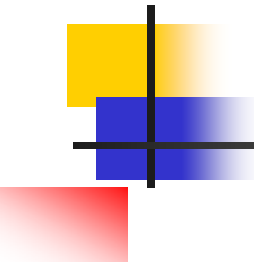




Clinical Decision Support Tools for Public Health

2017 Netsmart Public Health Summit
Overland Park, KS
August 3, 2017

Noam H. Arzt, PhD, FHIMSS
HLN Consulting, LLC

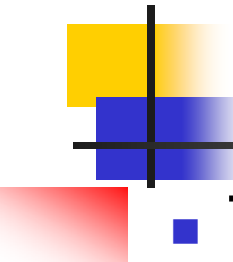


Definitions

Clinical Decision Support (CDS) tools important to support surveillance:

“Computer-based clinical decision support (CDS) can be defines as **‘the use of information and communication technologies to bring relevant knowledge to bear on the health care and well-being of a patient.’**”

Greenes RA. Definition, scope and challenges. In: Greenes RA, ed. *Clinical Decision Support: The Road to Broad Adoption*. 2nd ed. Waltham, MA: Elsevier, 2014.



A Common Foundation

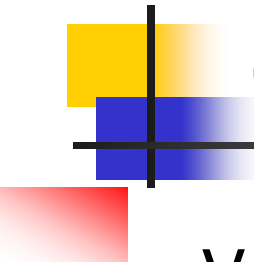
- Three use cases described here – all use common framework and underlying CDS foundation and products
 - OpenCDS (<http://www.opencds.org/>)
 - HLN CDS Technical Framework (<http://www.cdsframework.org>)
 - CDS Administration Tool (CAT) for:
 - Rule authoring
 - Testing
 - Terminology maintenance





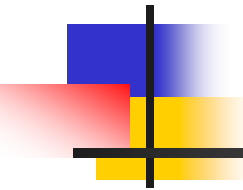
CAT Software Characteristics

- Framework for developing middle tier services and web-based front ends
- Plugin architecture for adding/removing features
 - Core module → administrative functions
 - User management, security, auditing, etc.
 - CDS module → clinical decision support features
 - Custom modules →
 - A means to add additional functionality, if desired
 - May be built on top of/supplement CDS module, or exclude it
 - Example custom modules: ICE, RCKMS Authoring Tool, HL7 QA Tool, Patient Administration

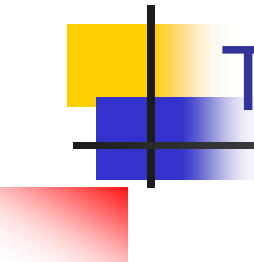


Overview of CAT CDS Functionality

- Value Set Editor → importing, managing value sets
- Concepts Editor → entering concepts and mapping to codes
- Data Model Editor → configure knowledge authoring data model
- List Editor → Context-specific values and dropdowns
- Rule Editor → authoring & deployment of rules
- Test Manager → Validate logic and create/execute test cases



Three Use Cases



Three Software Systems Using CAT/OpenCDS

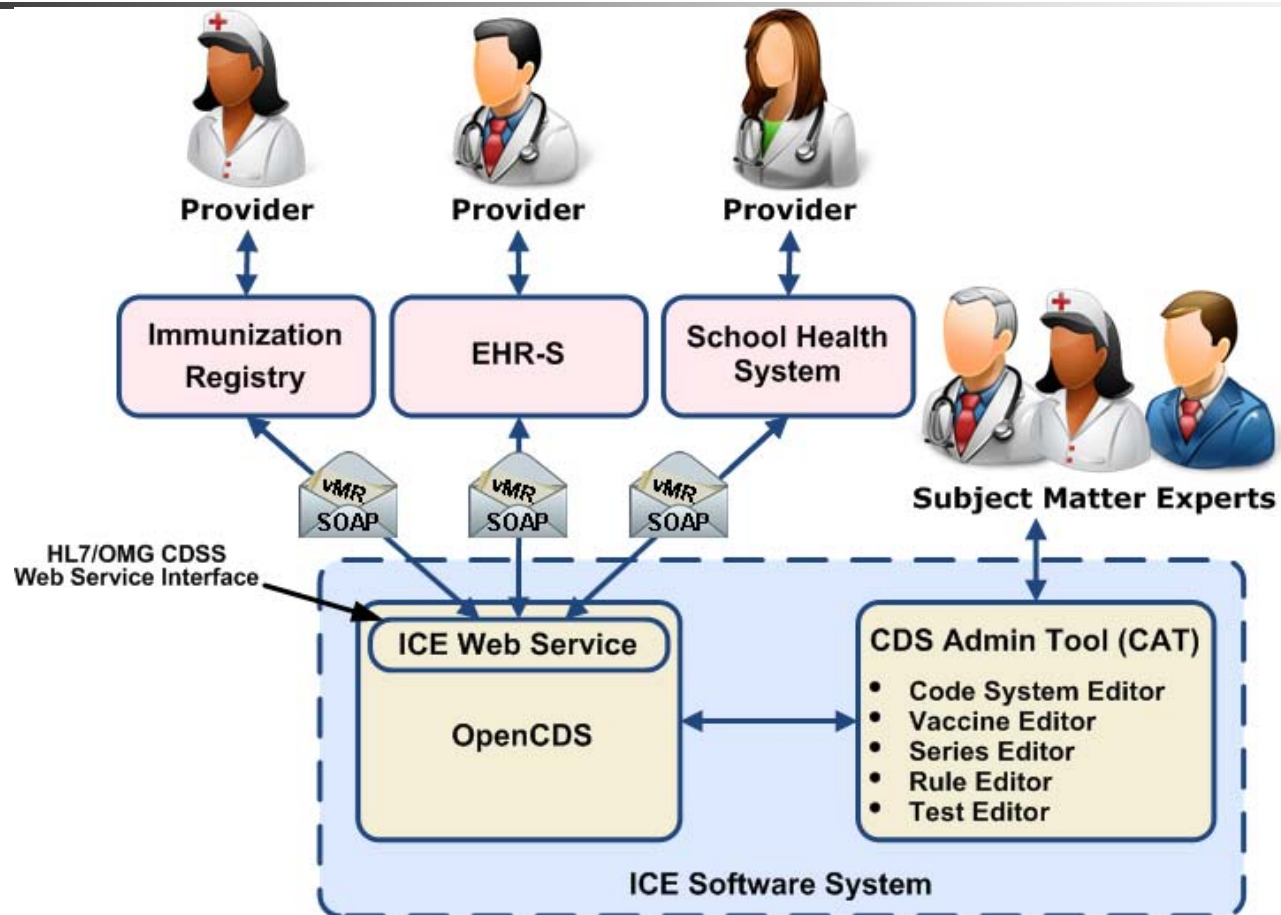
1. Immunization Calculation Engine (ICE)
2. Reportable Condition Knowledge Management System (RCKMS)
3. Decision Support for Data Segmentation (DS2)

Use Case 1: Immunization Calculation Engine (ICE)

- Service-oriented, standards-based immunization forecasting software system
- Evaluates a patient's immunization history and generates the appropriate immunization recommendations
- Can be deployed in diverse technical environments, centrally or distributed
- Designed to easily integrate with registries, surveillance systems, clinical systems (EHRs, PHRs)



Sample ICE Deployment



ICE Client – Sample Screen

Patient Info

Name: John Smith

DOB: 20140801

Gender: M

Evaluation Date: 20140904

Age @Evaluation: 0y 1m 3d

Patient Output Grid

Vaccine Group

Recommendations

Evaluations

HepB

Date: 20141001
Status: FUTURE_RECOMMENDED
Message: DUE_IN_FUTURE
Vaccine Group: HepB

Date: 20140802
Age: 0y 0m 1d
Valid: true
Vaccine: Hep B,
adolescent/high risk infant (42)

Test Case Summary (ICE custom module)

Test Reference View:

[Show Date Calculator](#)

Test #: 125

Name: Minimum interval minus one day (51 days) between Dose 2 and Dose 3.

Test Execution Date: 10/21/2011

Patient DOB: 04/01/2011

Age @ Execution Date: 6 months 20 days (203 days)

Administered Immunization Components

ID	Admin Vaccine Code	Comp Vaccine Code	Admin Date	Age @ Admin Date	Evaluation	Reason(s)
263	HepB peds < 20yrs (CVX 08)	HepB peds < 20yrs (CVX 08)	04/29/2011	28 days (28 days)	VALID	
264	HepB peds < 20yrs (CVX 08)	HepB peds < 20yrs (CVX 08)	07/23/2011	3 months 22 days (113 days)	VALID	
265	HepB peds < 20yrs (CVX 08)	HepB peds < 20yrs (CVX 08)	09/12/2011	5 months 11 days (164 days)	INVALID	Below Minimum Interval

Shot Component Intervals

Interval Between...	Interval...
Shot 1 (Group HepB/CVX 08) and Shot 2 (Group HepB/CVX 08)	2 months 24 days (85 days)
Shot 1 (Group HepB/CVX 08) and Shot 3 (Group HepB/CVX 08)	4 months 14 days (136 days)
Shot 2 (Group HepB/CVX 08) and Shot 3 (Group HepB/CVX 08)	1 months 20 days (51 days)

Proof of Immunity/Documented Disease

Antigen	Immunity Date	Age @ Imm Date	Immunity Reason
No records found.			

Recommendations

Recommended Vaccine/Group	Date Due	Age @ Rec Date	Recommendation	Reason
HepB	11/07/2011	7 months 6 days (220 days)	Future Recommendation	Due in Future

Test Suite "Run" (ICE custom module)



Total Tests Passed: 123 of 124
Total Tests Failed: 1 of 124
Total Tests Skipped: 0
Total Duration (ms) : 14,156.43
Avg Duration (ms) : 114.16

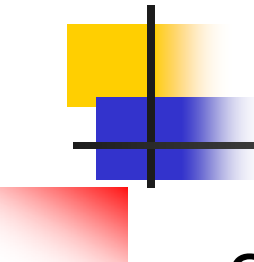
Suite Details

Suite Test Results

Suite Test Results for: HepB Tests

Expand rows to see detailed information

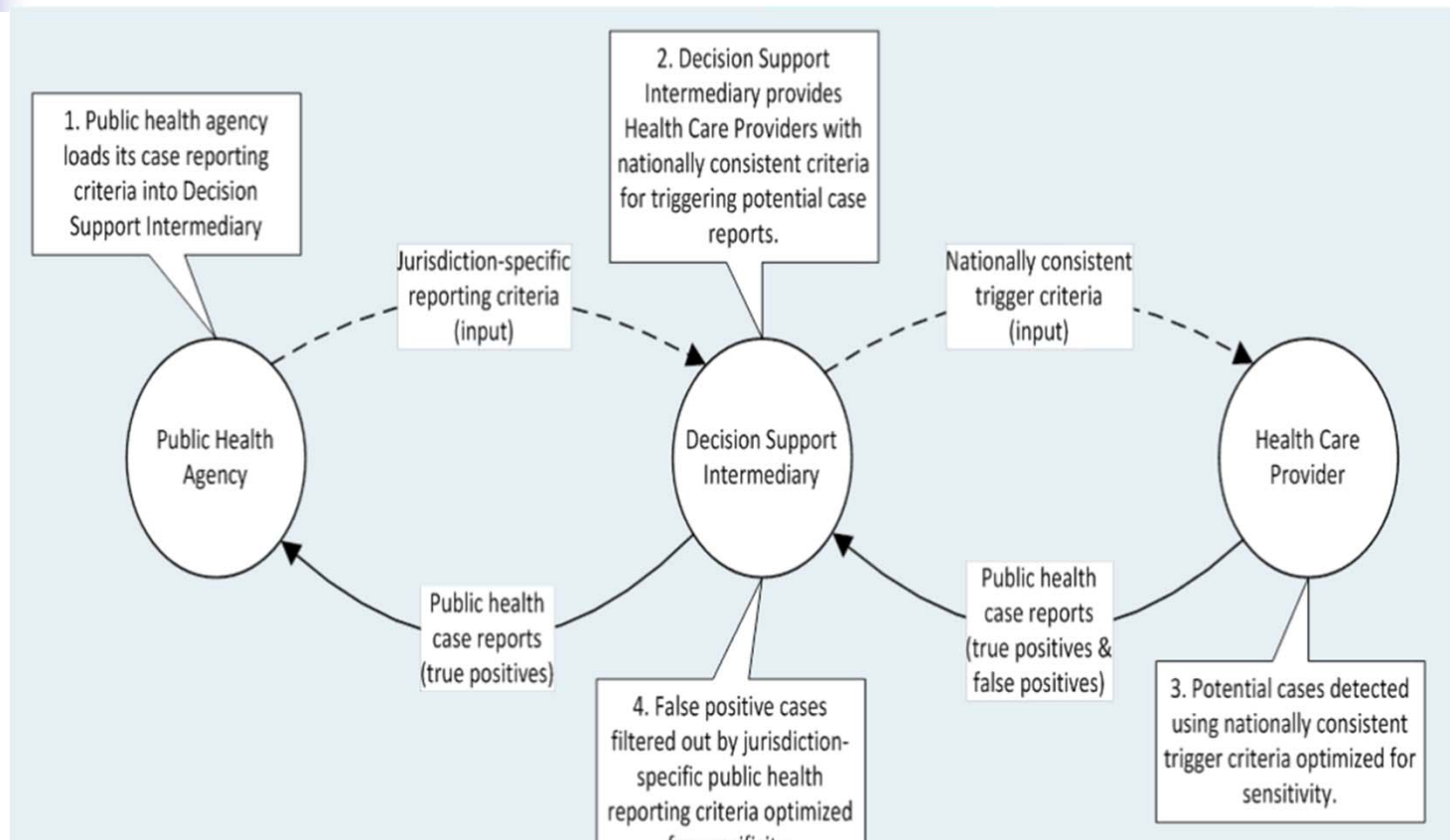
	ID ▲	Name ◇	Duration (ms)	Eval. Passed?	Rec. Passed?	Passed? ◇
▶	72	Minimum interval minus one day (23 days) between Dose 1 and Dose 2.	97	✓	✓	✓
▶	73	Minimum interval (24 days) between Dose 1 and Dose 2.	115.39	✓	✓	✓
▶	74	Minimum interval plus one day (25 days) between Dose 1 and Dose 2.	93.18	✓	✗	✗
Differences						
Recommendation Date Due date values do not match: ICE =10/01/2011; EXPECTED =10/10/2011						
▶	75	Minimum interval minus one day (51 days) between Dose 2 and Dose 3.	96.92	✓	✓	✓



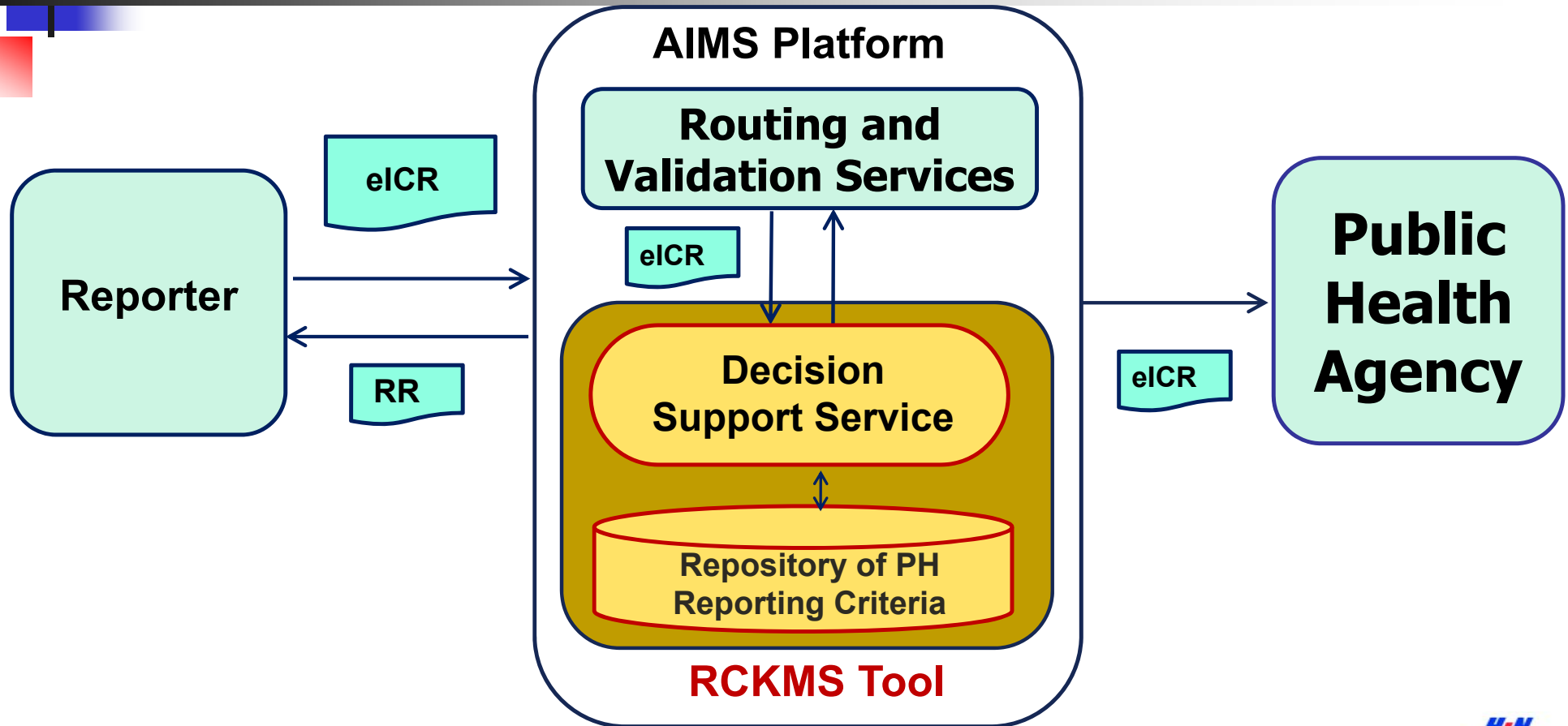
Use Case 2: Reportable Condition Knowledge Management System (RCKMS)

- Service-oriented, standards-based which allows EHR systems to submit initial electronic case reports to public health based on “triggering” event
- Evaluates conditions for reportability to a state/local jurisdiction and returns decision and instructions
- Expected to be deployed nationally on a shared platform with authoring tool for local jurisdictions to configure their rules

eCR Process Flow



eCR Data Flow



RCKMS Authoring Tool (custom module)

 Main Menu ▾

Home About RCKMS ⚙ ▾

Reporting Specification

Show 10 ▾ entries Search:

Nationally Notifiable? ⚡	Condition Name ⚡	Category ⚡	Status ⚡	Assigned To ⚡	Created By ⚡	Last Updated ⚡	
Y	Chlamydia	Sexually Transmitted Infections	Not Published		daryl	06/03/2017 10:13 AM	 
Y	Gonorrhea	Sexually Transmitted Infections	Not Published		daryl	06/03/2017 10:15 AM	 
Y	Pertussis	Vaccine Preventable Conditions	Not Published		daryl	06/03/2017 10:10 AM	 
Y	Salmonellosis	Enteric Diseases	Not Published		daryl	06/03/2017 10:15 AM	 
Y	Zika	Zoonotic and Vectorborne Diseases	Not Published		janet.hui	06/03/2017 10:17 AM	 
Nationally Notifiable?	Condition Name	Category	Status	Assigned To	Created By	Last Updated	

Previous 1 Next

[+ Add Reporting Specification](#) [⬆ Deploy Reporting Specifications](#)



Reusable Criteria Templates (set up by Administrator)

Reporting Specification

Edit Reporting Specification

Details
Criteria / Logic Sets
Specifications
Internal References
External References

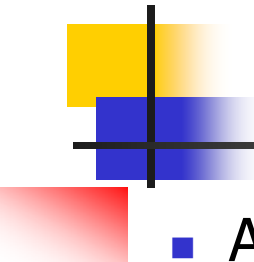
Reporting Specifications

	Lab Reporting (Lab2)	Provider/Facility Reporting (CLIN+EPI)	Provider/Facility Reporting (DX)	Provider/Facility Reporting (Lab)
Reporting Timeframe	1 day(s)	1 day(s)	1 day(s)	1 day(s)
Clinical		Necessary		
Diarrhea				
Salmonellosis (Diagnosis or active problem)			Sufficient	
Laboratory	Sufficient			Sufficient
Detection of Salmonella (except S. typhi and S. paratyphi) nucleic acid by any method in a clinical specimen				
Identification of Salmonella (except S. typhi and S. paratyphi) by culture method in a clinical specimen, including identification tests performed on an isolate	Sufficient			Sufficient
Epidemiologic		Optional		
Contact of a person with Salmonellosis (Not Yet Implemented)				



Use Case 3: Decision Support for Data Segmentation (DS2)

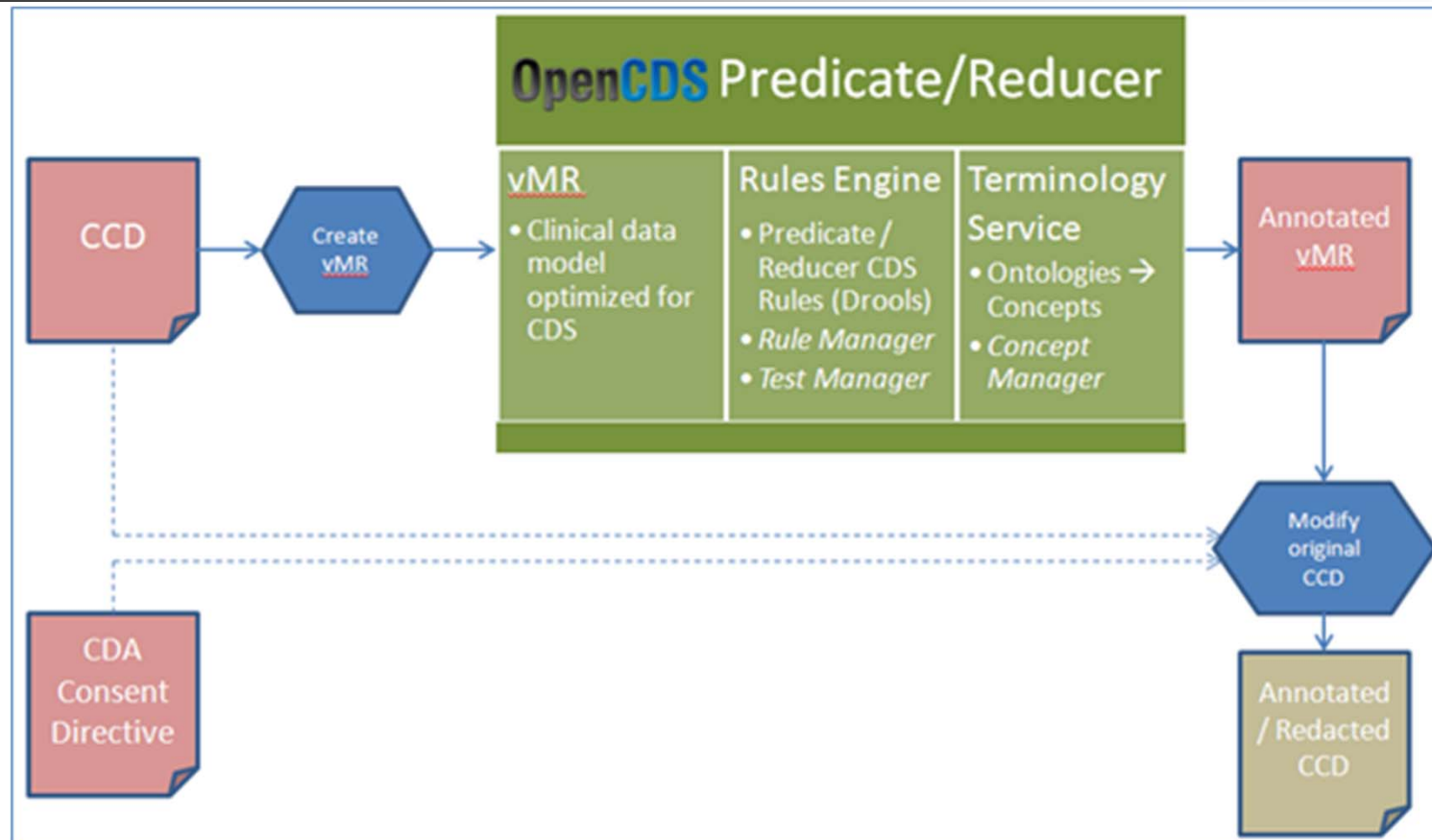
- Part of ONC HITECH SHARP research project in a state-level HIE environment
- Uses OpenCDS to identify and redact selected sensitive conditions from clinical summary documents
- Includes a web-based "inference analyzer" for visualizing the effectiveness and the impact of probabilistic redaction
- Includes a suite of related tools for creating, importing, and editing Continuity of Care (CCD) documents; testing redacted CCDs



DS2 Research Objectives

- Analyze (de-identified) patient problem lists to determine which conditions that may reveal information deemed “sensitive” (*e.g.* - STDs, mental health conditions, substance abuse)
- For HIV: explored ways to remove as little data as possible to not reveal sensitive condition while retaining as much of the medical record as possible
 - Deterministic “Level 1” predicates written using Drools
 - Probabilistic “Level 2” and “Level 3” predicates incorporated using Weka machine learning toolkit
 - By combining a classifier with established deterministic rules, the system could “learn” how “guessable” a condition might be after redacting specific medical data from the patient’s record

DS2 Workflow



DS2: Sample Output from Predicate/Reducer

107.170.66.72/cda-ws-web/

Predicate Reducer

Select ILHIE classifications to disclose:(leave blank to redact all classifications)

- ☐ HIV (ILHIE_HIV)
- ☐ Mental Health (ILHIE_MentalHealth)
- ☐ Substance Abuse (ILHIE_SubstanceAbuse)

Upload file for reducing:

+ Choose a CCD file:

Summary of key clinical facts from selected parts of the the Virtual Medical Record (vMR)

Problems
1. Human immunodeficiency virus [HIV] disease (SNOMED-CT 86406008) ILHIE_HIV
2. Candidiasis of lung (SNOMED-CT 3487004) ILHIE_HIV
3. Other specified bacterial infections in conditions classified elsewhere and of unspecified site, mycoplasma (SNOMED-CT 95889002)
4. Acute maxillary sinusitis (SNOMED-CT 68272006)

Substance Administration
1. combivir (RxNorm 192254) ILHIE_HIV
2. norvir (RxNorm 196479) ILHIE_HIV
3. procrit (RxNorm 227303)
4. azithromycin (RxNorm 18631)
5. fluconazole (RxNorm 4450)

Encounters

Procedures
1. Laparoscopic appendectomy (SNOMED-CT 470.1)

Version: 1.0

DS2: Redacted Output/Consent Document

Predicate Reducer

Redacted output (CCD with redactions based on returned vMR and selected preferences) for: sample-CCD-3.xml

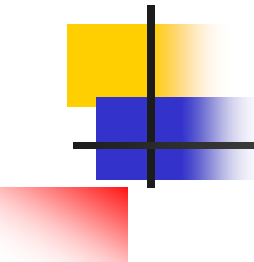
```
<?xml version="1.0" encoding="UTF-8"?>
<ClinicalDocument xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="urn:hl7-org:v3" xmlns:sdctc="urn:hl7-org:sdctc"
  <realmCode code="US"/>
  <typeId root="2.16.840.1.113883.1.3" extension="POCD_HD000040"/>
  <templateId root="2.16.840.1.113883.10.20.22.1.1"/>
  <templateId root="2.16.840.1.113883.10.20.22.1.2"/>
  <id root="2.16.840.1.113883.19.5.99999.1" extension="TT988"/>
  <code code="34133-9" codeSystem="2.16.840.1.113883.6.1" codeSystemName="LOINC" displayName="Summarization of Episode Note"/>
  <title>Community Health and Hospitals: Health Summary</title>
  <effectiveTime value="201209150000-0400"/>
  <confidentialityCode code="N" codeSystem="2.16.840.1.113883.5.25"/>
  <languageCode code="en-US"/>
  <setId root="2.16.840.1.113883.19.5.99999.19" extension="sTT988"/>
  <versionNumber value="1"/>
  <recordTarget>
    <patientRole>
```

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Consent document:

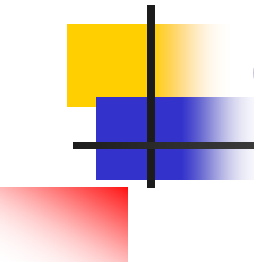
```
<?xml version="1.0" encoding="UTF-8"?>
<ClinicalDocument xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="urn:hl7-org:v3" xsi:schemaLocation="urn:hl7-
  <realmCode code="US"/>
  <typeId root="2.16.840.1.113883.1.3" extension="09230"/>
  <templateId root="2.16.840.1.113883.10.20.3"/>
  <templateId root="2.16.840.1.113883.3.445.1"/>
  <id root="1.3.6.4.1.4.1.2835.888888" extension="8686dada-2de1-474f-892a-2a41aad0f27c"/>
  <code code="57016-8" codeSystem="2.16.840.1.113883.6.1" codeSystemName="LOINC" displayName="Privacy Policy Acknowledgement"/>
  <title>Consent Authorization</title>
  <effectiveTime xsi:type="IVL_TS" value="20140819"/>
  <confidentialityCode code="N" codeSystem=""/>
  <recordTarget>
    <patientRole>
      <patient>
        <id root="2.16.840.1.113883.3.933" extension="6fc36ff3-6fe4-4529-a3bb-56e87c0b5965"/>
      </patient>
```

Download



Resources

- HLN CDS Framework (ICE, CAT, SHARPS)
<https://www.cdsframework.org/>
- OpenCDS
<http://www.opencds.org>
- RCKMS
<http://www.cste.org/group/RCKMS>



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