

The SAGE Project

Standards-Based Sharable Active Guideline Environment

SAGE

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Corp.

Sharable Active Guideline Environment

- An R&D consortium to develop the technology infrastructure to enable computable clinical guidelines, that will be shareable and interoperable across multiple clinical information system platforms
- Scope: 3 year, \$18 M, multi-site, collaborative project
- Partners in the project are:
 - IDX Systems Inc.
 - Apelon, Inc.
 - Intermountain Healthcare
 - Mayo Clinic
 - Stanford Medical Informatics
 - University of Nebraska Medical Center
- Funded in part by: NIST Advanced Technology Program

SAGE Interoperability Goals

6 months \leq time to import new rule \leq never

A technology infrastructure that supports:

- Clinical practice guidelines – encoded in a computable, standards-based representation.
- Once encoded, guideline content can be deployed to multiple different clinical information system platforms.
- Surfacing guideline content via functions and user interface native to the local CIS.
- Allows different institutions to share guideline content and knowledge bases
- *“Write once, distribute quickly, use widely”*

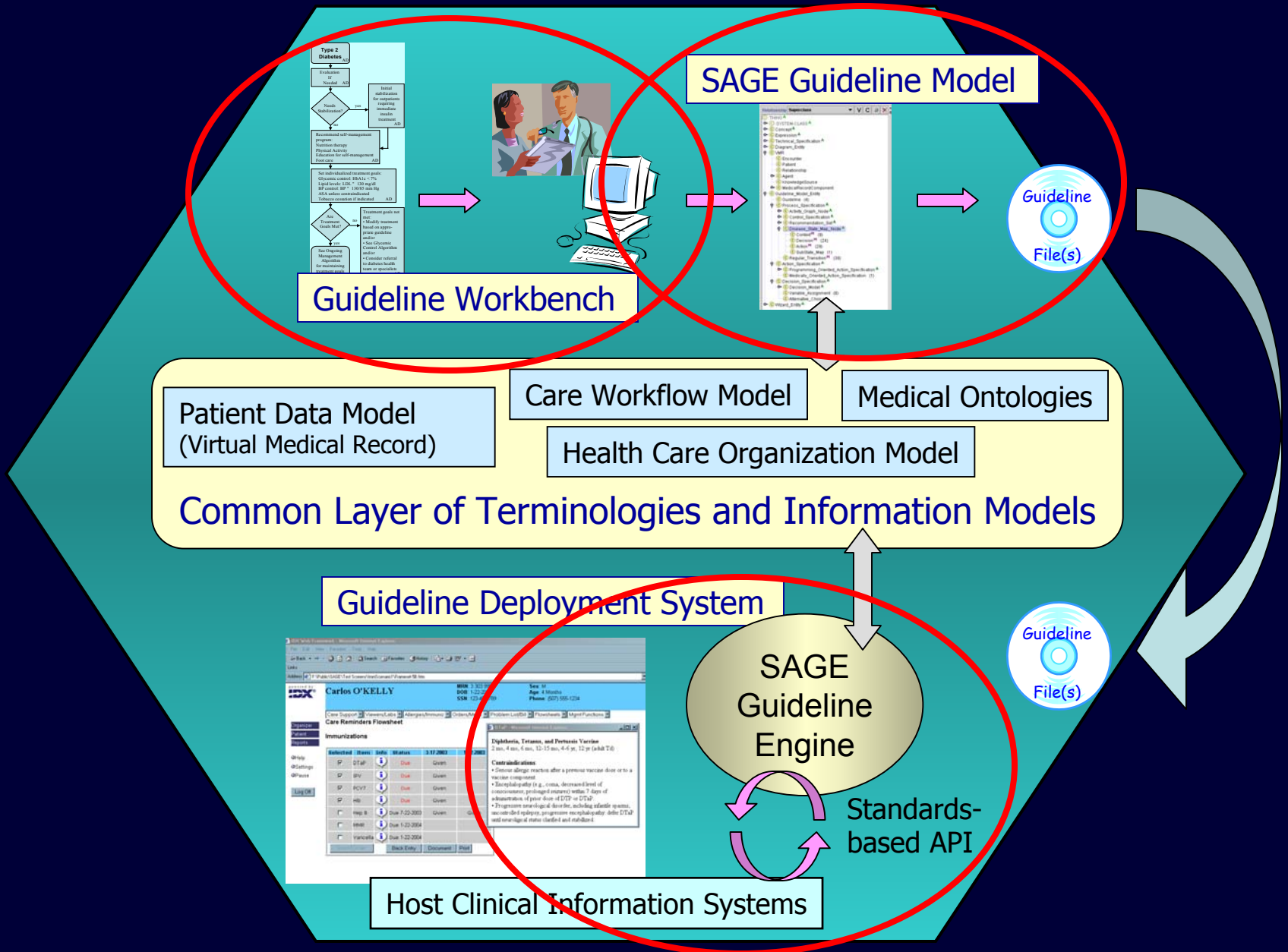


Major findings

- ◆ Multiple systems/application w/ CDS
 - Multi-vendor environment
 - Many apps as result of academic projects
 - Main goal to demonstrate effectiveness
 - One-of-a-kind implementations
 - Not standards-based
 - Knowledge embedded in systems
 - Difficult to extract, generalize, replicate

Specifically, the SAGE program was established to address these problems...

Overview of the SAGE Infrastructure

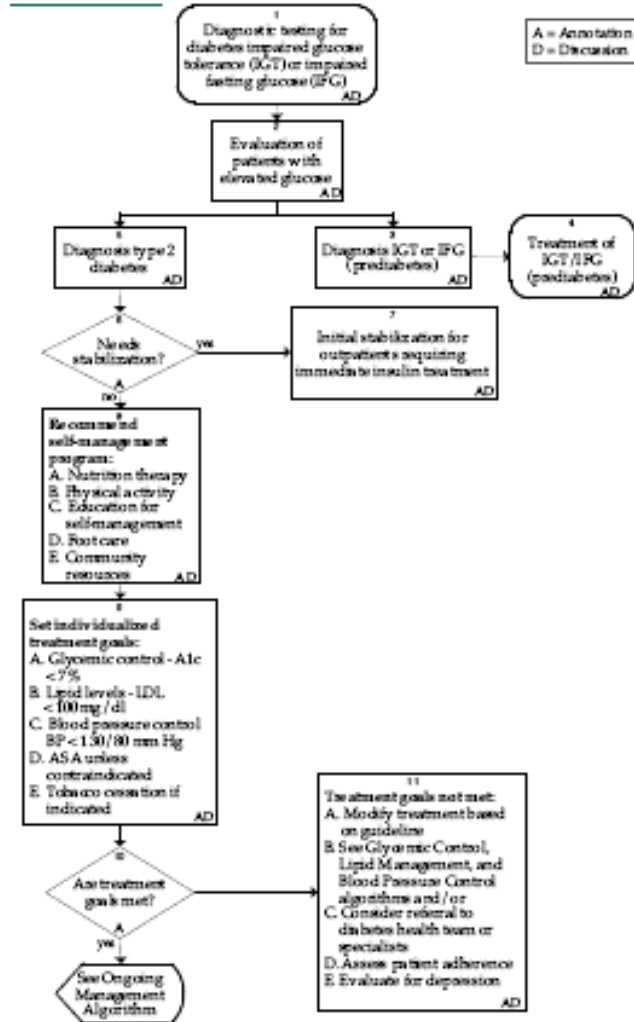


Guideline Knowledge Encoding and Representation

- Start with source guideline (text)
- Encode guideline content aimed at specific clinical care scenarios
- Envision clinical workflow and identify opportunities for decision support
- Determine how guideline recommendations can best be presented via CIS functions



Health Care Guideline: Management of Type 2 Diabetes Mellitus



A = Annotation
D = Discussion

General Implementation September 2002
Work Group Members Work Group Leader JoAnn Sper-Hillen, MD HealthPartners Medical Group Endocrinology Richard Bergental, MD International Diabetes Center Steve Smith, MD Mayo Clinic Nephrology Michael G. Sommerwyler, MD Mayo Disease and Critical Care Association Family Practice Patrick O'Connor, MD HealthPartners Medical Group Internal Medicine JoAnn Sper-Hillen, MD HealthPartners Medical Group Podiatry Troy Sobole, DPM HealthPartners Medical Group Pharmacy Peg Sarna, R.Ph. HealthPartners Medical Group Medical Nutrition Therapy Cindy Halstensen, RD, CDE HealthPartners Medical Group Nursing Bev Walsh, RN, CDE CentralCare Health System Health Education Cindy Halstensen, RD, CDE HealthPartners Measurement Advisor Jane Gerdmn ICSI Facilitator Jennifer Meyer, RN ICSI
These clinical guidelines are designed to assist clinicians by providing an analytical framework for the identification of key clinical practice areas and associated evidence to explore a clinician's subject or to establish a protocol for all patients with a particular condition. A guideline will not establish the only approach to a problem.

www.icsi.org

Courtesy: Institute for Clinical Systems Improvement

Guideline Scenario:

We envision the clinical context

Diabetes Mellitus – Primary Care Visit

The patient is an elderly man with longstanding Type II Diabetes Mellitus. Comorbidities include hypertension (well-controlled) and hyperlipidemia (marginally controlled). He reports for a routine clinic visit with his primary care doctor.

We identify opportunities for CDS

Triggered by clinic check-in and the presence of diabetes on the problem list, guideline logic activates, automatically enrolls the patient on the diabetes guideline, and then checks to see if vitals and home glucose measurements have been entered. If not, the nurse is prompted to collect this information.

We integrate guideline logic with care workflow

After required information is entered, the guideline resumes execution, queries patient EMR data, and evaluates decision logic – resulting in:

- Setting and evaluation of clinical goals for this patient.
- Notifications to clinicians (e.g., “*HbA1C not in control*”),
- Pending orders for lab tests, medications, and for diabetes education.
- Referrals for specialty treatment (e.g., Cardiology)

Guideline recommendations are “channeled” via CIS functions

SAGE Guideline Representation: An Overview

Context Nodes organize and specify the relationship to workflow.

- What triggers the session
- Who is involved
- Where the session occurs

Adult
Diabetes
Patient

Decision Nodes provide support for making choices:

- Specification of alternatives
- Logic used to evaluate choices
- Can change the clinical workflow

Action Nodes define activity to be accomplished by CIS:

- User interaction, query, messaging
- Order sets
- Appointments and referrals
- Goal setting
- Documentation and recording

When
should
lipid labs
be
ordered?

Order lipid
labs 12
months
from last
labs

Order lipid
labs 24
months
from last
labs

Order lipid
labs for 3
months
from last
labs

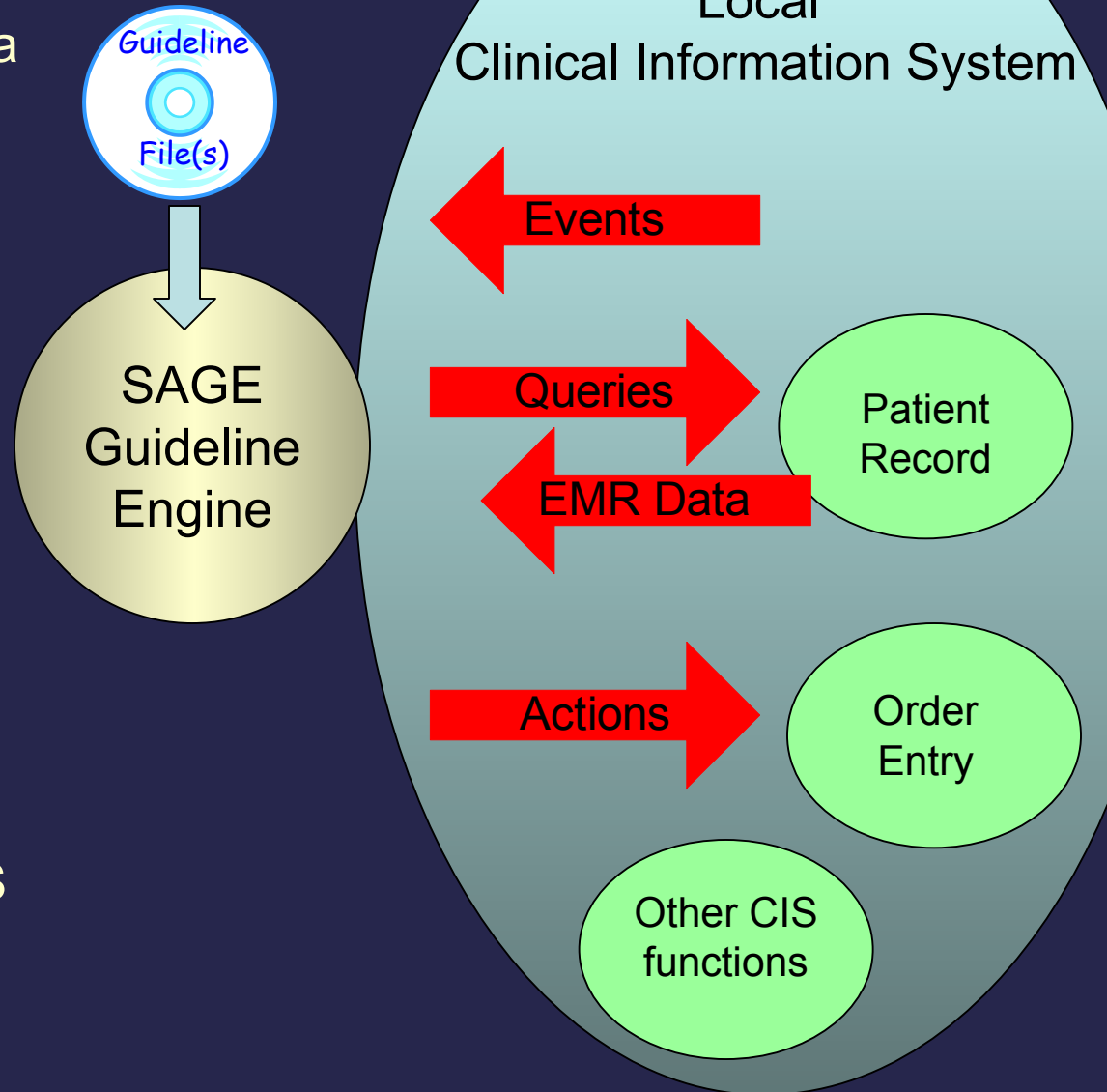
The guideline has been encoded. Now what?

Initial “set up” and preparation work:

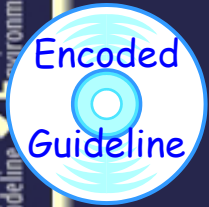
- Guideline downloaded to local system
- Guideline reviewed by medical staff
(assess recommendations, workflow, etc.)
- Guideline is “localized”
(edited for local conditions, restrictions, whim . . .)
- Interfaces and services installed
(CIS – specific “binding” and terminology mapping)
- Guideline activated

How does SAGE interact with clinical information systems ?

- It communicates with CIS via standards-based interfaces
- It detects events in the clinical workflow (e.g. patient is admitted)
- It queries data from the CIS electronic medical record (e.g. age)
- It executes guideline logic based on patient specific data
- It makes real-time, patient-specific recommendations via functions of the local CIS



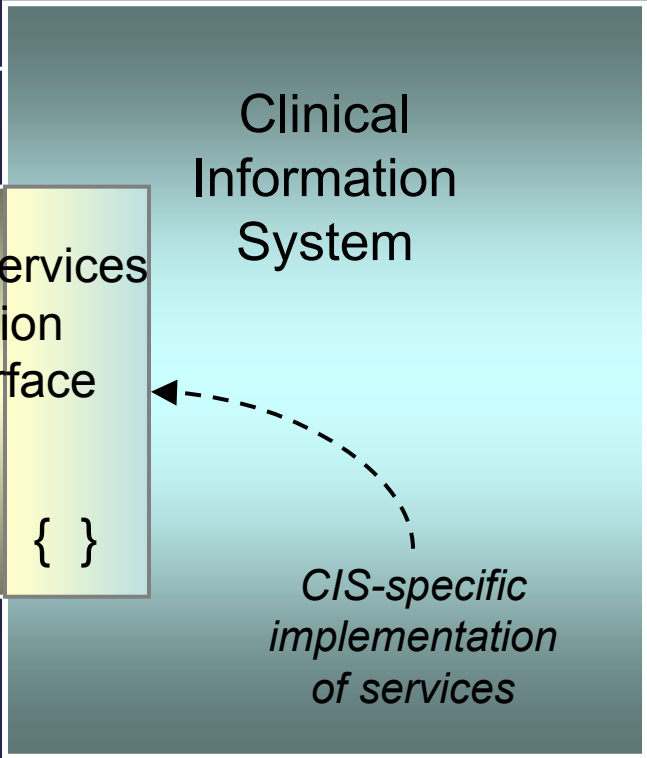
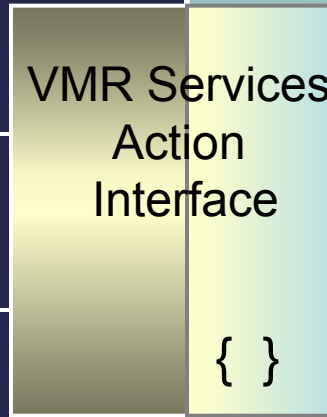
SAGE Guideline Execution Architecture



Event Notifications

VMR Service calls

Action Service calls



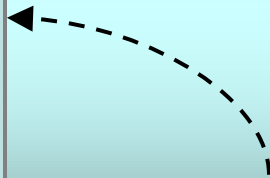
Clinical Information System

CIS-specific implementation of services

Terminology Functions

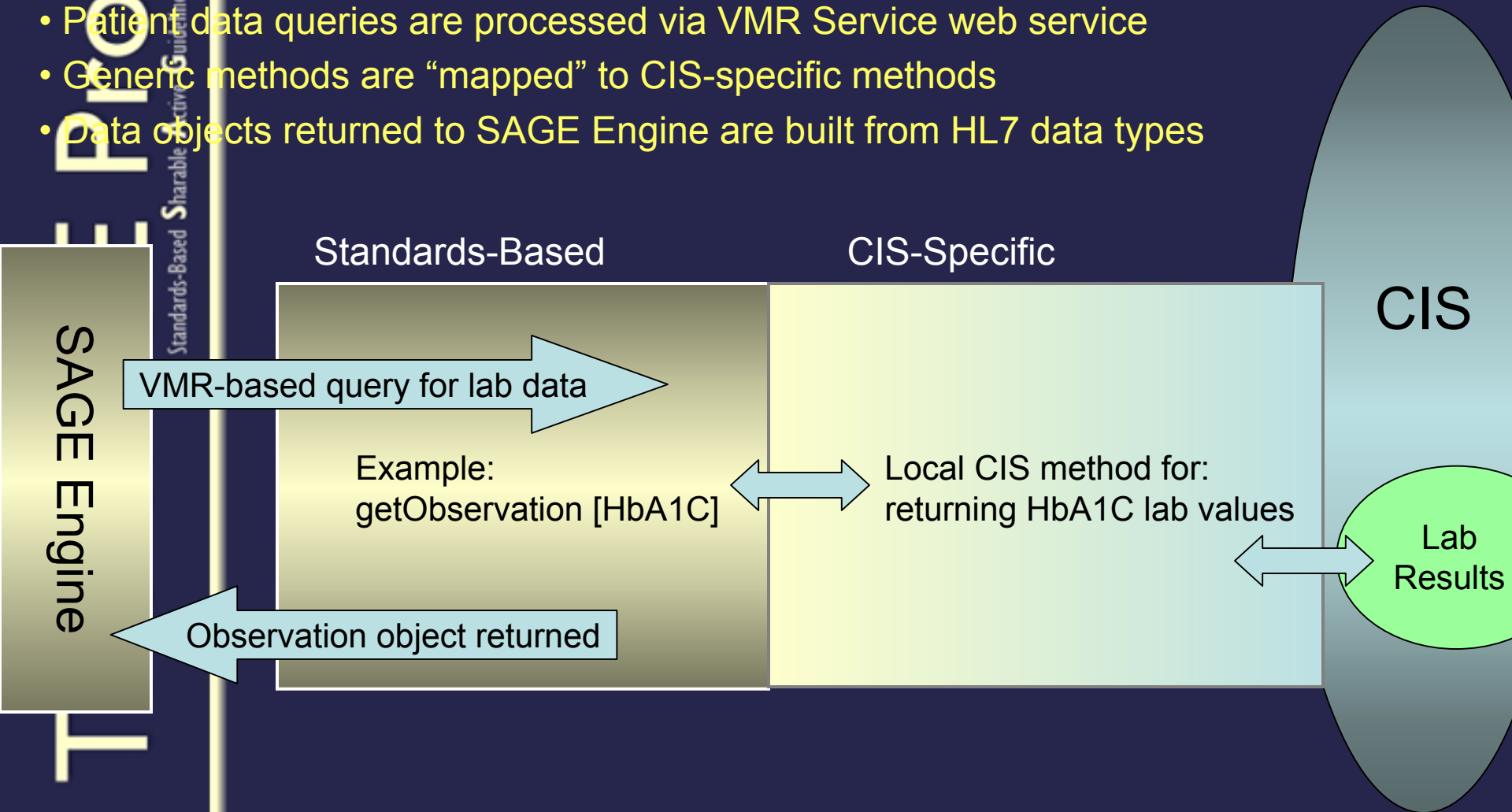


Standards-based I/F based on web services



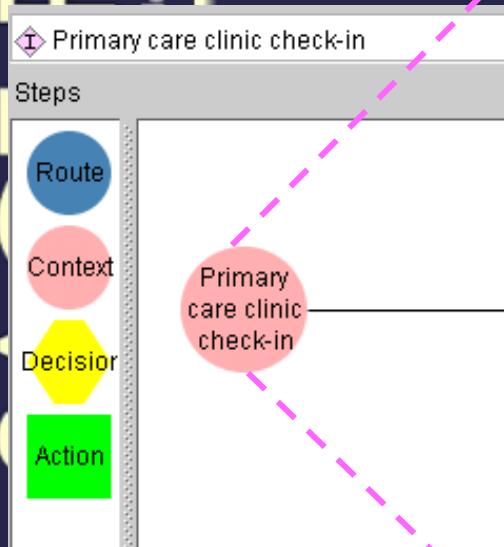
VMR Services Interface

- In the guideline model, patient data concepts are represented using VMR classes
- Queries for patient data are represented using standard VMR-based methods
- Patient data queries are processed via VMR Service web service
- Generic methods are “mapped” to CIS-specific methods
- Data objects returned to SAGE Engine are built from HL7 data types



Guideline Execution:

SAGE listens for and detects context-specific events



Primary care clinic check-in

Label: Primary care clinic check-in

Scheduling Constraint: V C + -

Clinical Context: V C + -
out patient primary-care clinic

Informatics Context: V C + -

Precondition: V C + -
Diabetes Mellitus on Problem List

Automation Mode: V C + -
automatic start and finish

Transition Restriction: V C + -
XOR join AND split

Subguideline: V C + -

Triggering Events: V + -
Outpatient clinic check-in event

Description: This is the Context in which a patient checks in to their primary care clinic.

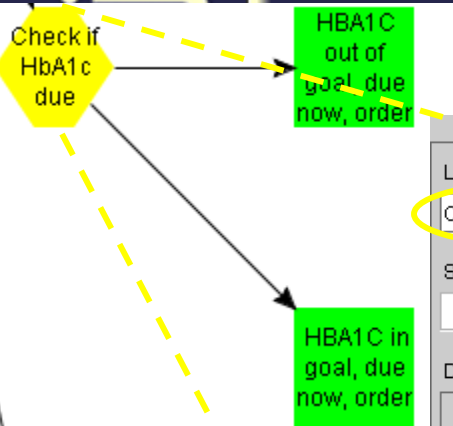
References: V C + -

New Session

Guideline Execution:

Project Environment

SAGE executes encoded decision logic



SAGE will query the patient EMR as necessary, and evaluate all decision criteria

Label: **Check if HbA1c due**

Triggering Events

Scheduling Constraint

Decision Model (1 values)

Subguideline

Alternatives

- HBA1C out of goal, due now, order
- HBA1C in goal, due now, order

Transition Restriction: XOR join XOR split

Automation Mode: automatic start and finish

Description: If HbA1C is out of goal, it must be measured every 3 months; if in goal, every 6 months.

References

Alternative: HBA1C out of goal, due now, order

Strength Of Evidence

Recommendation Threshold: 3

Strength Of Recommendation

Strict Rule Out

Strict Rule In

- A1C not obtained in last 3 months
- A1C not ordered in next month
- HbA1C is out of goal range

Rule Out

Rule In

Evidences

The SAGE Standard

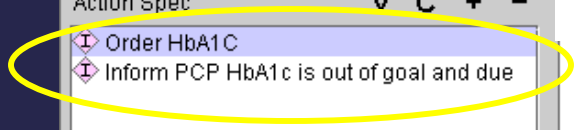
Guideline Execution:

SAGE communicates actions to the CIS

Project
Sharable Active Guideline Environment

HBA1C
out of
goal, due
now, order

Label	HBA1C out of goal, due now, order	Triggering Events	
Scheduling Constraint			
Repeat Expression		Description	Place order request for HgA1c
Action Spec	<ul style="list-style-type: none"> Order HbA1C Inform PCP HbA1c is out of goal and due 		
Termination Condition		References	
Automation Mode	automatic start and finish		
Transition Restriction	XOR join XOR split		
Subguideline			



The SAGE

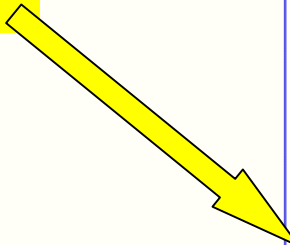


Desktop

Current Patient List: GRP: SAGEdiabetes Sage

MRN	Patient Name	Other Information
01000215	ANDERSON, John	
01000207	STOCK, Marie	
01000223	THOMPSON, Bill	
01000231	WHITE, Betty	

SAGE guideline execution has generated patient-specific notifications to care providers



Select Remove Add Active Find.. Temp List Print List Refresh

Command Central

Command:

Active MRN: Global Name Lookup

Patient List Directory

Freq Folders Avail

List Name	Type	Owner
Hotlist		
SAGEdiabetes	GRP	Sage
SAGEimmunization	GRP	Sage

Select Make Default Make Freq Move/Remove

InBox Messages

All Mine Patient

Notifications	Count
EO Related	
LEO forwarded orders	2
SAGE Messages	
Message from SAGE Engine	1

Create Resolve Refresh Sage



Notification: Message from SAGE Engine

Date	Time	Subject	From	FYI	Note
31Aug2004	11:02	Sage Mesg.	SAGE, USER		

subject: Aspirin recommendation
 message: This patient has indications for aspirin therapy, and has not been prescribed aspirin. Please consider starting aspirin therapy at 75 to 325 mg/day.

subject: Inform clinician that BP is missing
 message: No blood pressure has been recorded for this patient today. This information is necessary for evaluation.

message: This patient's HbA1C is out of goal range."

subject: Prompt physician to indicate whether cardiovascular signs/sx present
 message: New CV signs/sx?

subject: Recommend referral to nephrologist if indicated
 message: Consider referral to a nephrologist. (Please see indications)

subject: If HbA1C is out of goal range, notify physician via inbox
 message: This patient's HbA1C is out of goal range.

subject: Suggest adding Hyperlipidemia to problem list via inbox
 message: Consider adding Hyperlipidemia to Problem List

Forwarded/Reassigned By: SAGE, USER

Reason for Forward/Reassign

Full Subject Text: Sage Mesg.

- Annotate
- Audit
- Forward
- Hold
- Reassign
- Reject
- Reply
- Resolve

Cancel

The SAGE Project



Patient Problem List

Add: Expand

Status	Problem Description	Gde
A	Obesity	
A	Osteoarthritis	
A	Renal insufficiency	
A	Hypertension	
A	Type II diabetes mellitus	

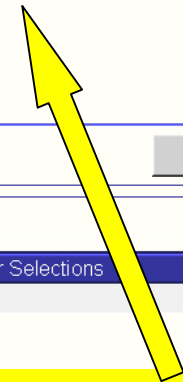
Update Guidelines

Patient Order List

ORDER LOG Save Session Context Prefs Expand

Current Order	ST	Sub ST	Start Date	Problem
SERUM CREATININE	U		27Jan2005	
Hemoglobin A1C	U		21Sep2004	
Albumin (Urine) Test Kit In Vitro	U			
LAB - HDL	U		21Jun2005	
LAB - TRIGLYCERIDES	U		21Jun2005	
LAB - LDL	U		21Jun2005	
Diabetic Patient Education	U			

Modify D/C Issue



Syn Order Selections

SAGE guideline execution has caused 7 pending orders to be created in the CIS

Select Order

Specify Search Information

Order Search Text:

Search Method

- Begins With
- Contains
- Leading Word

Searching for

- All
- Non-Meds
- Meds
- Ord Sets

Find Matches Show Favori...

Fac: LWGH Loc:

Prescription Historical

<input type="checkbox"/>	Resp (BREATHS/MIN)					22	20	20
<input type="checkbox"/>	Temp (DEGREEC)					36.0	37.0	37.1

Information Required Goals

<input type="checkbox"/>	New CV signs/sx? ()			Due now				
<input type="checkbox"/>	Tobacco use status? ()			Due now				
<input type="checkbox"/>	Foot exam ()			Due now				

Diabetes Mellitus

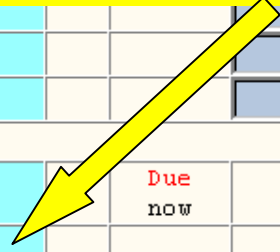
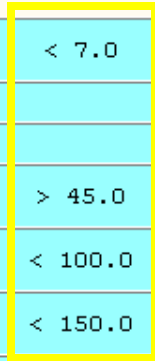
Assessment

<input type="checkbox"/>	Home Glucose High (mg/dl)							120
<input type="checkbox"/>	Home Glucose Low (mg/dl)							85
<input type="checkbox"/>	Smoker/Tobacco use							
<input type="checkbox"/>	Foot Exam							norm
<input type="checkbox"/>	Annual Retinal Exam							
<input type="checkbox"/>	Cardiac Stress Test							

SAGE guideline execution can populate a patient-specific clinical care "flowsheet" with guideline recommendations, goals, and reference information.

Lab Tests

<input type="checkbox"/>	HbA1c (%)	< 7.0		Due now				7.5	7.5
<input type="checkbox"/>	Fasting BG (mg/dl)								
<input type="checkbox"/>	Total Cholestrol (MG/DL)								
<input type="checkbox"/>	HDL (MG/DL)	> 45.0	i	Due now					
<input type="checkbox"/>	LDL (MG/DL)	< 100.0	i	Due now					
<input type="checkbox"/>	TGL (MG/DL)	< 150.0	i	Due now					
<input type="checkbox"/>	Creatinine (mg/dl)								
<input type="checkbox"/>	Urine Microalbumin (mg/24 h)								



Education

<input type="checkbox"/>	Diabetes Self-Care							
<input type="checkbox"/>	Nutrition counseling							

General Info

- Height (CM)
- Weight (KG)
- Systolic BP (MM)
- Diastolic BP (M)
- HR (BEATS/MIN)
- Resp (BEATS/MIN)
- Temp (DEGREEC)

Information Required

- New CV signs/sx
- Tobacco use sta
- Foot exam ()

Diabetes Mellitus

Assessment

- Home Glucose Hi
- Home Glucose Lo
- Smoker/Tobacco
- Foot Exam
- Annual Retinal
- Cardiac Stress Test

Tests

<input type="checkbox"/> HbA1c (%)	< 7.0	i
<input type="checkbox"/> Fasting BG (mg/dl)		
<input type="checkbox"/> Total Cholestrol (MG/DL)		
<input type="checkbox"/> HDL (MG/DL)	> 45.0	i
<input type="checkbox"/> LDL (MG/DL)	< 100.0	i

Rationalé for patientId : 658 - Microsoft Internet Explorer

Conclude HbA1C due 3 months from last measurement
Criteria Evaluated:
 HbA1C has not been obtained:false
 HbA1C within goal:false
 No existing order for HbA1C:true

Actions taken:
 Check when HbA1C due and whether out of goal
Action Specs executed:
 Order HbA1C 3 months from last measurement
 Conclude HbA1C due 3 months from last measurement
Criteria Evaluated:
 HbA1C has not been obtained:false
 HbA1C within goal:false
 No existing order for HbA1C:true

Recommendation Backing:
 Haemoglobin A1c (HbA1c) should be measured at 2?6 monthly intervals; the interval should depend on: acceptable levels of control, D and stability of blood glucose control, D and/or change in levels of blood glucose, D and/or change in therapies. D Six-monthly measurements should be made if the blood glucose level and blood glucose therapy are stable. D Resource:ADA Diabetes Care Guideline

Conclusions

Actions

Rationale

SAGE guideline execution can support display of guideline rationale, accompanied by patient-specific clinical logic.

Summary of Feasibility Demonstration

We have:

- Shown that clinical guidelines can be encoded in a standards-based, sharable, computable format.
- Demonstrated the capability to represent complex guideline content and logic for both acute and chronic care domains.
- Used standard information models and terminologies to support interoperable transfer of medical knowledge.
- Addressed interoperability goals via:
 - A standards-based guideline model
 - A VMR-based interface to CIS
 - Standard web services to access EMR data
 - Standards based access to terminology services