The Standard Sharable Active Guideline Environment

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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
Agenda for Today

• Overview of SAGE Project
  – Vision
  – Objectives
  – Architecture

• Overview of SAGE guideline execution
  – Overview of guideline encoding model
  – Guideline execution architecture
  – Highlights of guideline execution
SAGE Interoperability Goals

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
- Required if we want to achieve economies of scale in clinical decision support: “Write once, use many”
Overview of the SAGE Infrastructure

Guideline Workbench

Patient Data Model
(Virtual Medical Record)

Care Workflow Model

Medical Ontologies

SAGE Guideline Model

Guideline Deployment System

Health Care Organization Model

Common Layer of Terminologies and Information Models

Guideline Workbench

SAGE Guideline Engine

Standards-based API

Host Clinical Information Systems

Guideline File(s)
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If Needed

yes
no

Recommend self-management program:
- Nutrition therapy
- Physical Activity
- Education for self-management
- Foot care

Set individualized treatment goals:
- Glycemic control: HbA1c < 7%
- Lipid levels: LDL ≤ 130 mg/dl
- BP control: BP ≤ 130/85 mm Hg
- ASA unless contraindicated
- Tobacco cessation if indicated

Treatment goals not met:
- Modify treatment based on appropriate guideline
- See Glycemic Control Algorithm
- Consider referral to diabetes health team or specialists

Are Treatment Goals Met?

yes
See Ongoing Management Algorithm for maintaining treatment goals and complication prevention

Initial stabilization for outpatients requiring immediate insulin treatment

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Guideline Deployment System
- SAGE Guideline Model
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- Guideline Deployment System
- Standards-based API

Host Clinical Information Systems
Overview of the SAGE Infrastructure

Initial stabilization for outpatients requiring immediate insulin treatment.

**Type 2 Diabetes Evaluation**

- **Needs Stabilization?**
  - **yes**
  - Recommend self-management program:
    - Nutrition therapy
    - Physical Activity
    - Education for self-management
    - Foot care
  - Set individualized treatment goals:
    - **Glycemic control:** HbA1c < 7%
    - **Lipid levels:** LDL < 130 mg/dl
    - **BP control:** BP < 130/85 mm Hg
    - **ASA unless contraindicated**
    - **Tobacco cessation if indicated**
  - **no**
  - Treatment goals not met:
    - Modify treatment based on appropriate guideline
    - See Glycemic Control Algorithm
    - Consider referral to diabetes health team or specialists

- **Are Treatment Goals Met?**
  - **yes**
  - See Ongoing Management Algorithm for maintaining treatment goals and complication prevention

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**Common Layer of Terminologies and Information Models**

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  - (Virtual Medical Record)
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**Guideline Workbench**

- **SAGE Guideline Model**
- **Guideline Deployment System**
  - **SAGE Guideline Engine**
    - Standards-based API

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**Host Clinical Information Systems**

- **Guideline Workbench**
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- **Guideline Deployment System**
- **SAGE Guideline Engine**
- **Guideline File(s)**
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<table>
<thead>
<tr>
<th>Guideline</th>
<th>Clinical Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immunizations</td>
<td>Routine health maintenance, in both outpatient and inpatient settings.</td>
</tr>
<tr>
<td>Diabetes Management</td>
<td>Chronic disease monitoring and treatment. Acute exacerbation of chronic disease.</td>
</tr>
<tr>
<td></td>
<td>Chronic disease as a comorbidity.</td>
</tr>
<tr>
<td>Community Acquired Pneumonia</td>
<td>Emergency room evaluation and diagnosis.</td>
</tr>
<tr>
<td></td>
<td>Outpatient treatment of acute disease.</td>
</tr>
<tr>
<td></td>
<td>Inpatient and ICU treatment of acute disease.</td>
</tr>
<tr>
<td></td>
<td>Follow-up of acute disease.</td>
</tr>
<tr>
<td>Total Joint Replacement</td>
<td>Surgical guideline. Comprehensive pre-op workup, inpatient plan of care, and post-op outpatient management.</td>
</tr>
</tbody>
</table>
Guideline Knowledge Encoding and Representation

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

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.

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.

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)
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We envision the clinical context

We identify opportunities for CDS

We integrate guideline logic with care workflow
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Guideline recommendations are “channeled” via CIS functions.
Sample Activity Graph:
Diabetes Primary Care

- Primary care clinic check-in
- Physician accesses the patient record
- Display diabetes data set to nurse
- Retrieve physician-entered data items and calculate items due
- Get diabetes data set for nurse
- Nurse accesses diabetes data set
- Aspirin therapy
- Out-of-goal notifications via inbox
- Smoking cessation counseling
- Prompt physician regarding last stress echo
- Cardiac screening
- Physician accesses diabetes data set
- Get diabetes data set for physician
- Retrieve nursing-entered data items and calculate items due
**Context Nodes** organize and specify the relationship to workflow. They record:
- Who is involved
- Where the session occurs
- What resources are required
  - Clinical
  - Information processing
- What triggers or begins session

**SAGE Guideline Representation:**

- **Adult Diabetes Patient**

- **When should lipid labs be ordered?**
  - Order lipid labs now
  - Order lipid labs for 6 months from last labs
  - 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
When should lipid labs be ordered?

**Decision Nodes** provide support for making choices:
- Specification of alternatives
- Logic used to evaluate choices
- Query data from patient record
- Can change the clinical workflow
Action Nodes define activity to be accomplished by clinical information system:

- User interaction and query
- Order sets
- Referrals
- Appointments and scheduling
- Goal setting
- Documentation and recording
- Messaging, print and paging
- Sub-guidelines

SAGE Guideline Representation: Action Nodes

Order lipid Labs 24 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

- SAGE Guideline Execution Engine
- Terminology Server
- Terminology Functions
- VMR Service calls
- Action Service calls
- Event Listener
- Event Notifications
- VMR Services Action Interface
- Clinical Information System
- CIS-specific implementation of services
- Standards-based I/F based on web services
- Encoded Guideline
SAGE Guideline
Execution Architecture

Encoded Guideline

SAGE Execution Engine

Event Listener

Event Notifications

Terminology Functions

Terminology Server

VMR Service calls

Action Service calls

VMR Services Action Interface

Clinical Information System

CIS-specific implementation of services

Standards-based I/F based on web services
- 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
SAGE listens for and detects context-specific events
Guideline Execution:

SAGE executes encoded decision logic
Guideline Execution:

SAGE executes encoded decision logic

SAGE will query the patient EMR as necessary, and evaluate all decision criteria.
Guideline Execution:

**SAGE communicates actions to the CIS**

- **HBA1C** out of goal, due now, order
  - Order HbA1c
  - Inform PCP HbA1c is out of goal and due
SAGE guideline execution has generated patient-specific notifications to care providers.
“subject: If HbA1C is out of goal range, notify physician via inbox.
message: This patient’s HbA1C is out of goal range.”
SAGE guideline execution has caused 7 pending orders to be created in the CIS.
SAGE guideline execution can populate a patient-specific clinical care “flowsheet” with guideline recommendations, goals, and reference information.
SAGE guideline execution can support display of guideline rationale, accompanied by patient-specific clinical logic.
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
The Standard Sharable Active Guideline Environment

Questions?

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www.sageproject.com
Thank You!

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