The SAGE Project

Standards-Based Sharable Active Guideline Environment

SAGE

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The SAGE Project
Standards-Based Sharable Active Guideline Environment

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

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Standards-Based Sharable Active Guideline Environment

SAGE Interoperability Goals

6 months ≤ time to import new rule ≤ never

A technology infrastructure that supports:

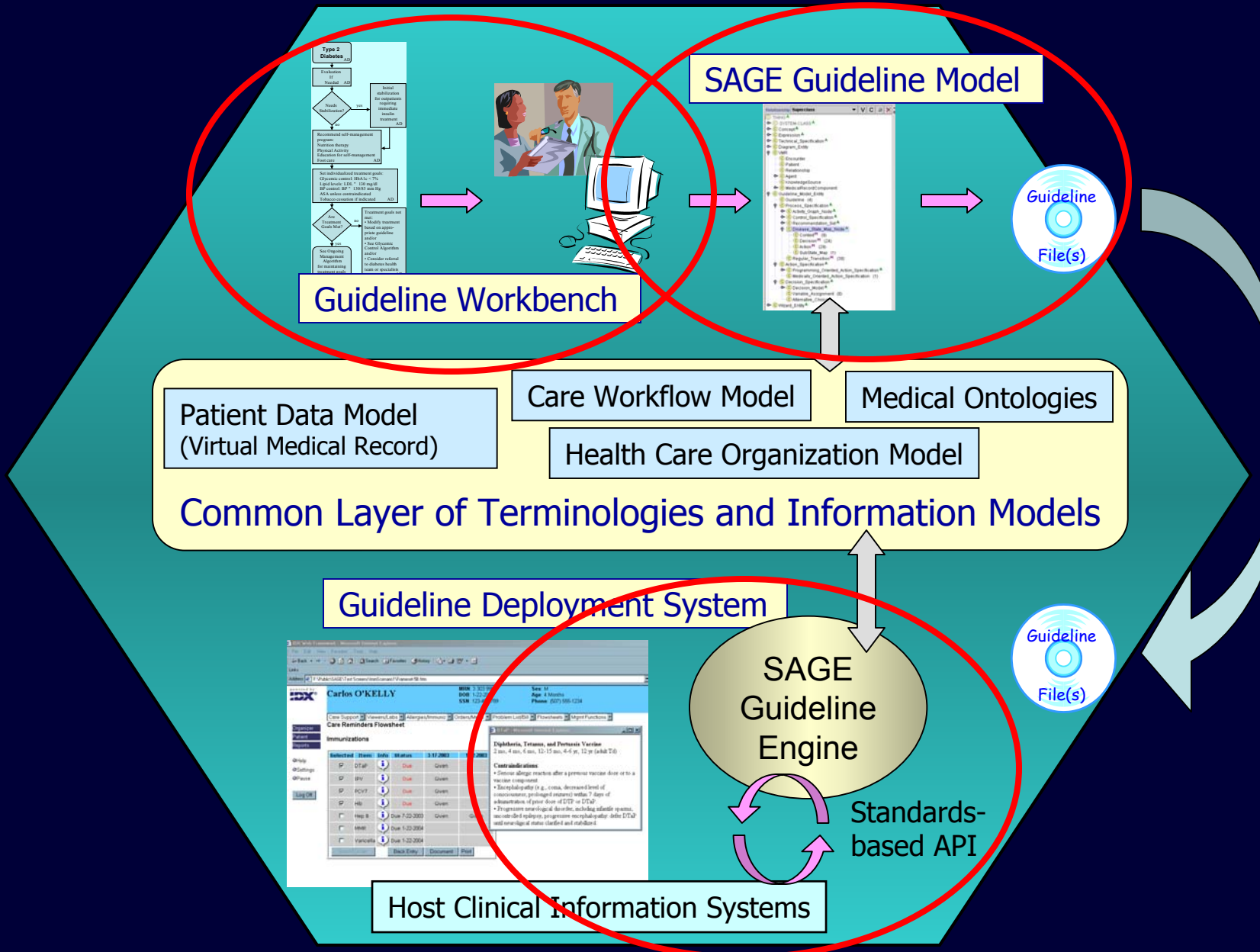
- Clinical practice guidelines – encoded in a computable, standards-based representation.
- Once encoded, guideline content can be deployed to multiple different clinical information system platforms.
- Surfacing guideline content via functions and user interface native to the local CIS.
- Allows different 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

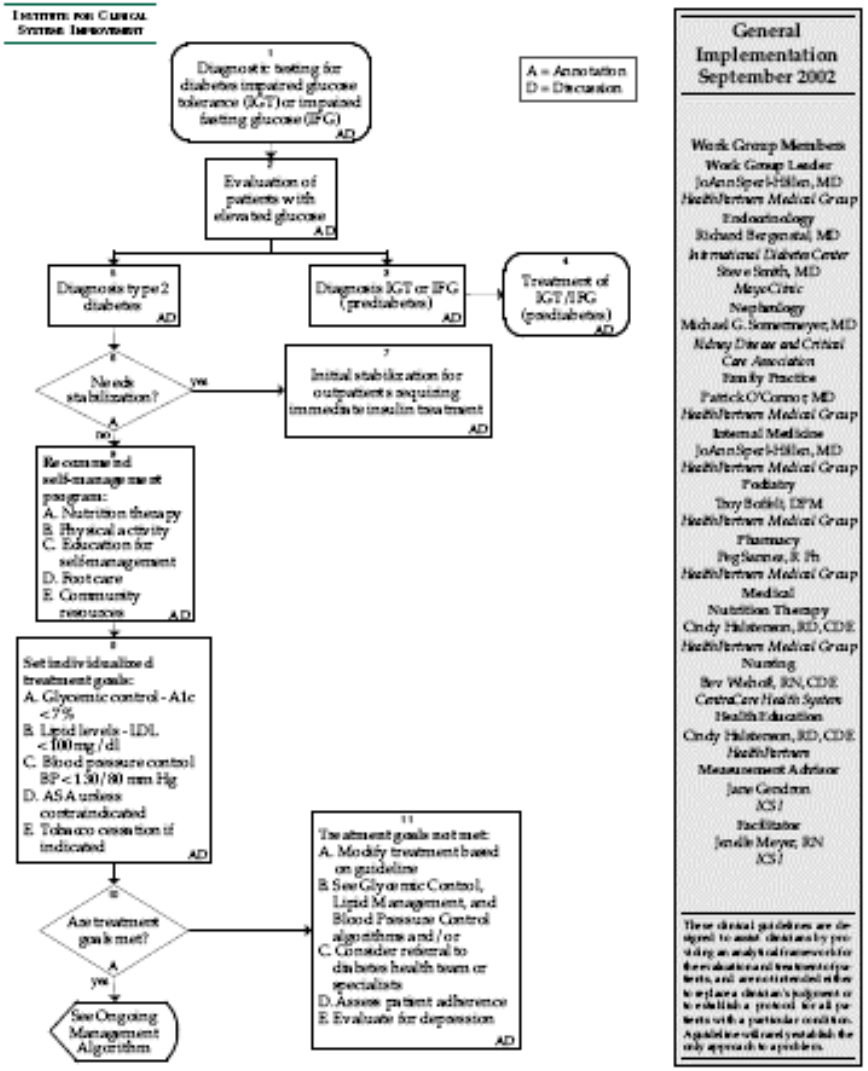
Specifically, the SAGE program was established to address these problems…

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



Courtesy: Institute for Clinical Systems Improvement

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Standards-Based Adaptable Workflow-Aware Environment

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)

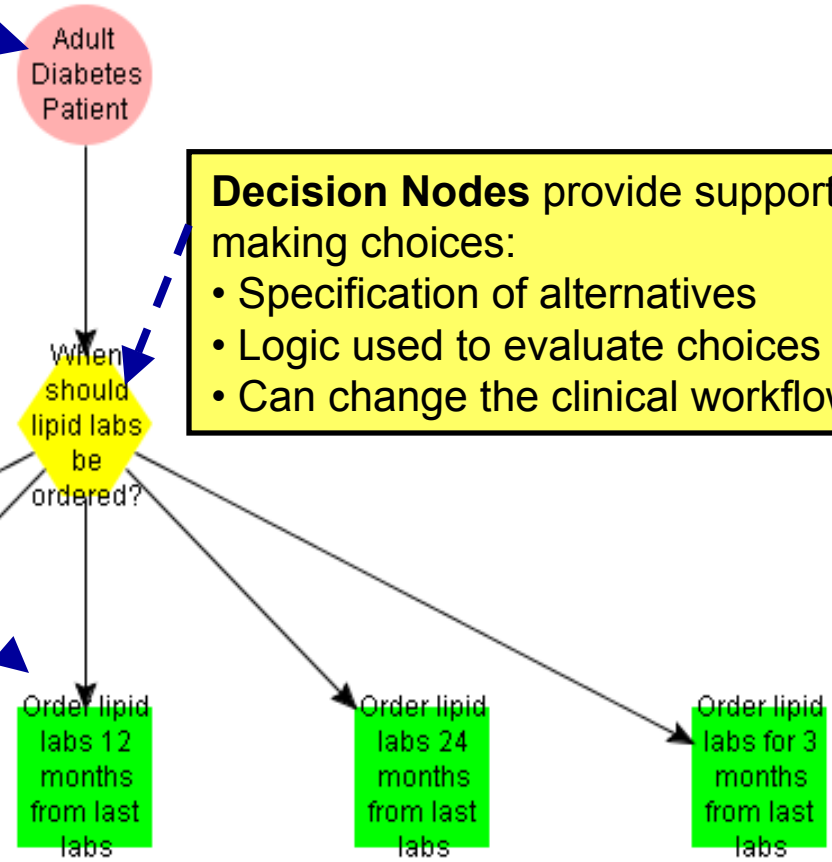
Guideline recommendations are "channeled" via CIS functions

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

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



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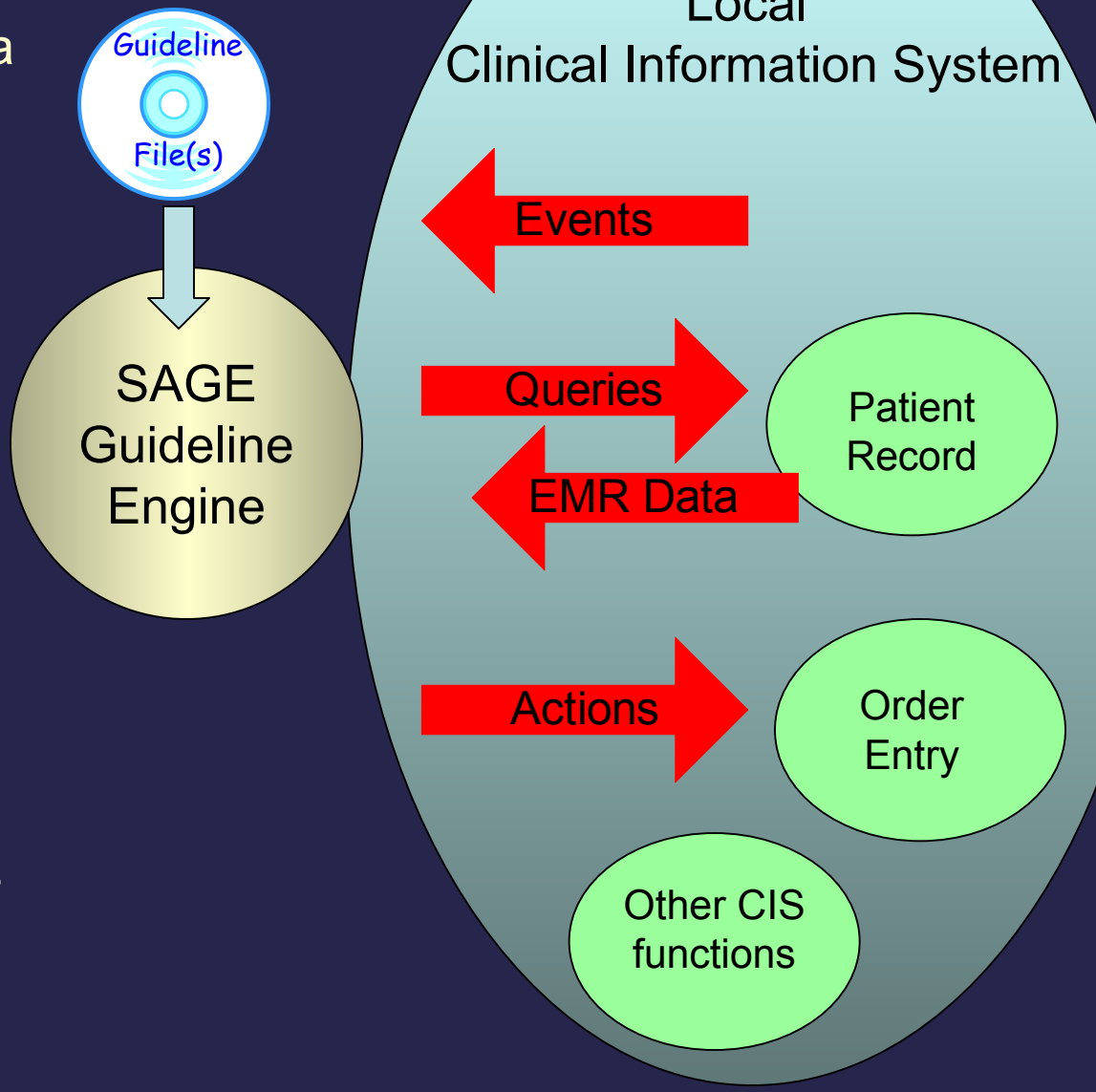
The guideline has been encoded. Now what?

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



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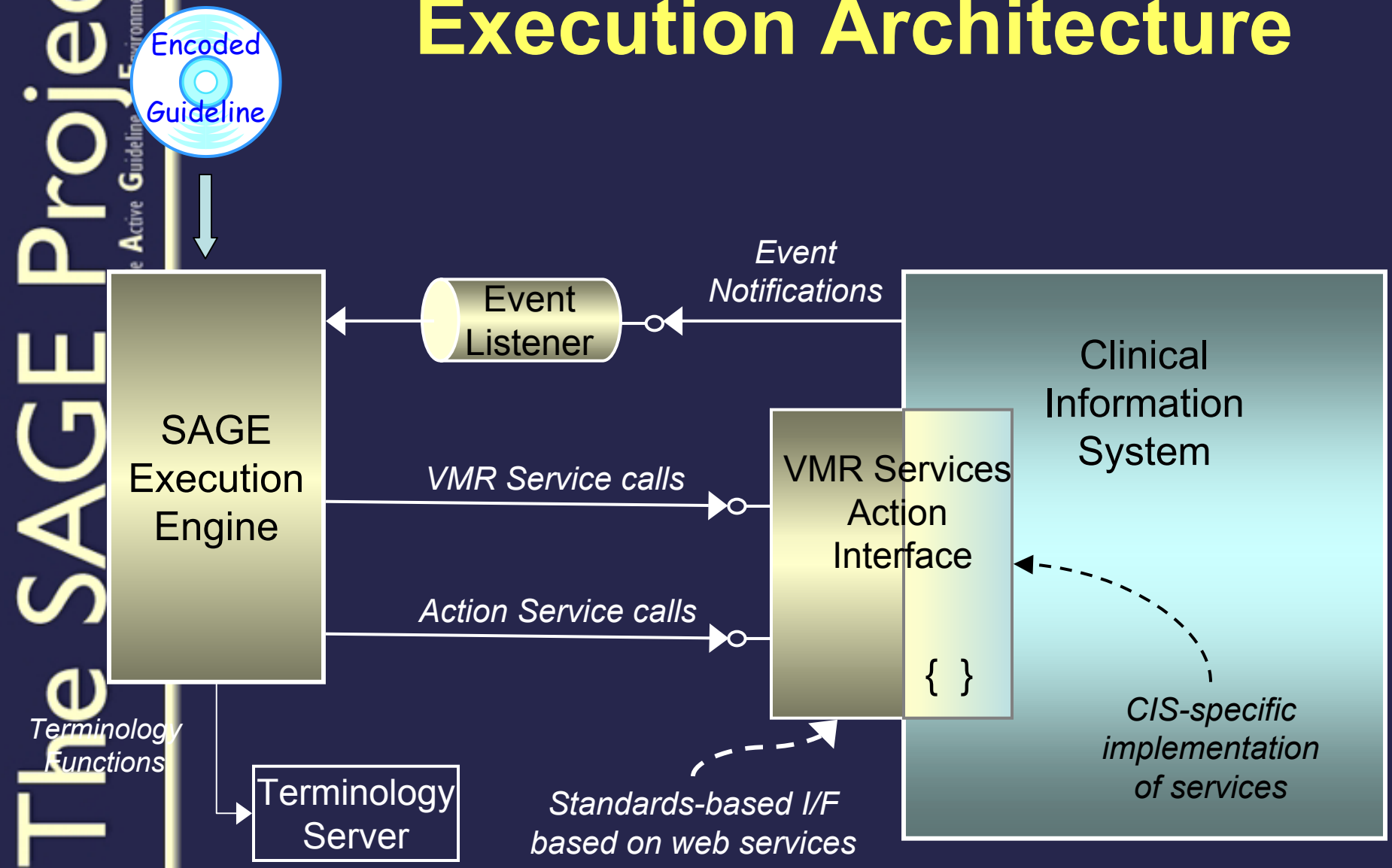
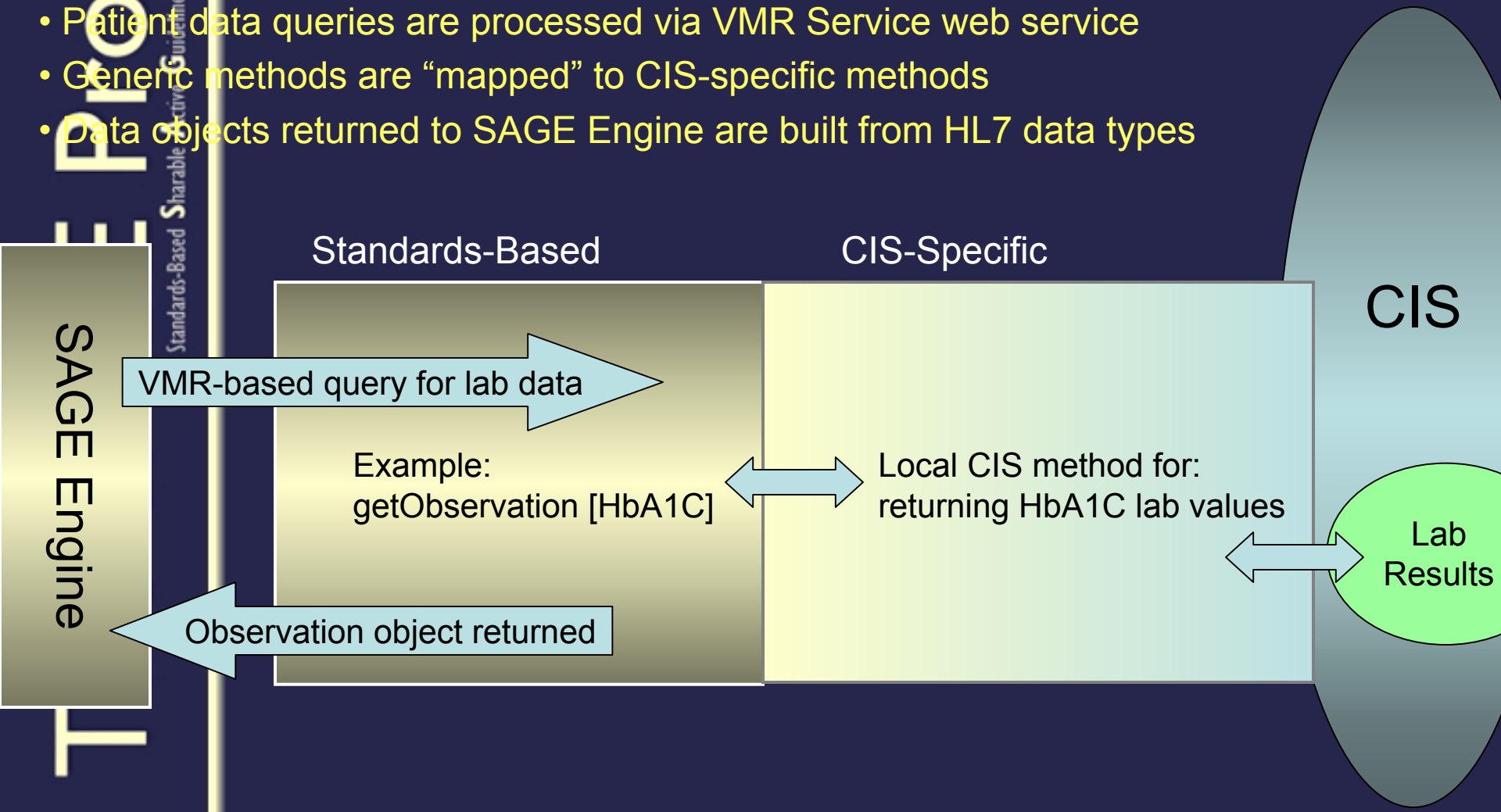
SAGE Guideline Execution Architecture



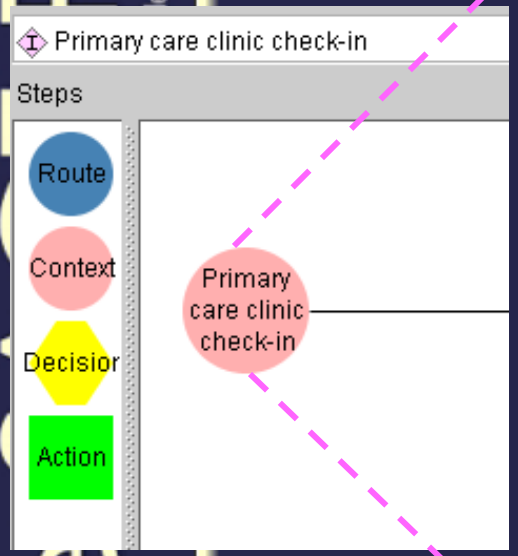
VMR Services Interface

- 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



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

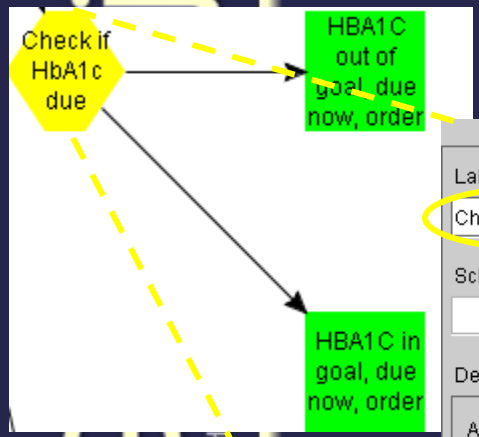
Description
This is the Context in which a patient checks in to their primary care clinic.

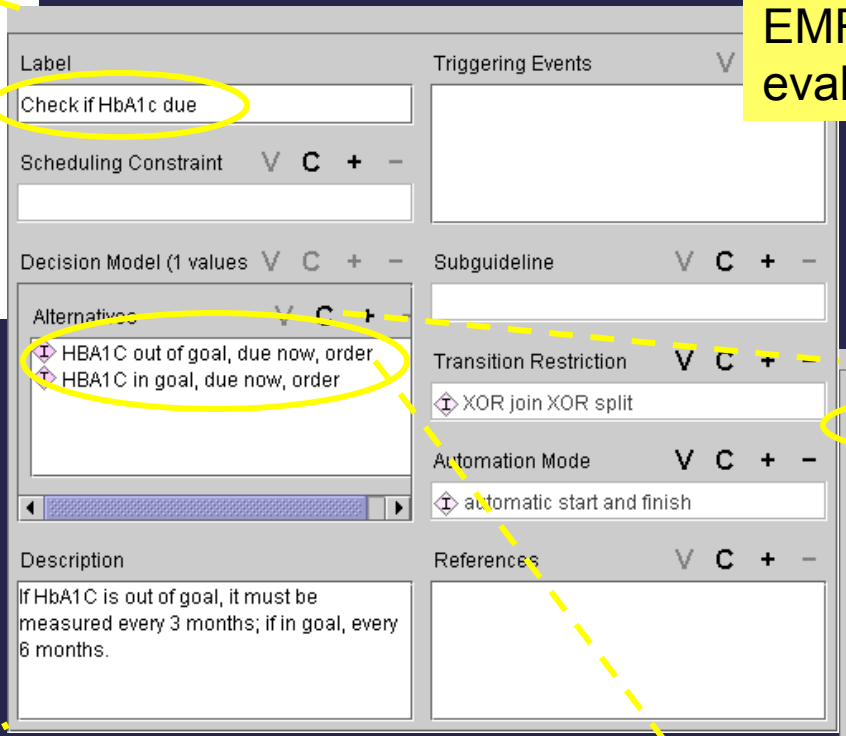
References V C + −

New Session

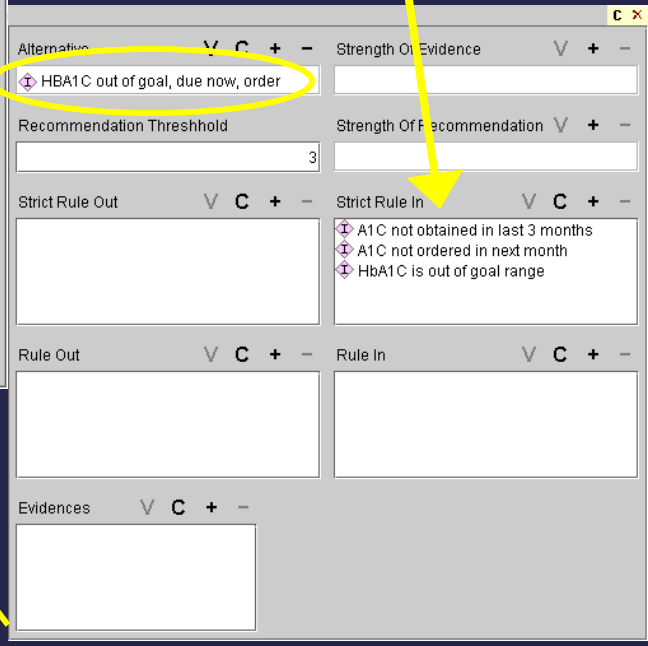
Guideline Execution:

SAGE executes encoded decision logic

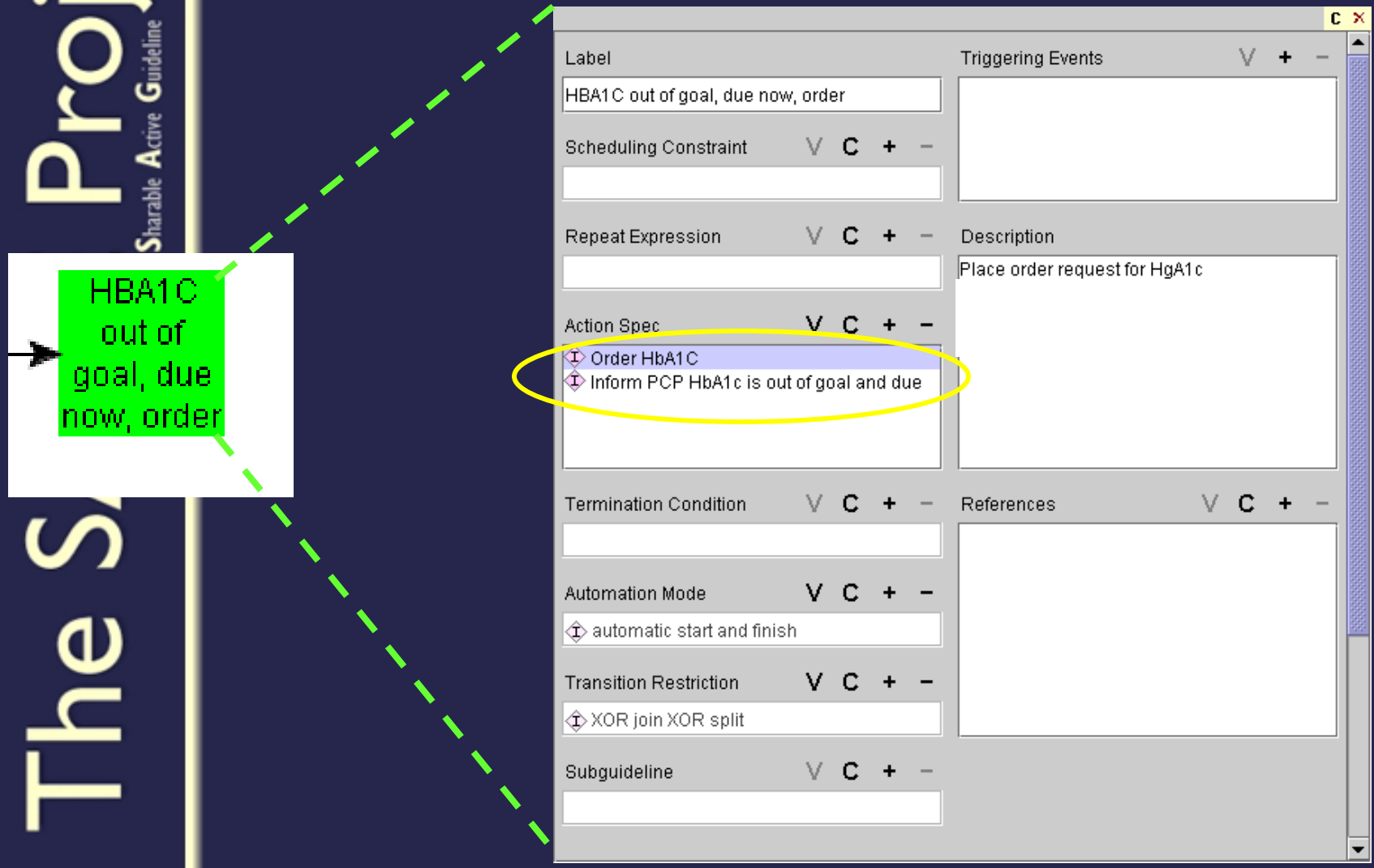


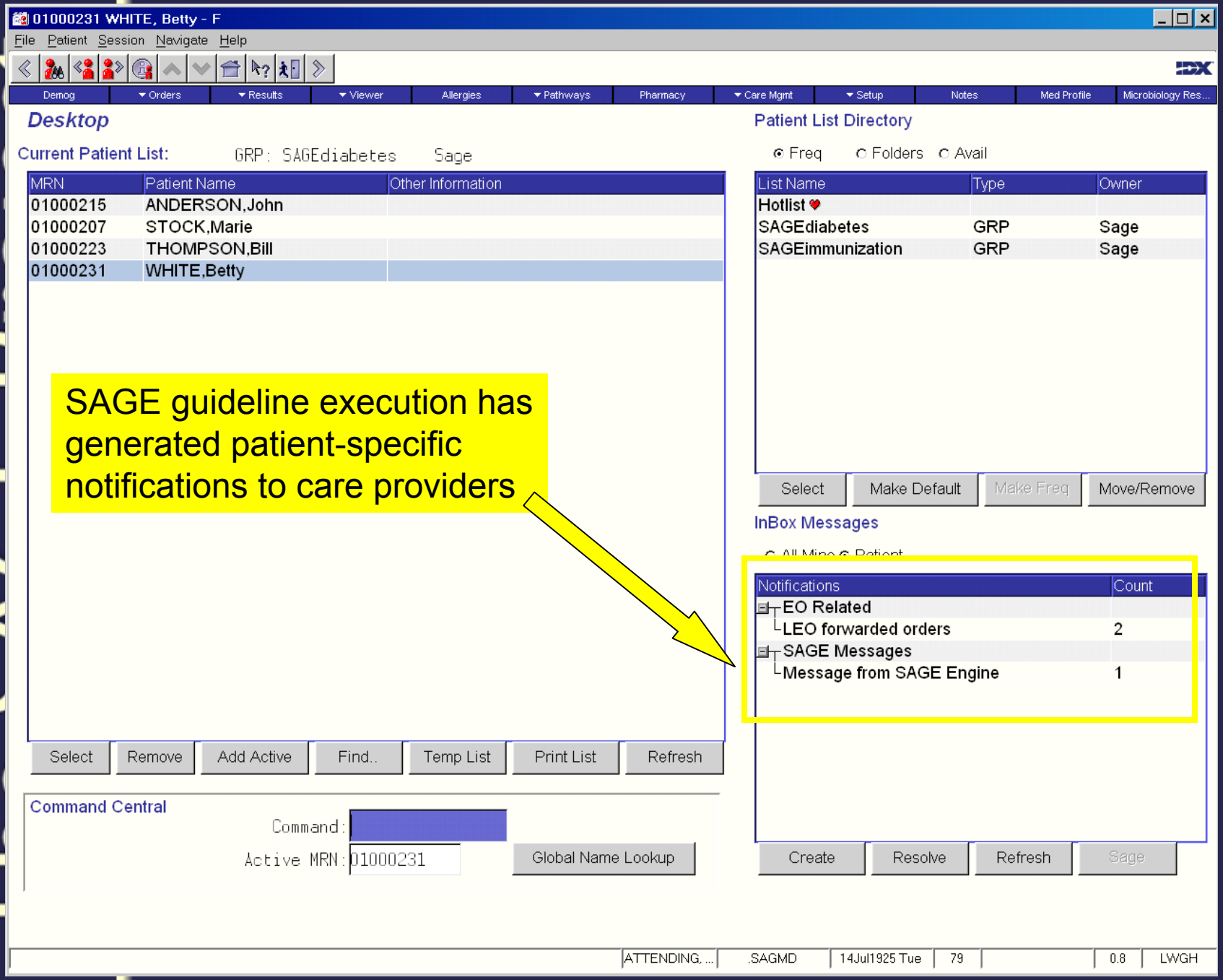


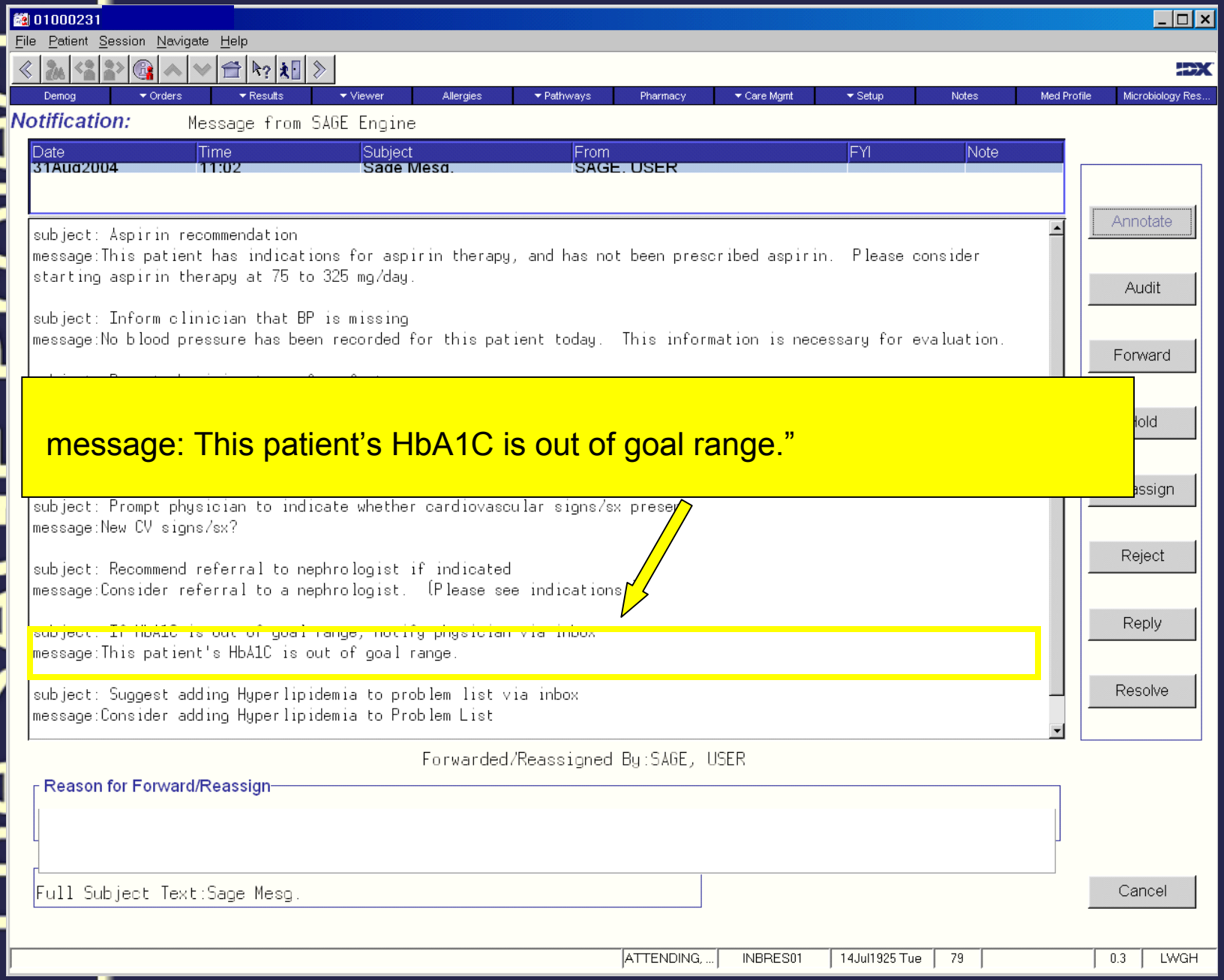
SAGE will query the patient EMR as necessary, and evaluate all decision criteria



SAGE communicates actions to the CIS




01000231 WHITE, Betty - F
File Patient Session Navigate Help
Demog Orders Results Viewer Allergies Pathways Pharmacy Care Mgmt Setup Notes Med Profile Microbiology Res...
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: 01000231
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
Notifications Count
EO Related
LEO forwarded orders 2
SAGE Messages
Message from SAGE Engine 1
Create Resolve Refresh Sage
ATTENDING, ...SAGMD 14Jul1925 Tue 79 0.8 LWGH



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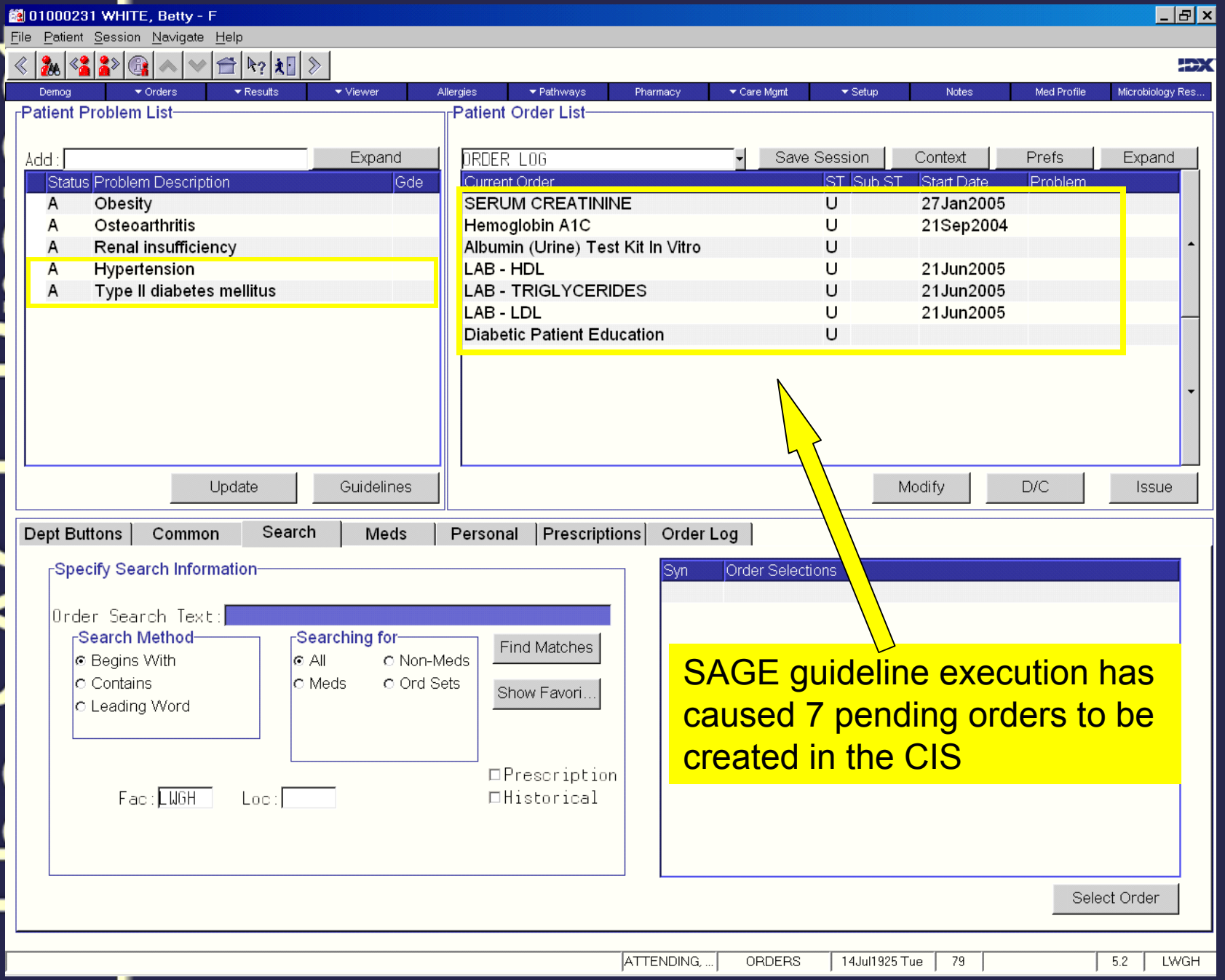

01000231 WHITE, Betty - F
File Patient Session Navigate Help
Demog Orders Results Viewer Allergies Pathways Pharmacy Care Mgmt Setup Notes Med Profile Microbiology Res...
Patient Problem List
Add :
Expand
Status Problem Description Gde
A Obesity
A Osteoarthritis
A Renal insufficiency
A Hypertension
A 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
Dept Buttons Common Search Meds Personal Prescriptions Order Log
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...
Prescription
Historical
Fac: LWGH
Loc :
Syn Order Selections
Select Order
SAGE guideline execution has caused 7 pending orders to be created in the CIS
ATTENDING, ... ORDERS 14Jul1925 Tue 79 5.2 LWGH

FlowSheet Index - Microsoft Internet Explorer

File Edit View Favorites Tools Help

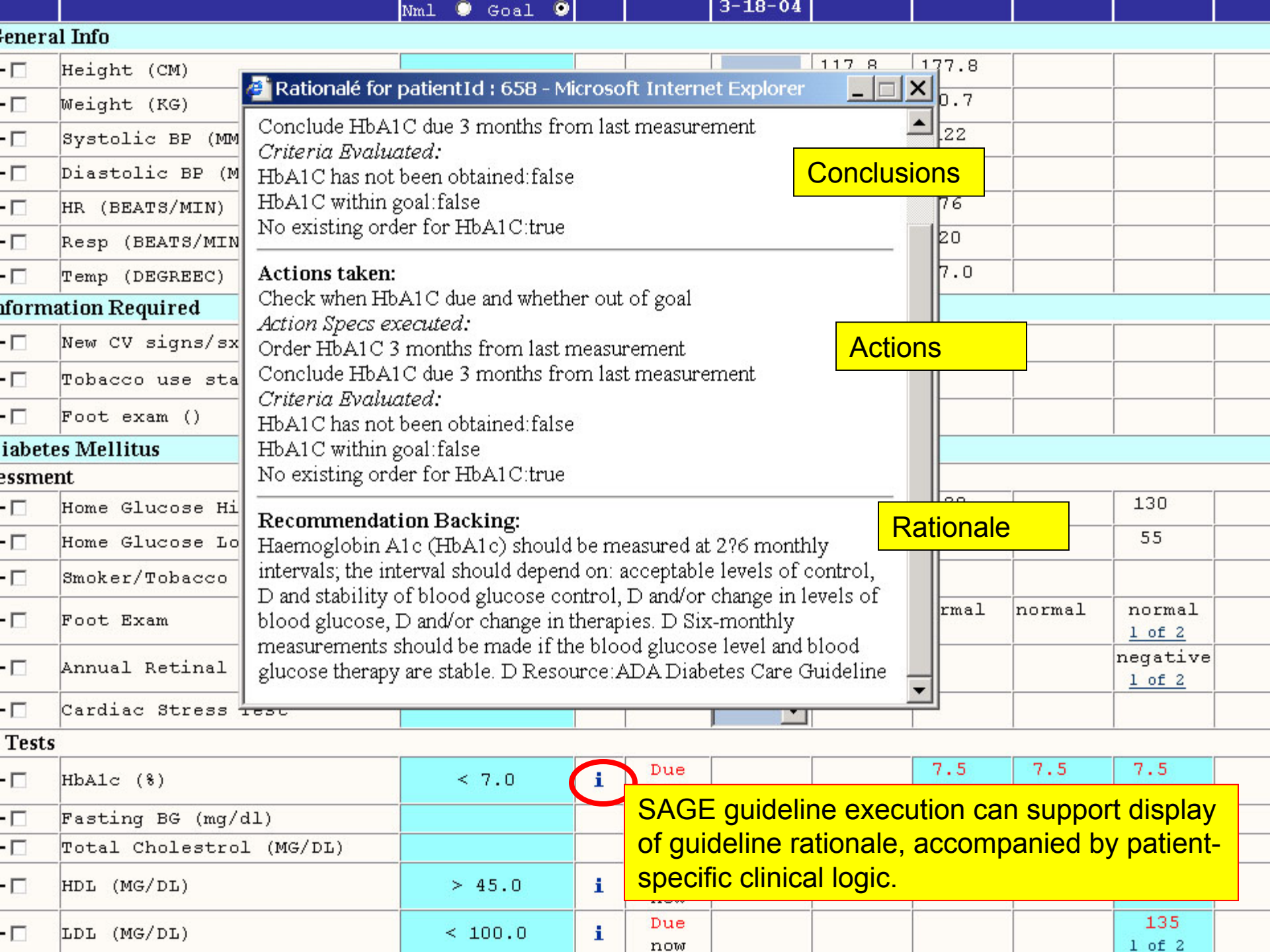
Help
Settings
Links
Email
Pause
Exit

	Resp (BREATHS/MIN)					22	20		20
	Temp (DEGREEC)					36.0	37.0		37.1
	Information Required	Goals							
	New CV signs/sx? ()			Due now					
	Tobacco use status? ()			Due now					
	Foot exam ()			Due now					
	Diabetes Mellitus								
	Assessment								
	Home Glucose High (mg/dl)								120
	Home Glucose Low (mg/dl)								85
	Smoker/Tobacco use								
	Foot Exam								norm
	Annual Retinal Exam								
	Cardiac Stress Test								
	Lab Tests								
	HbA1c (%)	< 7.0		Due now				7.5	7.5
	Fasting BG (mg/dl)								
	Total Cholestrol (MG/DL)								
	HDL (MG/DL)	> 45.0	i	Due now					
	LDL (MG/DL)	< 100.0	i	Due now					
	TGL (MG/DL)	< 150.0	i	Due now					
	Creatinine (mg/dl)								
	Urine Microalbumin (mg/24 h)								
	Education								
	Diabetes Self-Care								
	Nutrition counseling								

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

Save Acknowledge Subm

Done Internet


Nml Goal
3-18-04
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
HbA1c (%)
< 7.0
Due
Fasting BG (mg/dl)
Total Cholestrol (MG/DL)
HDL (MG/DL)
> 45.0
LDL (MG/DL)
< 100.0
Due now
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
177.8
0.7
22
76
20
7.0
130
55
normal
normal
1 of 2
negative
1 of 2
7.5
7.5
7.5
135
1 of 2
SAGE guideline execution can support display of guideline rationale, accompanied by patient-specific clinical logic.

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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