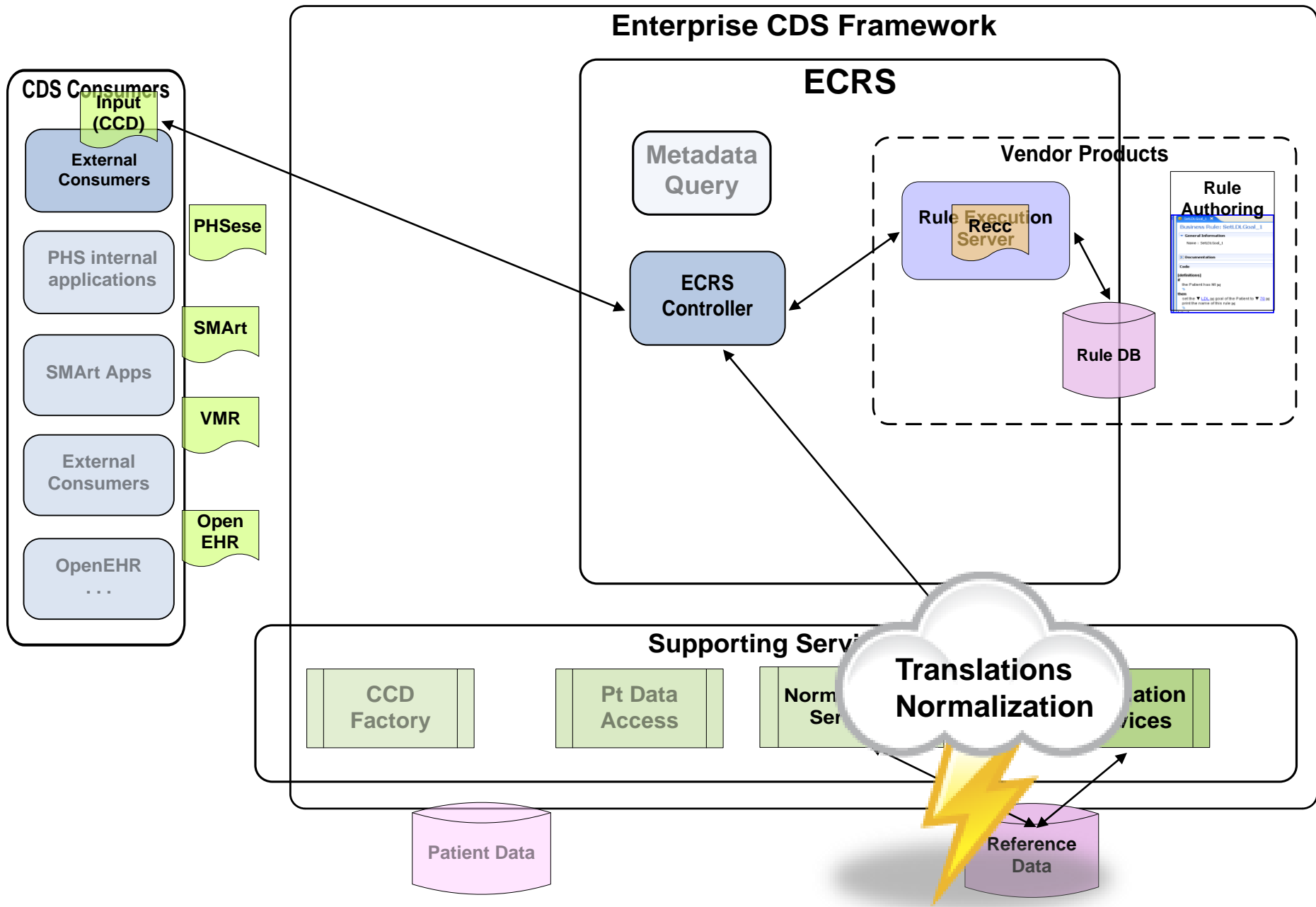
Application :

All Applications
BICS Event Monitor
BICS Order Entry

General Surgery
GI Colorectal Surgery
Hematology and Oncology
Infectious Disease
Nephrology
Neurology
Neurosurgery
Newborn/Neonatology
Obstetrics and Gynecology
Ophthalmology

CDS Consortium KM Portal Access

Document	Rank
Diabetes-Mellitus-SNOMED-Classification-Subset-L4	1
G6PD-deficiency-SNOMED-Classification-Subset-L4	1
Nephrotic-Syndrome-SNOMED-Classification-Subset-L4	3
Ischemic-Heart-Disease-SNOMED-Classification-Subset-L4	4
CDSC-Diabetes-L4	4
End-Stage-Renal-Disease-SNOMED-Classification-Subset-L4	5
ACDS-Response-Value-Set-L4-Diabetes-Not-on-Problem-List	6
ACDS-Response-Value-Set-L4	6



CDSC Services in Partners LMR

LMR OC4A2 SUMMARY - Windows Internet Explorer

File Edit View Favorites Tools Help

LMR OC4A2 SUMMARY

Bwhlmmapltest,Four

24252934 (BWH) 07/15/1939 (71 yrs.) F

Home Select Desktop Pt Chart: Summary Oncology Custom Reports Admin Sign Results ? Resource Popup

Customize

Reminders

- No documented tobacco status. Click to enter status.
- Patient 65 yrs or older, due for Pneumovax.
- Patient 50 years old or greater, recommend influenza vaccination.
- Patient has CAD-equivalent on problem list and a beta blocker is not on the medication list. Recommend beta blocker.
- Patient has CHD-equivalent, overdue for lipid assessment (rec: q 1 year).
- Pt is overdue for colonoscopy (rec: q 10 years). FamHx indicates average risk for colorectal cancer.
- Diabetic patient is overdue for HgbA1c measurement (recommended every 6 months).
- Diabetic patient is due for ophthalmologic exam (recommended yearly).
- Diabetic patient is due for foot exam (recommended yearly).
- Diabetic Patient with renal disease, consider starting angiotensin-converting enzyme inhibitor (ACE-I).
- Patient has CAD or equivalent, consider starting anti-platelet therapy, but potential contraindications exist.
- Patient is overdue for blood pressure assessment (recommended yearly).

Never used tobacco Execute

Referral requested Execute

Order HbA1c Execute

Appointment scheduled Execute

Appointment scheduled Execute

Order ACEI Execute

Order Aspirin Execute

Done Elsewhere Execute

Flowsheets Add New

Medications Enter new medic Add New

Procedures Enter new proc Add New

Physicians Enter new phys Add New

Notes Add New

Problems Enter new probl Add New

- Diabetes mellitus
- Renal insufficiency
- Coronary artery disease
- Peptic ulcer disease

Health Monitoring Enter new hm it Add New

HM Item	Date of Last	Result

Care Providers Add New

BMT Flowsheet

HM Form

Sticky Notes Add New

Allergies Add New

Allergen	Reaction
Milk Protein - Moderate	- Itching - Rash

Visits

Date	Provider	Clinic

Pharmacies Add New

Patient M/A List

Oncpro

To Do Add New

Immunization

Trusted sites 100%

Regenstrief G3

Welcome to G3! | Relay Health | External Resources | Leave Feedback | Help

Inbox

Notifications - All Patients

				Patient	Subject	Delivered
					Patient is overdue for blood pressure assessment (recommended yearly).	28-Dec-2010 15:03
					Diabetic patient is overdue for HgbA1c measurement (recommended every 6 months).	28-Dec-2010 15:03
					Diabetic patient is due for foot exam (recommended yearly).	28-Dec-2010 15:03
					Diabetic patient is due for ophthalmologic exam (recommended yearly).	28-Dec-2010 15:03

Sender: USER, CARERULE
Viewed:
Can Delete: true
Priority: low
Info Only: true
Can Forward: true

Message:
 Diabetic patient is due for foot exam (recommended yearly).
 Document the foot exam.
 Refer to Podiatrist.
 Recommend giving to the patient the handout 'Diabetic Foot'

DISCLAIMER
 This decision support reminder may be inaccurate or based on incomplete data. The clinician should always use proper judgement while taking care of the patient, and should disregard this reminder if it seems clinically inappropriate. This decision support reminder is provided by the Clinical Decision Support Consortium as a component of a research study. It is based on the recommendations of the United States Preventive Services Task Force. For any questions please contact: Linas Simonaitis (email: lsimonaitis@regenstrief.org) (phone: 317-423-5535) or Brian Dixon (email: bdixon@regenstrief.org)(phone: 317-423-5582)

Inbox

Date Delivered	Patient	Subject
28-Dec-2010 15:03		Patient is overdue for blood pressure assessment (recommended yearly).
28-Dec-2010 15:03		Diabetic patient is overdue for HgbA1c measurement (recommended every 6 months).
28-Dec-2010 15:03		Diabetic patient is due for foot exam (recommended yearly).
28-Dec-2010 15:03		Diabetic patient is due for ophthalmologic exam (recommended yearly).

Screenshot of CDSC Reminders, now moved to the “Prevention/

G3 3.18.0.BUILD-SNAPSHOT - Mozilla Firefox

File Edit View History Bookmarks Tools Help

localhost:8080/CareWebWishard/

Most Visited Getting Started Latest Headlines Local CareWeb AppDev CW INPC Production Support W... AppDev CW Wishard Product Application C...

G3 3.18.0.BUILD-SNAPSHOT Relay Health External Resources Leave Feedback Help Development Change Password Logout

TEST, PATIENT (91) Change DOB: 10-Jun-1946 (65 yrs) Female Chart Search SIMPSON, HOMER D at BLACKBURN

Inbox Dashboard Order Entry View Chart Medication Reconciliation Primary Care Physicians Orderset Builder Relay Health ResNet Settings Administration

Patient Landing

Orders and Documentation

- DEV Only Release Orders
- Release Orders
- Verbal Orders **Draft**
- Verbal Release Orders
- Quick Orders **Draft**
- Verbal Quick Orders **Draft**
- Phone Encounter
- Other Documentation
- Student Notes
- Observations

Problems

- back pain (724.5)
- diabetes mel insulin dep (250.01)
- psychosomatic dis (306.9)

Medications

- Alprazolam 0.25 MG
- Amitriptyline 1.25 MG
- Amoxicillin 875 MG
- Aspirin 500 MG
- Atenolol/Chlorthalidone 100-25 MG
- Atenolol/Chlorthalidone Tab 100-25 MG
- Atomoxetine 10 MG
- BEER 4 %
- Beer 25 Liter(s)
- Bupropion Nasal Spray 22 mg/DIET

Allergies

- ASA MEDS
- BLOOD RELATED
- CODEINES

Recent Orders

Date	Order Name	Provider
04-Apr-2012	BEER	SIMPSON, HOMER
03-Apr-2012	BEER	TWIGG MD, HOMER L
24-Mar-2012	Rivastigmine	SIMPSON, HOMER
24-Mar-2012	Alprazolam	SIMPSON, HOMER
23-Mar-2012	NO CODE	BREHM, MICHAEL H
23-Mar-2012	Oxycodon5/Acet325	BREHM, MICHAEL H
21-Mar-2012	Cetirizine	BREHM, MICHAEL H
13-Mar-2012	FULL CODE	SIMPSON, HOMER

Prevention/Recommendations

- Diabetic Patient with renal disease, consider starting angiotensin-converting enzyme inhibitor (ACE-I). (disclaimer)
- Start ACE-I.
- Diabetic patient is due for foot exam (recommended yearly). (disclaimer)
- Refer to Podiatrist.
- Diabetic patient is due for ophthalmologic exam (recommended yearly). (disclaimer)
- Refer to Ophthalmologist.
- Refer to Optometrist.
- *** BLOOD / BODY FLUIDS PRECAUTIONS.
- TO-DO's

Chart

- View/Print Orders
- All Results
- Labs
- Imaging
- Provider Notes
- Admission/Discharge
- Cardiology Studies
- G.I. Studies
- Pathology
- Other Results

Patient Profile

- Preferred Pharmacy
ENGLEWOOD PHARMACY
- Demographics
- Appointment History

Alert Manager - no alerts

NextGen EHR: Test9 CDSC NICKNAME: DOB: 12/10/1965 AGE: 46 years 9 months (Male) - 08/24/2012 03:11 PM: "SOAP - OV"

File Edit Default View Tools Admin Utilities Window Help

Logout Save Clear Delete ZDefault Location Provider-TestOnly, MVIPA Do-Nc Patient History Inbox PAQ EPM ICS Close Templates Procedures Problems Allergies Medications

08/24/2012 03:11 PM: "SOAP - OV" x

Mv Cdisc View Close

Alert CDS

Reason for

Patient ID: a4ac19fd-73cd-4de4-97e9-73bafb52126d
Organization ID: NextMD
Generated On: August 23, 2012 20:04

Recommendation(s)

Recommendation 1

- Diabetic patient is due for urine microalbumin/creatinine ratio measurement (recommended yearly).
- [Recommend giving to the patient the handout 'Diabetic Kidney Problems'](#)

Recommendation 2

- Diabetic patient is due for foot exam (recommended yearly).
- [Recommend giving to the patient the handout 'Diabetic Foot'](#)

Recommendation 3

- Diabetic patient is due for ophthalmologic exam (recommended yearly).
- [Recommend giving to the patient the handout 'Diabetic Eye Problems'](#)

Recommendation 4

- Diabetic patient is overdue for HgbA1c measurement (recommended every 6 months).


Legal disclaimer: This text needs to be replaced with the appropriate text based on the signed legal agreement requirements.












Previous mv_ov_soap

Office visit summary

Provider Communications Diagnostic Req Lab Req Procedure Note Next Task

SHARP-C “SMARt” Container




-  Patient List
-  Alerts
-  API Playground
-  API Verifier
-  BP Centiles
-  Direct Messages
-  EMR View (Dev)
-  Med List
-  My App
-  Problems
-  Manage Apps

< Amy Shaw >

Neelima Karipineni · Logout

Immunization Record SMART Application



Immunizations References

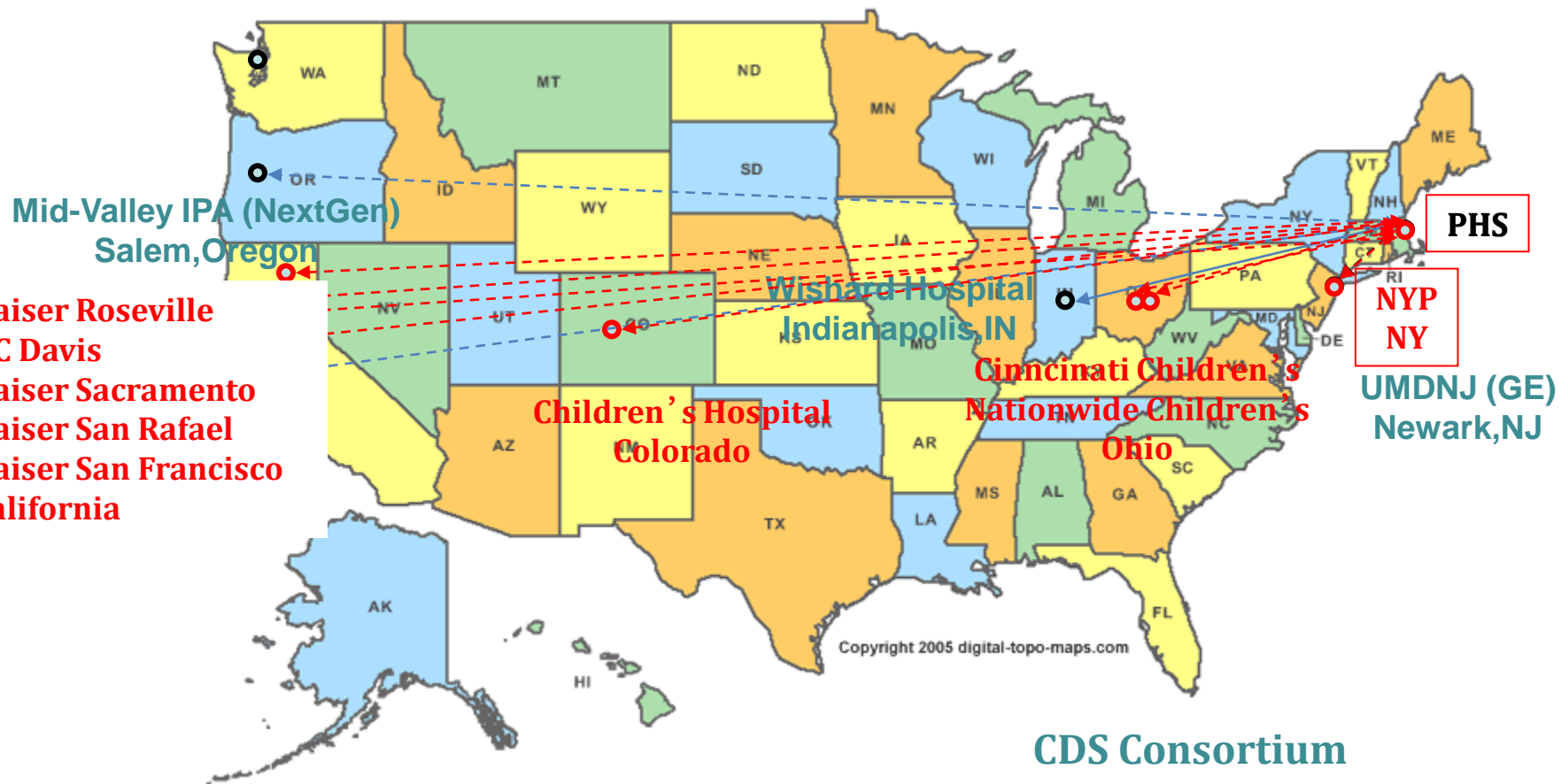
Child Adult Administered Due Recommended Not Recommended Optional

Amy Shaw (female, DOB: 2007-03-20) [Show Allergies](#)

Vaccine	Due	Doses				
ROTAVIRUS	5/1/12	5/24/07				
DTAP	3/1/12	9/27/07				
HepB	1/2/12 - 2/1/12	9/27/07				
POLIO	3/1/12	9/27/07	1/27/11	5/27/11		
HPV	1/1/23 - 1/1/24					
MENING	1/1/23 - 1/1/24					
HepA	1/1/13 - 7/1/13					
ZOSTER	Not indicated - Patient not yet indicated for ZOSTER vaccine					
VARICELLA	1/1/13 - 4/1/13					
HIB	3/1/12					
MMR	1/1/13 - 4/1/13					
PneumoPCV	3/1/12 - 4/1/12					
FLU	Not indicated - Current date is not within influenza season					

CHIP · HMS · © 2012

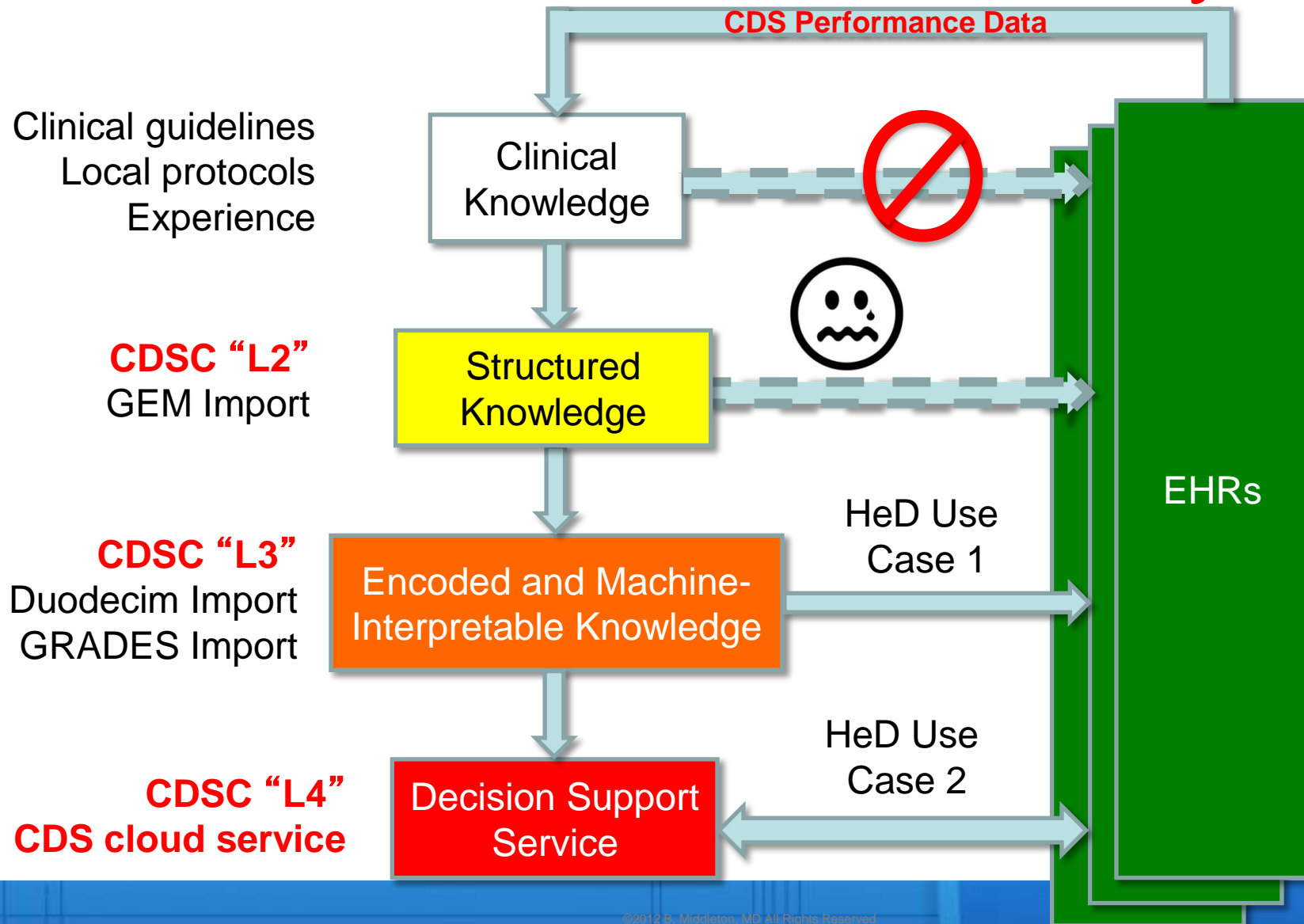
Toward a National Knowledge Sharing Service



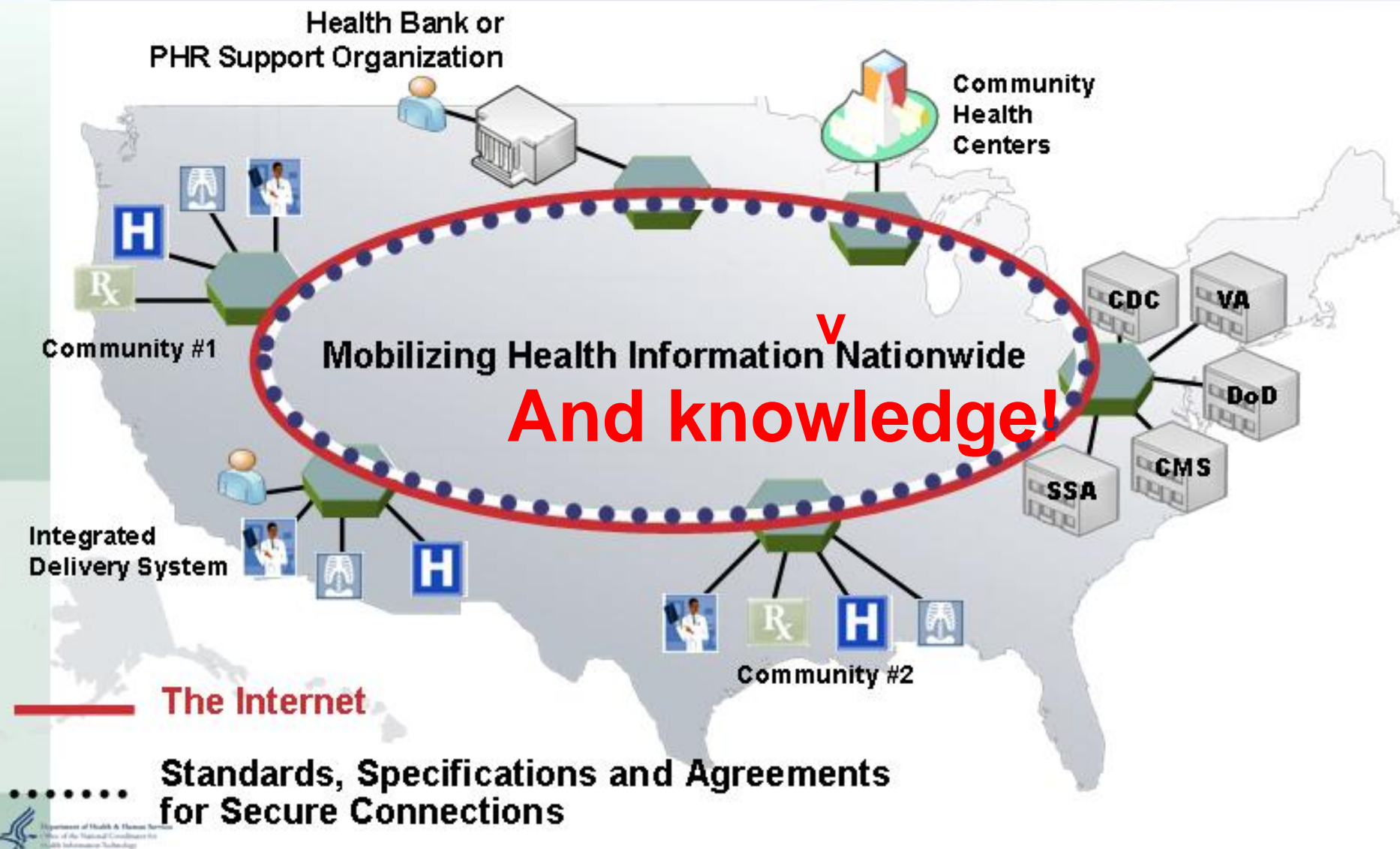
CDS Consortium

PECARN TBI CDS

CDSC within Unified Theory



The Nationwide Health Information Network



Acknowledgements

AHRQ: HHSA290200810010

Principal Investigator: Blackford Middleton, MD, MPH, MSc

CDSC Team Leads:

Research Management Team: Lana Tsurikova, MSc, MA

KMLA/Recommendations Teams: Dean F. Sittig, PhD

Knowledge Translation and Specification Team: Aziz Boxwala, PhD

KM Portal Team: Tonya Hongsermeier, MD, MBA

CDS Services Team: Howard Goldberg, MD

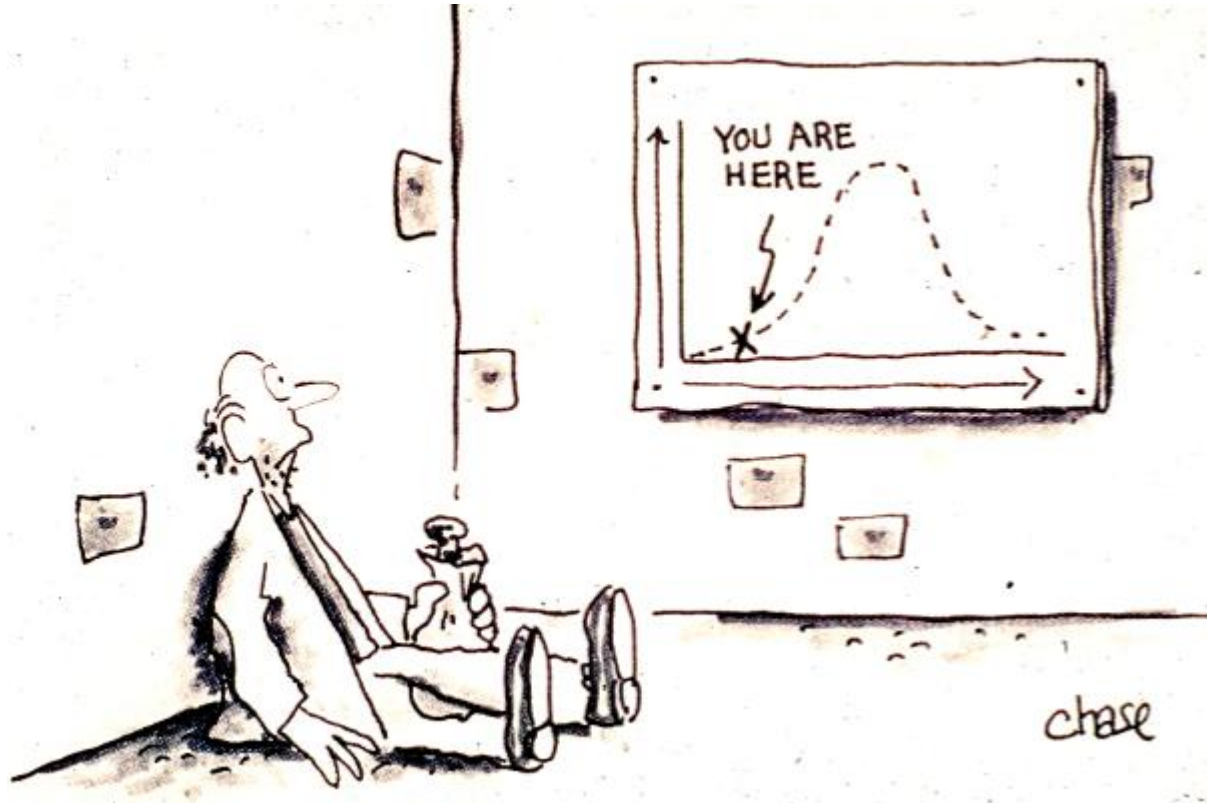
CDS Demonstrations Team: Adam Wright, PhD

CDS Dashboards Team: Jonathan Einbinder, MD

CDS Evaluation Team: David Bates, MD, MSc

Content Governance Committee: Saverio Maviglia, MD, MSc

Where are we?



Thank you!

Blackford Middleton, MD

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www.partners.org/cird

❖❖ Conclusions and Driving Questions

- **Need for common approach to CDS**
 - How do we unite around an agreed upon approach so we can focus on providing VALUE to patients?
- **Critical role of HHS and ONC**
 - What more can the government do?
- **Need for academic-private-public collaboration**
 - How can we foster more productive collaborations?
- **Don't let perfection be the enemy of the good**
 - How can we make progress today?
- **A perfect storm is coming...**
 - How can we best align with ARRA, HITECH, ACOs, payment reform, etc. to advance CDS and patient care?