

From Demonstration to Standard Practice: Developing sustainable tools and processes for CDS:

An Implementer's Notes

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Agenda

- CDSC Accomplishments Review
- Inputs / Outputs / CDA Documents
- General Purpose Rule Engines
- Knowledge Specifications
- Terminologies
- Testing
- Necessary Expertise
- Summary

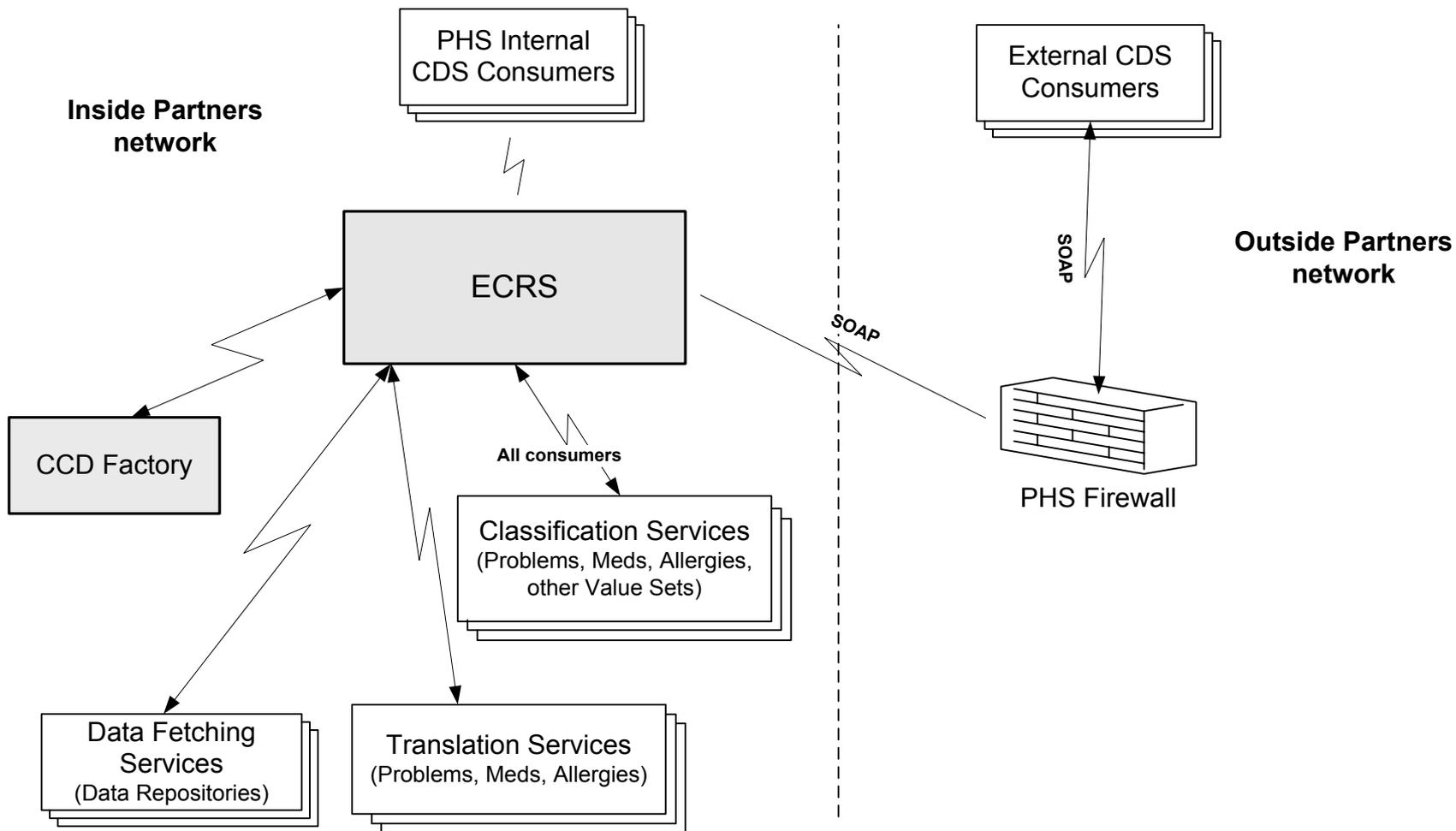
CDSC Accomplishments

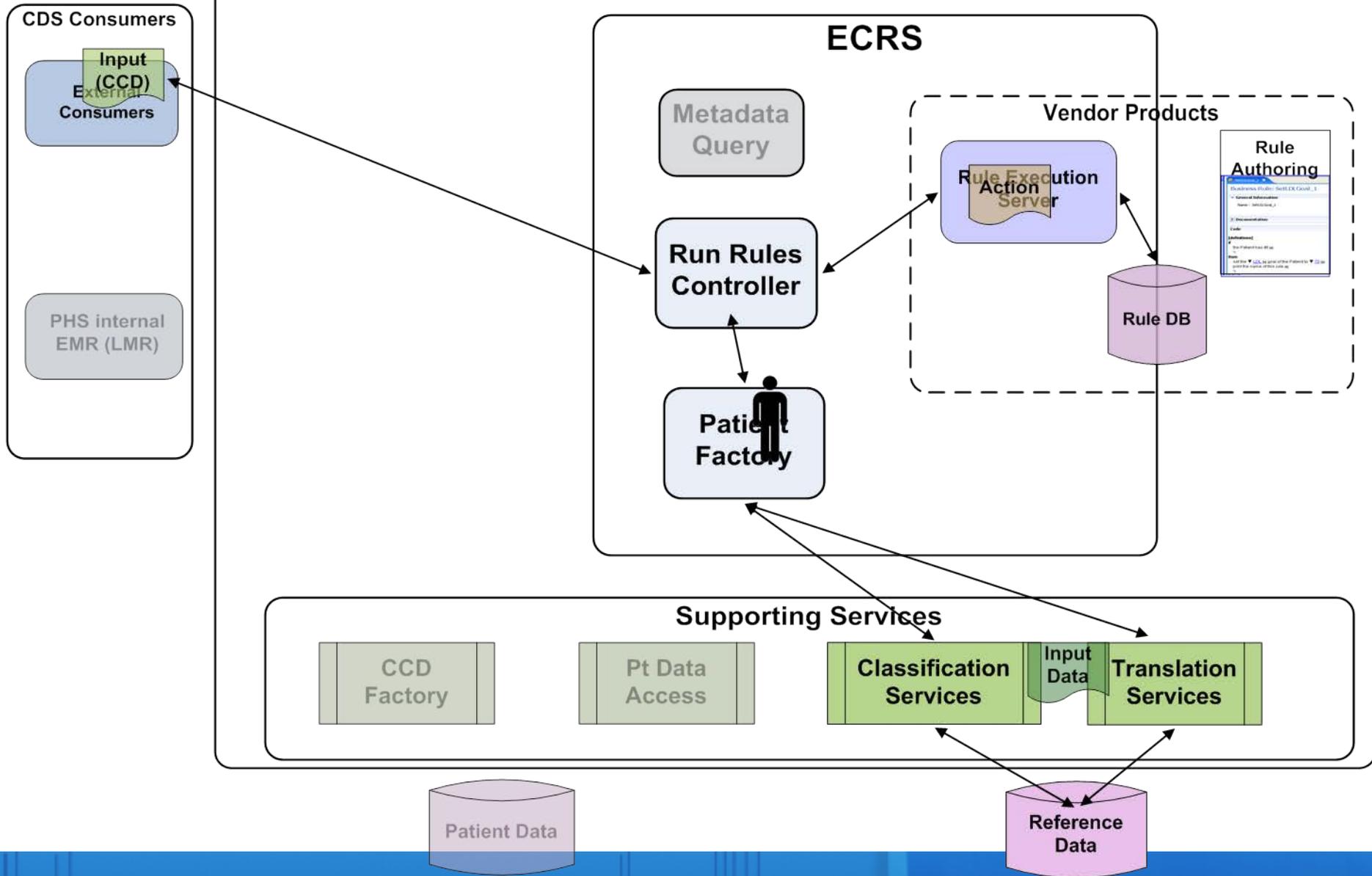
1. Defining CDS and KM (knowledge management) best practices
2. Four Layer Knowledge Representation
3. CDS Common Action-Recommendation Model
4. Collaborative Knowledge Engineering
5. CDS Rules Service
6. KM Portal and Repository
7. CDS Knowledge Authoring Tool
8. CDSC Demonstrations
9. CDS Dashboard
10. Legal Framework
11. Related work ONC Advancing CDS Project

CDS Runtime – What Does a CDS Service Do?

- Identify rules to run, required data, and services
- Validate input data
- Fetch missing data
- Manage data cache
- Instantiate / (update) patient data structures
- Normalize, classify, or otherwise elaborate data
- Execute rules
- Format & return response

Communication mechanisms between consuming applications and ECRS service





CDS – Inputs

- Input Requirement Descriptor
 - Data / Argument Mapping / Model descriptor as ‘Semantic Signifier’
 - Format solves the inventory problem
 - Issues:
 - Limited experience with Semantic Signifier
 - No experience with multiple request maps / Maps to CDA
 - Services should be multi-lingual, limit dependence on rule author preferences

CDS – Outputs

- HL7 standard
 - Discrete data return via output specification
 - Can't use CDS if can't interpret returned data
- Common Action / Recommendation Model
 - Eases consumer adoption burden
 - Minimizes dependence on author preferences
 - May benefit from inventory specification

CDS – CDA/CCD Documents

- High value to CDSC
 - Everyone must produce them per MU
 - Experience will improve with
 - Implementation / deployment experience
 - Improvement in specification
 - More CDA derivatives would be better!
 - PECARN Head Trauma rules using ER Note
 - Custom formats don't scale well
 - Context of CDS use requires further investigation
 - Real-Time CCD for CDS?? Jury still out
 - Suggests benefits of standardizing data aggregators
 - HL7 Retrieve, Locate, Update Service—standard data query

CDS – General Purpose Rules Engines

- Still looking for CDS requiring healthcare-specific engine
 - Special purpose engine may limit problem-solving patterns available to CDS author
- Stateless / Stateful / Asynch /
 - Point-of-care
 - Long-running guideline
 - ‘Event’ Engine
- Opportunities for sharing common object libraries
 - JodaTime: time instants, intervals, durations
 - Jscience: unit analysis, validation for observations

CDS – Knowledge Specifications

- Necessary but not sufficient for executable rules
- Don't provide insight into optimal solutions with respect to maintenance, future expansion
- Least-common denominator: exhaustively enumerate specification as rules
- Taxonomies of ruleset patterns, flows needed

CDS – Terminologies

- Large numbers of reference objects for reasoning:
 - Problems, Meds, Allergies, Observables
 - Clinical States
- How should we symbolize reference objects for inference?
 - Problems and Meds: Multiple vocabularies
 - Clinical States—no reference vocabulary

CDS – Testing

- Rulesets require exhaustive positive and negative tests to assure correctness
- Testing takes 4-5x longer than authoring
- Test case generation tools in combination with other QA tooling required to author at scale.
- PHS
 - Unit testing underlying object methods
 - Test rules as part of unit testing
 - Positive / Negative test cases via test harness for rule authoring
 - End-to-end testing rules in integration testing

CDS – Necessary Expertise

- **Knowledge of healthcare**
 - Practice;
 - Domains;
 - Modeling;
 - Terminologies
- **Object-oriented analysis**
 - Bottom-up: objects in a healthcare environment
 - Top-down: objects needed to solve this problem
- **Production rules experience**
 - Knowledgeable of rete and related technologies
 - Recognize problem patterns
 - Partition problem into discrete tasks and flows
 - Develop individual algorithms to solve discrete tasks
- **Success: Patterns**
 - with natural-language-like rules
 - Templated / emulated by junior staff

CDS – Summary

- Make Use of What is Known
 - Standard Terminologies
 - Technical Protocols
 - Industry Standard Practices, i.e. thorough testing
 - Existing Technologies, i.e., Rules Engines
- Recognize Limitations in Current Standards
 - CCD ‘standard’ open to variable interpretation
 - Multiple reference vocabularies require decisions
 - ‘Missing’ standards, i.e., clinical state definitions, common action model
- Obtain Resources with the Right Experience
 - Clinical Informatics: CDS, Healthcare practice, workflow, domains
 - Technology, Objects, Modeling
 - Business Rules Systems & Analysis
 - Testing and Quality Assurance
 - Terminologies
 - Success

Key Principles for a National Clinical Decision Support Knowledge Sharing Framework

ONC Advancing CDS Project – Task 4 Project

Table 2. In-house CDS content provided by EHR system vendors.

CDS Content Type	% of Vendors Providing In-House CDS Content of Type
Order sets	100% (6/6)
Documentation templates	100% (6/6)
Alerts and reminders	100% (6/6)
Flow sheets	100% (6/6)
Drug-drug interaction checking and allergy checking	83% (5/6)
Relevant data display for ordering	83% (5/6)
Dictionaries	67% (4/6)
Expert dosing	50% (3/6)
Indexed reference information for integration via Infobuttons	17% (1/6)

Table 3. Third-party CDS content provided by EHR system vendors.

CDS Content Type	% of Vendors Providing Third-Party CDS Content of Type
Drug-drug interaction checking and allergy checking	80% (4/5)
Indexed reference information for integration via Infobuttons	60% (3/5)
Order sets	60% (3/5)
Documentation templates	40% (2/5)
Alerts and reminders	20% (1/5)
Expert dosing	20% (1/5)
Relevant data display for ordering	20% (1/5)
Flowsheets	0% (0/5)
Dictionaries	0% (0/5)

Principles for establishing and maintaining a national CDS knowledge sharing framework

- *Strive to make the CDS knowledge sharing framework the most cost-effective means available for meeting relevant Meaningful Use requirements.*
- *Apply the resources and authority of the federal government to accelerate desired changes.*
- *Support multiple complementary approaches and allow the marketplace to determine the “winners.”*
- *Make the knowledge sharing framework as simple as possible to adopt, but no simpler.*
- *Provide high-value content and tooling, preferably in an open-source manner.*
- *Focus on use cases with clearly identified business needs.*
- *Accelerate the development or licensing of required, pragmatic standards.*
- *More closely coordinate related efforts and seek to establish a common “wave” that propels all stakeholders toward a common destination.*
- *Acknowledge and address need for local adaptation and customization.*
- *Acknowledge and address medical-legal liability concerns.*
- *Utilize a flexible and adaptive design and development strategy.*
- *Establish a self-sustaining business model.*