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GLIDES PROJECT

GuideLines Into DEcision Support

sponsored by
The Agency for Healthcare Research and Quality

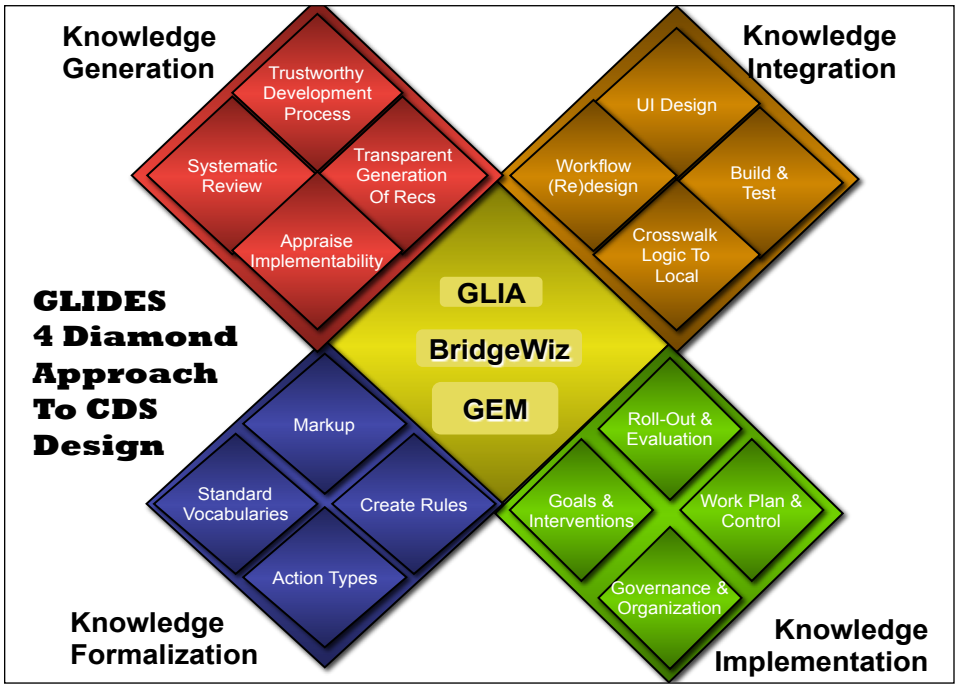
Yale New Haven Health
Yale School of Medicine
Nemours.
The Children's Hospital of Philadelphia
GEISINGER
American Academy of Otolaryngology–Head and Neck Surgery
ECRI Institute
American Academy of Pediatrics
Dedicated to the Health of All Children
American Urological Association
ALLIANCE OF CHICAGO
Community Health Services, L3C
ASCO
American Society of Clinical Oncology

Introduction

Overview Of GLIDES Approach To Clinical Decisions Support

The GLIDES Project (GuideLines Into Decision Support) is a collaboration of guideline developers, disseminators, and implementers working to design, develop, implement, and demonstrate clinical decision support (CDS) applications using systematic and replicable processes for knowledge transformation and CDS design. GLIDES was commissioned by the Agency for Healthcare Research and Quality (AHRQ) in February 2008, and is now completing its fourth year of operations. The objective of the GLIDES project is the development, implementation and evaluation of demonstration sub-projects that advance understanding of how best to incorporate clinical decision support (CDS) into the delivery of healthcare. The project is exploring how the translation of clinical knowledge into CDS can be routinized in practice, and taken to scale, to improve the quality of healthcare delivery in the U.S. Following an initial two-year AHRQ contract to pursue this objective, GLIDES has now completed two additional Option Years of demonstration work.

GLIDES believes it is necessary to pursue improvements across several dimensions of the guideline development and implementation process. GLIDES envisions these dimensions as follows:



- **Knowledge Generation** is the process of creating guidelines that can be implemented effectively.
- **Knowledge Formalization** is the process of translating narrative guidelines into structured knowledge that can be implemented consistently as automated CDS.
- **Knowledge Integration** covers the activities necessary to design and build a local CDS solution.
- **Knowledge Implementation** includes project organization, management and evaluation activities necessary to implement the CDS in clinical settings.

Figure 1. GLIDES Dimensions Of Guideline Knowledge Management

A centerpiece of GLIDES strategy is the Guideline Elements Model (GEM). GEM is an XML-based knowledge model for guideline documents. It incorporates a set of more than 100 tags to categorize guideline content. Initially published as a Document Type Definition (DTD), it was successfully balloted as a standard by the American Society for Testing and Materials (ASTM) in 2002. In 2006, the model was updated as GEM II, published as an XML schema, and again accepted as a standard (E-2210-06). A third revision is currently undergoing consideration of standardization. GEM provides a bridge between Knowledge Generation and CDS implementation and provides the backbone tools for Knowledge Formalization.

Option Year Two Goals

The following goals formed the basis of GLIDES' Option Year Two (OY2) initiatives and project plan:

1. **Using systematic and replicable processes, we will continue to design, develop, implement, and demonstrate guideline-based clinical decision support. This will focus both on new guidelines and implementation partnerships, as well as enhancing and improving the CDS already produced at Yale, Children's Hospital of Philadelphia (CHOP), and Geisinger.**
   - Focus more closely on consolidating the successful practices and lessons learned into a formal set of tools and methods that is systematic, replicable and documented.
   - Continue to fund completion of implementation activities, while increasing interaction and collaboration among implementation partners to add insight and crystallize key conclusions and lessons learned for CDS development.
   - Engage additional advisors and experts in specific areas of controversy to add value and perspective.

2. **Recognizing the critical importance of transparently developed and clearly stated guideline recommendations for effective implementation, work closely with guideline developers to provide tools and guidance to improve guideline development and reporting processes.**
   - Continue to work with the American Academy of Pediatrics (AAP) and the American Academy of Otolaryngology-Head and Neck Surgery (AAO-HNS) to integrate BridgeWiz and GLIA tools into their guideline development processes.
   - Expand our focus to additional guideline developers, potentially including such developers as National Heart, Lung, and Blood Institute (NHLBI), the American Thoracic Society (ATS), the American Urological Association (AUA), the American Society of Clinical Oncology (ASCO), the American College of Emergency Physicians (ACEP), the American College of Chest Physicians (ACCP) and Developing Evidence to Inform Decisions about Effectiveness (DEcIDE).
   - Formalize the recommendations and then focus on dissemination to other guideline development organizations, with emphasis on promotion of software tools.

3. **Update the Guideline Elements Model and increase GEM adoption nationally and internationally.**
   - Focus on completion, standardization and promotion of the new GEM release.
   - Focus on how BridgeWiz and GEM can be integrated.
   - Work with the ECRI Institute and Silverchair to demonstrate how GEM-encoded guidelines can be disseminated through the National Guidelines Clearing House (NGC).
   - Work with other AHRQ knowledge representation projects, in a spirit of best practice sharing.

4. **Continue evaluation of both existing and newly developed CDS implementations.**
   - In OY2 GLIDES will continue evaluation activities across each of the collaborators, and production of associated papers.

5. **Disseminate the findings and lessons learned via a variety of modalities.**
   - In OY2 GLIDES will provide more opportunities for collaborators to share their results and lessons learned (TEP participation, papers, etc).

Option Year Two Accomplishment Summary

GLIDES investigators delivered on our goals and commitments in OY2, and were able to do so within our OY2 budget.

- GLIDES worked with four leading healthcare delivery organizations — Geisinger, Children's Hospital of Philadelphia and Alliance of Chicago — to implement Clinical Decision Support demonstration applications. Yale implemented a major enhancement to the Asthma CDS previously delivered by GLIDES, which automates the direct capture of patient information during the registration process, using iPad technology. CHOP implemented CDS applications for management of premature infants. Geisinger implemented CDS applications for management of Low Back Pain and began to pilot an audio-recording application that captures and evaluates feedback from patient encounters and integrates it into the CDS flow. Finally, Alliance implemented a version of Yale's Asthma CDS, customizing it to meet their local workflow and clinical needs, thus examining the challenges of local customization and implementation.

- GLIDES worked with four national guideline development organizations — AAP, AAO-HNS, AUA and ASCO - to design, implement and pilot processes and tools intended to make guidelines clearer and more implementable. Specifically, these tools include the automated guideline-authoring tool – BridgeWiz – and the Guideline Implementability Appraisal tool (GLIA). In OY2, we continued to refine and enhance these tools, incorporating feedback from the collaborations. Regardless of the infrastructure chosen by guideline implementers to design and deliver CDS, these tools for guideline developers can enhance the "implementability" of medical guidelines and policy statements.

- Continued to leverage and enhance the GEM toolset, incorporating lessons learned back into enhancements and improvements to a new version of GEM –GEM III. This release incorporates more granular concepts of knowledge components and new elements and attributes of codes and codesets. It also features integration with BridgeWiz, whereby guidelines authored in BridgeWiz can be stored in the GEM XML structure, to assist with implementation. GEM III has been submitted and balloted at ASTM International.

CDS Implementation Results

CHOP CDS Implementation (Task 2.1)

CHOP pursued several opportunities with CDS demonstration projects in OY2, including: moving beyond alerts and reminders; providing the correct level of decision support; and understanding factors beyond the user interface. In OY2, CHOP also assessed current clinical workflow processes and identified opportunities to improve them with technology.

Status Of Planned Activities and Deliverables

Task	Activity	Deliverables	Status
2.1.1	**Complete Final CDS Development and Testing** • Complete Final Release Development • Perform Use Case Testing • Perform Final Usability Testing • Deployment	• Accomplishment of Retinopathy of prematurity (ROP)/Synagis Release • Use Cases • Usability Testing	**Respiratory syncytial virus** (RSV)/Palivisumab delivered (10/11) ROP/Synagis delivered (2/12 for trial, full release 3/12)
2.1.2	**Post-Deployment Assessment** • Initial Evaluation	• Interim data analysis	In process as planned – will be completed in OY3
2.1.3	**Dissemination** • Implementation Guide • Technical Appendix	• Implementation Guide • Technical Appendix	Documents delivered (will be included in GLIDES Repository for OY3)

Specific Accomplishments

CHOP implemented a CDS application for management of premature infants – the Premature Infant Assistant - which utilizes real time Electronic Health Record (EHR) data mining and is integrated with a rules-based expert system and custom EHR application framework. The CDS application was applied to two clinical guidelines (policy statements) from the American Academy of Pediatrics: *Respiratory Syncytial Virus and Palivizumab* and *Retinopathy of Prematurity* (ROP). GEM was used to transform the policy statements into more than 100 rules, applied to 30+ patient variables extracted from the EHR.

Highlights of the CDS functionality include:

- Growth and Nutrition: Real time assessment of growth and tools to create feeding recommendations and education
- Development: Assess/monitor documentation of development and provide automatic age-corrected development documentation tools in the EHR.
- Blood Pressure Screening: Recommend screening at corrected age, plus data mine EHR for any abnormal readings in past and recommend screening.

CHOP followed a user-centered development process to design and build the CDS applications, with extensive use case development and validation. Multiple and iterative user interface and workflow design sessions were performed,

involving over 25 clinicians. Extensive usability testing was performed on the functioning system. CHOP responded to user feedback and made user interface/workflow changes to improve usability/utility.

CHOP created an extensive implementation guide detailing the overall architecture and development process used, including a technical appendix with system diagrams, supporting files and libraries.

CHOP performed an initial analysis of outcomes and usage data. Initial results focus on usage and findings on RSV and delays in administering dosing of Palivizumab. In addition, CHOP compiled premature infant parent education content and developed a Portable Document Format (PDF) generator integrated with the EHR programming framework to auto-generate patient specific education materials from the EHR.

Independently, Jeremy Michel at Yale marked-up the Palivizumab guideline and developed a rule set for it, working with the CHOP team to reconcile the differences. This exercise was useful in identifying ambiguities with significant consequences and demonstrating how two different knowledge translation processes can generate different results.

Evaluation Findings

Evaluation of the CDS applications is in progress and will be completed in OY3. Initial evaluation highlights include:

- Differential interpretation of the policy state on Palivizumab administration would result in significant and costly differences in the eligible pool of patients.
- The RSV Care Assistant was deployed to twenty general pediatric practices and was used to help manage the care of 343 patients in the first two months of the post intervention RSV season.
- Analysis of the subgroup of 131 children eligible to receive monthly Palivizumab for the entire RSV season revealed that 112 (85%) had received at least one dose by 12/31/2011.
- By comparison, among a cohort of 119 children eligible to receive monthly doses for the prior RSV season, only 69 (77%) had received at least one dose by 12/31/2010 (p=.095).

Barriers, Risks and Issues

Although CHOP investigators were able to deliver all planned work products, the implementation of the CDS applications was delayed during the course of OY2 to allow more time for user testing and incorporation of usability improvements identified during CHOP's user-centered development process. Specific delays were due to high complexity of rules and analysis of free text notes in the EHR. Specific challenges included:

- Clinician Acceptance/Buy-In: In particular, gaining clinician agreement that CDS is needed for the identified patients/issues and their commitment to use and adopt the CDS prior to implementation. To achieve this, CHOP investigators communicated closely with clinicians prior to development, engaged high-level stakeholders and engaged clinicians and stakeholders closely in their user-centered development approach. This approach, while necessary to ensure a high quality design, also creates a subsidiary problem: the need to recruit busy clinician subjects for user-centered methods/activities.

- Guideline Ambiguity/Gaps: CHOP's work demonstrated again that published guideline documents will often not provide complete coverage for logic implementation. To resolve this, CHOP formed a clinician expert panel to review, research and (where required) make informed decisions to address any ambiguity or gaps in the document translation.

- Inconsistency Of EHR Data: CHOP's project needed to resolve data quality problems inherent in the EHR system that impacted the CDS design. Some required data was either missing, in different locations and/or in different formats. To address this, CHOP performed analytics/reporting prior to development to test and validate the required data sources and queries. In addition, extensive data testing was performed early in the system development process and a limited "beta" release was introduced to a small group of clinicians to pilot the design in real world clinical environments.

Geisinger CDS Implementation (Task 2.2)

In OY1, GLIDES provided funding, tools and support for use of GEM to codify the Institute for Clinical Systems Improvement (ICSI) guidelines on primary care management for back pain. The coded guidelines were used to aid in designing the electronic patient questionnaire. Geisinger applied GEM to these guidelines to codify them for real time use in clinical practice. In OY2, GLIDES provided funding and support for expanding the coded guidelines to translate into rules for real time application of management recommendations based on patient reported data on back pain. This is displayed in the clinical decision support web display to the provider in the exam room. In addition, Geisinger investigators are audio-recording the patient-provider dialogue of consenting patients randomized to the eLowBackPain intervention group and consenting patients randomized to the usual care group. The audio recordings are being evaluated, using the Roter Interaction Analysis System (RIAS), to identify and assess differences for patients in the intervention group versus the usual care group. (Note that funding for the implementation of the eLowBackPain application itself was not supplied by GLIDES – GLIDES funding was used to support the audio-recording-related enhancements only).

Status Of Planned Activities and Deliverables

Task	Activity	Deliverable	Status
2.2.1	**Select Appropriate Instruments for Audio Assessment** • Determine requirements • Research potential options • Select option/approach • Prepare design specifications	• System design • Technology selection	Complete
2.2.2	**Development and Approval** • Develop consent screen process and language • Obtain system compliance and approval • Obtain IRB approval	• Consent language/ design	Complete
2.2.3	**Install In Clinic** • Install devices • Install software • Go-live	• Accomplishment of System Installation milestone	Complete
2.2.4	**Transcription and Analysis** • Obtain patient consents and perform recordings	• Initial data analysis of recordings and transcriptions	In progress – to be completed in OY3

	• Perform transcription and coding analysis • Complete data analysis		

Specific Accomplishments

In OY2, Geisinger introduced the audio-recording protocol in one of the five clinic sites and will consider implementation on other clinic sites in OY3. Geisinger investigators commenced work on the transcription and analysis activities in OY2. Approximately 25% of the patient consents and recordings and transcription and coding analysis work was completed. The balance of this work, and related evaluation, will be completed in OY3.

Barriers, Risks and Issues

Implementation of the e-health back pain sponsored protocol in primary care was delayed by three months, which had a follow-on impact on the delivery of the audio-recording enhancements. To accelerate enrollment and fulfill support from the Geisinger system, the team expanded and implemented the protocol to four additional clinic sites by the end of January 2012. Particular challenges included:

- Institutional Review Board (IRB) Approval: Geisinger were required to submit a separate IRB application for the AHRQ funded work. They originally submitted an amendment to the original study, but the sponsor concluded that their protocol review would not accept that method of approval. While Geisinger do not anticipate any problems with gaining approval for a separate IRB application, additional time and effort was required to assemble and submit the application for review.

- Technology: The Geisinger IT team had to create a new classification on the exam room computers to account for the recording software and microphone. This had to be added to the classification setup used for the e-health back pain protocol and tested to make sure it was secure and the necessary components were locked down for patient use.

Evaluation Findings

The objective of OY2 was to determine if the e-health back pain protocol resulted in superior dialogue and shared decision making between the patient and provider. Patients and providers who consented would be audio recorded during the back pain visit and their recordings would be evaluated by an expert team using a well standardized protocol for coding and rating the quality of the doctor-patient interactions. This evaluation work is now in progress, which includes the transcription and analysis activities noted above. This work has not yet progressed to a stage where specific evaluation findings can be drawn. This work will be completed in OY3.

Yale Patient-Centered Data Capture (Task 2.3)

GLIDES investigators and Yale New Haven Health System Information Technology experts collaborated on a CDS initiative for patient-centered data capture using iPad tablets. This initiative was designed to address a major finding from the Asthma CDS implementation and evaluation: namely that pulmonologists avoided using the CDS in real time by making notes on a paper based clinical inventory. The patient-centered data capture project examines whether CDS avoidance can be overcome when patients enter interim history (necessary to trigger decision support) on a tablet and the information is only available for review within the EHR/CDS. In OY1, an initial version of the application was deployed

in the Asthma Specialty clinic at Long Wharf, in New Haven CT. In OY2, Yale continued to evaluate and improve the patient-centered data collection pilot.

Status Of Planned Activities and Deliverables

Task	Activity	Deliverable	Status
2.3.1	**Optimize Current Pilot Operation**	Optimized pilot system	Complete
2.3.2	**Evaluate Current Pilot** • Finalize evaluation plan • Perform patient surveys and interviews • Perform evaluation studies	Evaluation Plan Review of registrar logs	In process – to be completed in OY3
2.3.3	**Consider Expanding Pilot For OY3**	Design proposal for Version 2.0 and OY3	Complete

Specific Accomplishments

The pilot application was enhanced and improved. Technical performance was improved, in areas such as security, performance and integration with IDX. Functional performance was also improved, in areas such as access to information types and access to the patient registry. Appointment registry data is now fed from the clinic's IDX system (GE Health, UK) to insure accurate patient identification before receipt of the device in the clinic waiting room. A series of multiple-choice questions (English or Spanish) are displayed on the iPad and answered by tapping on the desired answer. Upon completion, responses are sent wirelessly over the secure clinic network to the web application server, creating a lab Health Level Seven (HL7) message with patient responses as observation terms. This information is then sent to the enterprise interface engine (eLink) and directed into the Centricity EHR.

A document outlining complexities incident to the use of patient-centered data collection devices in an enterprise environment is being drafted. Preliminary design work on enhancements for a new release of the tablet application, to be delivered in OY3, is in progress.

Barriers, Risks and Issues

The main challenge was how to acquire hardware (iPad equipment) to expand the pilot. The pilot is currently functioning in the Yale Long Wharf clinic, with three clinicians using the application regularly. We could extend the pilot for use at Yale's main pulmonology clinic in New Haven. It could also be implemented at other primary care clinical locations at Yale. However, the terms of the GLIDES contract do not allow for acquisition of new hardware.

Evaluation Findings

All of the pulmonologists at the Long Wharf expressed satisfaction with the system. Prior concerns regarding additional burdens on the registrar staff (responsible for distribution of the iPad devices) did not materialize. Patients were able to use the system with minimal training and expressed satisfaction.

Since iPad pilot initiation, 116 patients have been seen for asthma: 111 (95.7%) patients were willing and successfully used the iPad application without any formal training or orientation to the device. Five (4.3%) patients declined to try

using the device. Server problems resulted in 14 (12.1%) lost transmissions but the root cause of these problems were permanently corrected in OY2. Overall, 97 (83.6%) patients had successful completion and transmission to EHR of asthma interval history into Centricity from the iPad application.

In March, the Yale team developed a poster summarizing the project's results, for presentation at the upcoming Pediatric Academic Societies Conference. The posted is entitled: *Pediatric Asthma History Review By Patients Using iPads: Challenges & Adoption.* The poster notes that: "While there are many technical and security steps to consider, an easily adopted, touchscreen graphical user interface device, such as an iPad can be used to successfully and securely collect and transmit data into an EMR. Provider and patient enthusiasm was extremely positive".

Add New Implementation Partner (Task 2.4)

In OY2 GLIDES began work with a new implementation partner, Alliance of Chicago, to implement clinical decision support interventions in OY2 and OY3. Alliance investigators planned to use the Yale-site designed Asthma CDS. They intended to customize and reuse it for implementation across the Alliance network, carefully noting barriers and facilitators of transferring a working CDS from one site to another where both sites use the same vendor-supplied EHR (GE's Centricity).

We were able to make significantly more progress than planned with this task. Our original goal was to organize the project, for delivery in OY3. However, the Alliance team was able to mobilize to perform design and development work in Q4 2011 and Q1 2012. Software and technical support were provided to Alliance to initiate development. Consequently, most of the application development and testing work for the CDS will be completed in OY2, allowing Alliance to focus on roll-out and evaluation work in OY3.

Status Of Planned Activities and Deliverables

Task	Activity	Deliverable	Status
2.4.1	**Select and build implementation / demonstration partnership** • Work with AHRQ to organize criteria for screening and selection of potential partner institutions • Evaluate partnership short list against screening criteria • Recommend organization for new partnership • Organize partnership project • Engage relevant partnership personnel in project • Review partnership plan with AHRQ for approval	Criteria for screening and selection of potential partner institutions Recommendations for new implementation partnership	Complete
2.4.2	**Select guidelines and conditions for implementation** • Agree clinical objectives for implementation • Identify quality gaps that might be addressed by guideline-based decision support systems. • Agree methodology/criteria for selection of guidelines and recommendations • Review selection and guideline plan with AHRQ	Recommendations for guidelines to be implemented	Complete
2.4.3	**Establish Project Governance and Organization** • Identify key stakeholders and guideline champions • Agree project management arrangements/methods	Project organization chart	Complete

	• Complete implementation project kick-off		
2.4.4	**Option Year Three Planning** • Prepare plans for completion, implementation and rollout	Activities and budgets documented and presented to AHRQ	Complete

Specific Accomplishments

Alliance investigators were able to successfully adapt the CDS content from Yale. Revised CDS forms (and additional content such as Handouts for Asthma Action Plan and Asthma Control Test) were developed and reviewed by Alliance subject matter experts. Form and content is currently being reviewed by usability testers, who are providing feedback. Although Alliance was able to work within the overall framework and structure of the Yale CDS, several detailed changes were incorporated into Alliance's version of the EHR "Asthma Management Form". These various changes illustrate the types of "on the ground" changes needed to customize a CDS application to allow it to operate effectively from one clinical context to another:

- The Control and Severity Form was added as a single tab in the Alliance Asthma form. This required:
    - Navigation changes: Removed radio buttons to select "visit type"; Removed radio buttons to jump to other forms; Added display to show previous Severity to enable providers to better select if Severity has been assessed; Added simple option to document Severity Classification in the case it had been determined by a provider prior to patient being seen in the clinic; Updated chart note translation to be easier to read and to reflect if both Control and Severity were documented in a single visit.
    - Changes to the look and feel of the Control/Severity including: Shortening the descriptions of some questions, adding popup buttons to offer the additional information that was removed; Added functionality to have provider accept the Control Assessment and the Severity Assessment; Shortened some responses to fit into available space (this resulted in the need to modify the 'calculation' to determine Control and Severity); Added pop up buttons with help in use of the form.
    - Functions to be updated to remove logic related to EHR document summary lines specific to Yale workflows: The Yale workflows had specific Encounter types for new Asthma visits that would default a specific summary line, thus triggering functions to load. Since Alliance cannot rely on a standard Encounter type used by all sites, this logic had to be removed and developed elsewhere; Text Components getting loaded into the update based on the summary line had to be moved to Visual Form Editor function library so that the library would be loaded whenever the form was added to any update.

- Changes to the Medication form: Removed radio buttons to select visit type; Removed radio buttons to jump to other forms; Updated look and feel to match Alliance Standard (button colors and fonts); Removed Refill buttons from individual lines and added a global button at the bottom of the tab; Functions moved to Visual Form Editor function library; Updated Text Files with new GPI codes to ensure all medications are added when selected; Updated functions to check if medication already on medication list and prompt user to update the medication list; Updated logic to add medications to observation terms.

- Changes to the Assessment Form: Removed radio buttons to select visit type; Removed radio buttons to jump to other forms; Updated look and feel to match Alliance Standard (button colors and fonts); Reduced size of 'image' to have tab without scroll bar; Removed items to display previous Control Classification, Impairment and Risk, and Severity Classification, Impairment and Risk. The Alliance form has a summary page that displays this information. Added just display for classification of Severity and Classification. Updated logic for displaying recommendations to

simplify based on provider classification. Moved functions to Visual Form Editor function library and form. Added section for documenting education of inhaler, control and medication adherence.

A roll-out plan is being prepared and will include training for providers on the current guidelines. Roll-out will most likely be phased to initial sites, then to remaining Alliance sites. This will be completed in OY3.

Barriers, Risks and Issues

- Local Factors: The extent of changes necessary to be made to the Alliance version of the CDS reflect the importance of differences in technical, workflow, clinical policy and other factors that vary from one implementation organization to another. This demonstrates that successful configuration and implementation of sophisticated CDS is a complex challenge, and not just a question of "plug and play" of software modules.

- Guideline Complexity/Need For Testing: Despite the "head-start" provided by leveraging the Yale CDS, the complexity of the content and calculations included within the CDS application still required extensive testing within the Alliance environment.

- Clinician Buy-In: Expert opinion and buy in from clinical providers was still critical for success when adapting EHR decision support. As with other implementations, few providers have significant free time to volunteer on calls, testing draft content, and provide specific feedback.

- Cost and Effort: While not completely unexpected, the amount of effort and time to incorporate the Yale content, specifically the complex programming functions, was greater than initially planned.

Evaluation Findings

Formal evaluation work will be performed in OY3.

Guideline Tool Development and Implementation (Task 2.5)

GLIDES worked with four national guideline development organizations — AAP, AAO-HNS, AUA and ASCO — to design, implement and pilot processes and tools intended to make guidelines clearer and more implementable. Specifically, these tools include the automated guideline-authoring tool – BridgeWiz – and the Guideline Implementability Appraisal tool (GLIA). In OY2, we continued to refine and enhance these tools, incorporating feedback from the collaborations. Regardless of the infrastructure chosen by guideline implementers to design and deliver CDS, these tools for guideline developers can enhance the "implementability" of medical guidelines and policy statements.

Status Of Planned Activities and Deliverables

Task	Activity	Deliverable	Status
2.5.1	Work with AAP to improve guideline	Advice and guidance for	Progressing as planned

Task	Activity	Deliverable	Status
	development through BridgeWiz/GLIA.	enhancement/deployment of tools	– will continue in OY3
2.5.2	Work with AAO to improve guideline development through BridgeWiz/GLIA.	Advice and guidance for enhancement/deployment of tools	Progressing as planned – will continue in OY3
2.5.3	Work with two new guideline development organizations to implement BridgeWiz/GLIA.	New partnerships	Partnerships mobilized with AUA and ASCO
2.5.4	Complete BridgeWiz/GLIA Development	New releases of BridgeWiz and GLIA tools	Progressing as planned – will continue in OY3
2.5.5	BridgeWiz Deployment Planning	Deployment plan Website for dissemination	Deployment sites defined and proposed for OY3

Specific Accomplishments

AAP's guideline committees continue to utilize BridgeWiz. The AAP team will be meeting on April 1, 2012 to discuss the IOM report. A meeting summary will be included in the final GLIDES Annual Report.

AAO-HNS has fully integrated CDS tools BridgeWiz and eGLIA, into its Guideline Development processes and is in the process of updating its Guideline Development Manual (last published in 2009). AAO-HNSF will be integrating the use for these CDS tools into the manual. This will be submitted to Otolaryngology—Head and Neck Surgery in March/April 2012 for republication as a Supplement with final publication anticipated in June/July 2012.

AAO-HNS successfully completed its first Open Public Comment of their SHL guideline. Although public commenting for developers is typically seen as a challenge, the AAO-HNS had a relatively benign experience and they believe strongly that doing the Open Public Comment is a good thing. They are looking to share their experience at the 2012 Guidelines International Network (G-I-N) in Berlin (Aug 2012) and at the G-I-N North America meeting in New York, Dec 2012).

Feedback on BridgeWiz has been positive. A general conclusion is that it "takes a lot of the guess work out of developing the action statements and ensuring that they truly are actionable". In addition, GLIDES has received several suggestions for improving the BridgeWiz tools:

- While creating action statements, if a user gets halfway through creating the full statement (ie going through each step) and decide that they need to revise the actual statement in the first window, change a keyword, etc. they are forced to start the process over. There does not currently appear to be the ability to go back and edit.
- The evidence-grading table is not applicable to diagnostic tests. AAO-HNS referenced the Oxford Centre for Evidence-Based Medicine evidence quality tables for diagnostic tests during both the SHL and IVO guidelines. The AAO-HNSF suggests the incorporation of additional evidence grading tables into the BridgeWiz software, allowing the user to switch between tables as necessary.
- The IVO panel also suggested that during 'Deontic' section where the level of obligation is determined, that a star or some other symbol, identify the evidence quality and benefit to harm assessment that was assigned.
- Remove the word 'consider' as a potential action verb – See activity 'CONCLUDE'.

In July and Oct 2011, the AAO-HNS reported out to the AAO-HNS Guidelines Development Task Force (GDTF) on how the AAO-HNS is or is not in compliance with each of the Institute of Medicine (IOM) standards. They believe they are about 85% in compliance and are working to get as close to 100% as they can. The areas of challenge for them include:

- They do not develop their own Cochrane-like systematic reviews (SR) on which to base their guidelines, using

existing SRs
- Documenting that patients have been involved in the review of the guideline (they are reaching out to patients as part of our new open public comment).
- Panel members divesting themselves 1-year prior and 1-year after serving on the guideline panel.

On Jan 24, 2012, Richard Rosenfeld, MD, MPH, AAO-HNSF Senior Consultant for Quality and Guidelines and Stephanie Jones, AAO-HNSF Director Research and Quality Improvement, participated in an interview with ECRI about the IOM standards. ECRI is interviewing guidelines developers to determine how developers are responding to the standards and to assist the National Guideline Clearinghouse (NGC) in determining how they might redesign the system to incorporate the IOM standards.

New Partners

AUA and ASCO are actively engaged in the GLIDES project, and SOW/sub-contracts have been prepared. AUA is working on the urodynamics guideline, using BridgeWiz, and plan to move on to the urotrauma guideline next.

In addition, GLIDES is working with Children's Mercy Medical Center in Kansas City, to pilot a version of BridgeWiz with the GRADE rating system for a number of guideline topics, including Febrile Infant, Diabetic Ketoacidosis, Jaundice and others. GLIDES also demonstrated BridgeWiz to the Canadian Partnership Against Cancer's (CPAC) Capacity Enhancement Program. This organization doesn't actually produce guidelines itself but does provide training and resources to cancer guideline development groups across Canada. CPAC plans to inform these groups about BRIDGE-Wiz, and GLIDES will be supporting them in this effort. Finally, GLIDES explored a potential collaboration with DECIDE.

We are also meeting with Yale University counsel to discuss licensing agreements for guideline development tools.

Knowledge Management and Transformation Toolkit (Task 2.6)

Based on feedback from collaborative efforts, GLIDES is enhancing GEM and related tools for the creation of implementable guidelines and the transformation of guideline knowledge into rules. Based on recommendations from AHRQ and knowledge gained during OY2, this toolkit is to be updated and finalized during OY3.

Status Of Planned Activities and Deliverables

Task	Activity	Deliverable	Status
2.6.1	**GEM Improvement** • Incorporate in a revised version of GEM new elements that will enhance GEM's ability to function in guideline development, implementation, dissemination and measurement environments. • Consider additional improvements to GEM, reflecting user's experience	Improved/enhanced GEM tools	GEM III is complete

Task	Activity	Deliverable	Status
	• Focus on how BridgeWiz and GEM can be integrated.		
2.6.2	**GEM Deployment Plan** • Develop a strategy to promote the new GEM version, through promotion, publications, online and other training aids, e-manuals, communication and other techniques to drive adoption. • Design, with AHRQ and Yale, an appropriate licensing arrangement for these tools.	Deployment plan	Deployment plan developed – will be implemented in OY3

Specific Accomplishments

The third revision of the Guideline Elements Model (GEM III) was submitted in January 2012 to ASTM International for balloting as an international standard for representation of guideline knowledge. The newest version adds a number of new elements. By February 1, only a single negative comment had been received that questioned the display of the model in the standard. We anticipate a successful balloting.

Jeremy Michel continues work on mapping the action-types taxonomy developed at Yale Center for Medical Informatics (YCMI) to the Quality Data Model from the National Quality Forum.

GEM Delivery Via NGC Site (Task 2.7)

GLIDES and ECRI have explored how NGC can best deliver GEM-parsed content via its web site, including planning for technical requirements with ECRI's IT subcontractor (Silverchair). ECRI and Silverchair designed and proposed modifications to the NGC website so it can accommodate GEM-parsed guideline content.

Status Of Planned Activities and Deliverables

Task	Activity	Deliverable	Status
2.7.1	**Organize project and evaluate requirements**	See Deliverable for 2.7.2 (below)	Complete
2.7.2	**Develop project plan for modifications to NGC website to accommodate GEM-parsed guideline content**	Detailed specification and design, project plan, and budget for GEM-ification of NGC website.	Complete
2.7.3	**Continue to support GEM improvement and promotion**	Report to Yale describing work performed, proposed enhancements and the rationale for suggesting them	Complete

Specific Accomplishments

ECRI has prepared draft specifications and designs, project plans, and budgets for GEM-ification of the NGC website. Yale is currently reviewing the material, which will be ready for review with AHRQ in Q2 2012. As part of this work. ECRI has:

- Proposed inclusion criteria for selecting guidelines for GEM-cutting.
- Developed use cases for the GEM-ified NGC website that includes the need for CDS implementers and quality improvement professionals to be able to register to receive alerts on the availability of GEM-cut guideline content in the topic areas of interest to them. The use cases will also include the need to view as well as download different components of the GEM packages.
- Established criteria for choosing guidelines currently represented on NGC for GEM-cutting, including consideration of use of GLIA and the new IOM Standards for Trustworthy Guidelines in addition to ECRI-specific criteria. For example: currency of the guideline, likelihood of receiving copyright permission from the guideline developer, whether the guideline addresses a high-priority condition, etc.
- Developed a protocol for production workflows to support the GEM-ification of NGC, created so as to not jeopardize production for existing NGC content.
- Explored the potential of using modified decision tables to aid developers in selecting guidelines to GEM-cut. After development and analysis of several decision tables, it was decided that, while the decision tables present some utility, it was not appropriate to fit into the workflow of the GEM-cutting process.
- Continued to evolve wireframes and design specifications for the GEM-ified NGC website, including offering "personalized" GEM-cut content. ECRI has utilized information gathered from engaging with implementers and guideline developers to continue to suggest refinements to the GEM process and GEM-Cutter tool.
- Established the parameters for what should be included in the workplan and budget for GEM-ifying NGC and reviewed these with Yale. ECRI created three unit cost models for the budget: for guidelines of low, medium, and high difficulty with respect to GEM-cutting effort.
- By the conclusion of OY2, ECRI will have submitted to Yale a full narrative proposal, project plan, and budget for proposed GEM-ification of NGC (April 30, 2012).

In addition, ECRI has:

- Continued discussions with guideline developers about issues related to offering GEM-cut guidelines through NGC.
- Continued to work with guideline implementers to better understand how GEM-ification of NGC can complement their work to implement guidelines into CDS.
- Completed GEM-cutting of two (2) Kaiser Permanente guidelines (Hypertension and Dyslipidemia) and has had follow-up discussions with the developer to address possible improvements to the GEM-cutting process, most notably in terms of how it could better complement the Kaiser CDS approach.
- Engaged with Geisinger, both as a GLIDES partner already using GEM-cut guidelines, and as a Beacon site to determine how GEM-cut output could benefit this project.

Dissemination Activities

Presentations

- Stakeholder Reactions to Standards for Trustworthy Guidelines. Institute of Medicine Implementation Workshop on Standards for Systematic reviews and Clinical Practice Guidelines. Washington, DC, May 10, 2011.
- Building Better Guidelines With BRIDGE-Wiz: A Briefing for the AUA. American Urological Association, Washington, DC. May 18, 2011.
- Transforming Evidence-based Knowledge into Clinical Decision Support. Veterans Administration/Department of Defense Evidence-based Practice Working Group, Washington, DC (via webinar); July 12, 2011.
- A software assistant to promote guideline development. Guidelines International Network. Seoul, Korea. August 29, 2011.
- Can the New IOM Standards for Guideline Development Improve Guideline Quality? Plenary Presentation. Guidelines International Network. Seoul, Korea. August 31, 2011.
- How Do IOM Standards Fit With the NHS Evidence Accreditation Scheme?
  Is Harmonis(z)ation Possible? NHS Evidence Satellite Meeting. Seoul, Korea, August 31, 2011.
- Evaluating Guideline Quality. 2011 Symposium on Clinical Practice Guidelines and Evidence-based Medicine. China Medical Doctor Association. Beijing, China. September 2, 2011.
- Acronyms, Shmacronyms: An Introduction to The Mystifying World of YCMI Abbreviations, for ASCO, September 7, 2011
- Assessing the Impact of the IOM Report on the Future of the National Guideline Clearinghouse. AHRQ Annual Meeting, Rockville, MD. September 15, 2011.
- GEM at 10: A Decade's Experience With the Guideline Elements Model. AMIA Annual Meeting, Washington, DC; October 24, 2011.
- Improving Transparency of AAP Policies. Steering Committee on Quality Improvement and management, American Academy of Pediatrics, Elk Grove Village, IL, November 19, 2011.
- Presented BRIDGE-Wiz to the American College of Emergency Physicians - 1/9/12. Feedback was positive..
- New IOM Standards for Trustworthy Guidelines: Implications for the North American Guidelines Community (Webinar). Guidelines International Network-North America. January 19, 2012.
- Promoting Trustworthy Guidelines for Rare Diseases: The New IOM Standards. First International Workshop on Clinical Practice Guidelines for Rare Diseases. Instituto Superiore di Sanita. Rome, Italy. February 24, 2012.
- Dr. Shiffman presented BridgeWiz to ASCO's Clinical Practice Guidelines Committee, which provides oversight and review for all ASCO guideline development activity.
- GLIDES presented to the March 19 Guidelines International Network (G-I-N) North America Board Meeting, promoting IOM standards.
- ECRI presented GLIDES work to the March 27 NGC/NQMC Expert Panel meeting at AHRQ.
- ECRI anticipates presenting its work on GEM-cutting at the CHOP Informatics Symposium (April 27, 2012).
- ASCO agreed to present topics covering their GLIDES activities at two upcoming events: the August G-I-N Meeting in Berlin and the G-I-N North America Meeting, New York City, Dec 10, 2012. The focus of these meetings will be: How can professional medical associations implement best practices when developing guidelines and overcome obstacles?

Publications and Submissions

- Hoeksema LJ, Bazzy-Asaad A, Lomotan EA, Edmonds DE, Ramírez-Garnica G, Shiffman RN, Horwitz LI. Accuracy of a computerized clinical decision support system for asthma assessment and management. J Am Med Inform Assoc 2011;18:243-250.
- Shiffman RN, Michel G, Rosenfeld R, Davidson C. Building better guidelines with BRIDGE-Wiz: a software assistant to promote quality, transparency, and implementability. J Am Med Inform Assoc 2012;19:94-101 doi:10.1136/amiajnl-2011-000172
- Hajizadeh N, Kashyap N, Michel G, Shiffman, RN. GEM at 10: a decade's experience with the Guideline Elements Model. Proc AMIA Symp 2011.
- Lomotan EA, Hoeksema LJ, Edmonds DE, Ramirez-Garnica,G, Shiffman RN, Horwitz LI. Evaluating the use of a computerized decision support system for asthma by pediatric pulmonologists. Int. J. Med. Inform. 2012;81:57-65. doi:10.1016
- ECRI submitted an abstract (prepared by Jane Jue) to the CHOP Informatics Symposium on the topic of "Translation Of Clinical Practice Guidelines for Implementation Into Electronic Health Records (EHRs) Through Clinical Decision Supports".
- Jeremy Michel (Yale) submitted an abstract to the CHOP Informatics Symposium on ambiguous, vague, and underspecified language in 2 AAP guidelines for management of premature infants.
- CHOP also submitted an abstract to the CBMi symposium on RSV.
- International Journal of Medical Informatics: Evaluating the use of a computerized clinical decision support system for asthma by pediatric pulmonologists. Published January 2012.
- AAO's Clinical Practice Guideline: Sudden Hearing Loss was published March 2012 as a Supplement in Otolaryngology. The methods section documents the use of BridgeWiz.
- AUA's Urodynamics Guideline, which was prepared using BridgeWiz, is now undergoing review by AUA's Board of Directors for final approval. AUA expect to officially release it at their upcoming Annual Meeting in May.

Posters, Webinars and Other Events

- Discussed with Troy Brennan of Caremark about applicability of GEM to their guideline transformation efforts in concert with IBM.
- CHOP had a poster accepted at the Human Factors Engineers Society Health IT conference in March (showcasing the RSV tool).
- CHOP also submitted an abstract to the Center For BioMedical Informatics (CBMi) symposium, also on RSV.
- Webinars with ASCO and AUA were held to demonstrate BridgeWiz, as part of partnership planning.
- ECRI hosted webinars with Geisinger and CHOP, as part of our efforts to identify effective practices and design templates/artifacts that can be reused by other implementers.
- ECRI updated the NGC/NQMC Expert Panel on March 27, 2012 about this work.
- GLIDES participated in a March 22 call with the World health Organization (WHO), to discuss the applicability of BridgeWiz.
- GLIDES participated in a March 23 call with the Centers For Disease Control (CDC), to discuss the potential use of GLIDES tools.
- GLIDES participated in the April Office of the National Coordinator (ONC) CDS Sharing meeting.

Repository

We continued to develop the "Four Diamonds" artifacts repository, gathering additional content from GLIDES partners and discussing technology and media options for presenting the information over the web. By the end of OY2 we will have created a solid prototype/conceptual model for this repository. The formal delivery of the repository will be accomplished in OY3.

The GLIDES repository will be a web application to provide public access to GLIDES' work products:

- Initial access to the GLIDES project, using the GLIDES "Four Diamonds" graphic, which provides an overview of the key activities required for guideline development, transformation, integration and implementation.
- Development of sub-pages for each of the "diamonds" activities (approximately 20). Each page will include:
    - An overview of the activity
    - Advice and guidance on key concepts
    - Discussion of GLIDES tools that can be re-used (GEM, GLIA, BRIDGEWIZ), with links to the deployment "tool-kit" sites for these tools (task 2.5)
- As required, additional links will provide access to specific GLIDES artifacts, which include
    - Forms and templates that have proven effective for GLIDES
    - Examples of GLIDES work products, created during demonstration projects
    - Screenshot examples of CDS applications, created during demonstration projects
- Examples of material that will be included in the repository include:
    - Detailed GEM specifications and reports for sample guidelines (Asthma, Obesity, Hoarseness, others)
    - Intervention design specifications and developer specifications for Asthma and Obesity
    - Application examples/screen shots from up to 8 CDS demonstration applications
    - Clinical workflow design/redesign examples
    - Usability Test Report - Usability Test Materials (with intro/preface)
    - Use Case Validation Results (with intro/preface)
    - Description of User Interface prototyping/mockups process
    - Interface/crosswalk between GEM and local development processes
    - Integration approach between GEM and rules engine (DROOLS Rules)
    - CHOP Implementation guide and technical appendix
    - AAO-HNS Clinical Practice Guidelines Manual, reflecting integration of BridgeWiz and GLIA
    - GLIDES Abstraction Rules
- Other links to relevant (non-GLIDES) CDS design and development sites will also be included.

These capabilities will be made available to CDS stakeholders: researchers, guideline developers (professional societies), guideline implementers (hospitals, EMR vendors and other organizations), CDS project managers, etc. Ease of use will be a key criterion. Much of the "content" for these capabilities is in place. We are gathering examples, content and artifacts from GLIDES partners (Yale, CHOP, Geisinger, Alliance, Nemours, AAP, AAO, AUA, ASCO, ECRI, etc).

Index of Acronyms

AAO-HNS: American Academy of Otolaryngology-Head and Neck Surgery
AAP: American Academy of Pediatrics
ACCP: American College of Chest Physicians
ACEP: American College of Emergency Physicians
AHRQ: Agency for Healthcare Research and Quality
ASCO: American Society of Clinical Oncology
ASTM: American Society for Testing and Materials
ATS: American Thoracic Society
AUA: American Urological Association
CBMI: Center For BioMedical Informatics
CDC: Centers For Disease Control
CDS: Clinical Decision Support
CHOP: Children's Hospital of Philadelphia
CPAC: Canadian Partnership Against Cancer's
DEcIDE Developing Evidence to Inform Decisions about Effectiveness
EHR: Electronic Health Record
G-I-N: Guidelines International Network
GDTF: Guidelines Development Task Force
GEM: Guideline Elements Model
GLIA: Guideline Implementability Appraisal
GLIDES: GuideLines Into Decision Support
HL7: Health Level Seven
HPI: History of Present Illness
ICSI: Institute for Clinical Systems Improvement
IOM: Institute of Medicine
IRB: Institutional Review Board
NGC: Guidelines Clearing House
NHLBI: National Heart, Lung, and Blood Institute
ONC: Office of the National Coordinator
OY2: Option Year Two
OY3: Option Year Three
PDF: Portable Document Format
RIAS: Roter Interaction Analysis System
ROP: Retinopathy of prematurity
RSV: Respiratory syncytial virus
SR: Systematic Review
WHO: World health Organization
YCMI: Yale Center for Medical Informatics