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Technical Expert Panel 2010

IMPLEMENTING IMPERFECT GUIDELINES: GEM MEETS WEB SERVICES

Objectives

- Describe an approach to using web-services to deliver guidelines in a vendor-supplied electronic health record
- Describe the experience using guidelines element markup (GEM) to implement guidelines
 - Case study: retinopathy of prematurity

A Mixture of Urban and Suburban Practice Cultures

4 Urban Primary Care Centers

1 Faculty Practice

26 Urban/Suburban and Rural Kids First Practices

8 Specialty Care Centers with 3 Ambulatory Surgical Centers

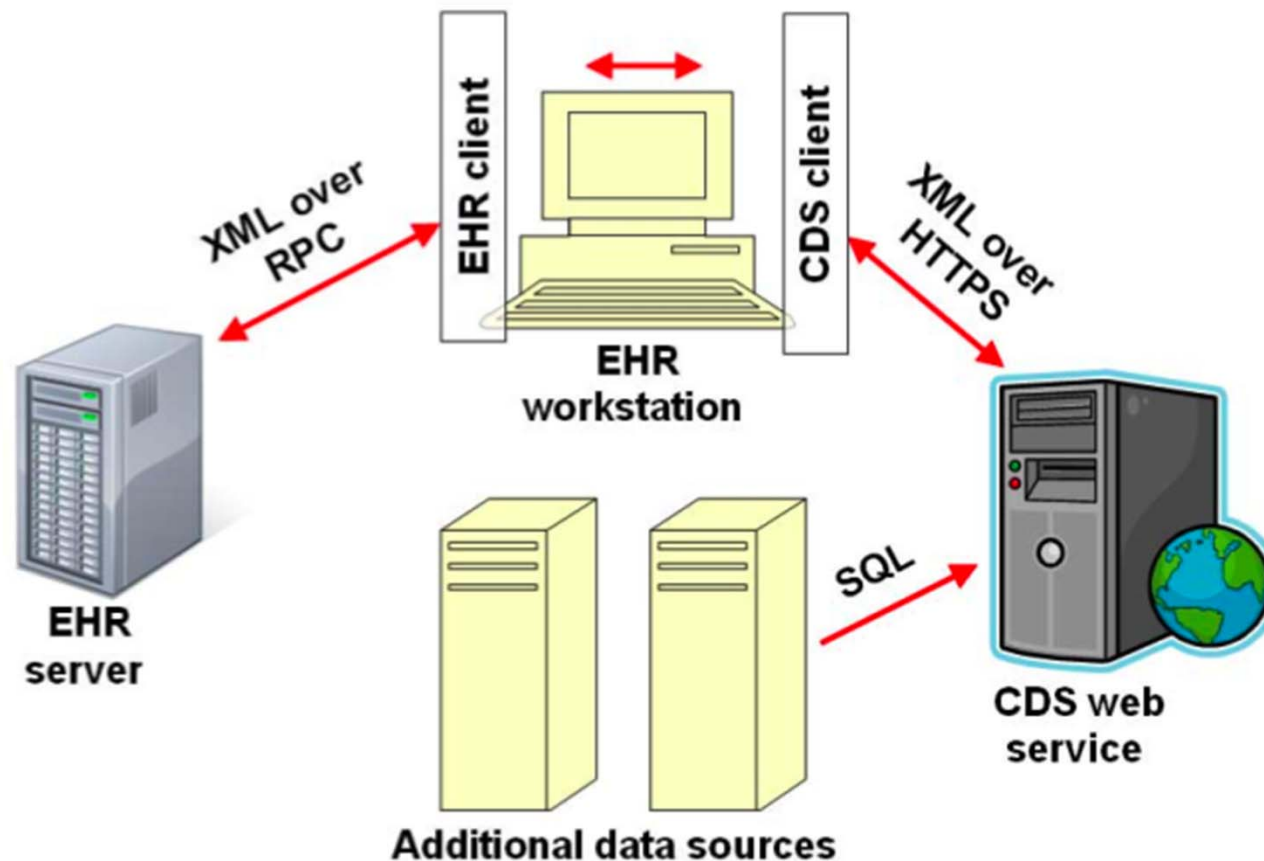
1 Hospital



Pediatric Research Consortium (PeRC) at CHOP

- System-wide EHR (Epic) to identify eligible participants, facilitate collection of data, and to allow implementation of decision support tools
- Over 638,000 total ambulatory visits in 2009 provided to about 200,000 patients
- 169 physicians and 22 nurse practitioners
- 39 active projects
- All practices currently participating in a minimum of 3 active research studies

Care Assistant: A Web-Service Framework



Web Service Components: EHR Server

- Process for registering the web services
 - URL of the service
 - Data “payload” to deliver
 - Specify data storage elements
- Data access methods
 - Billing and problem list diagnoses
 - Medications, orders, and immunizations
 - Flowsheet data, etc

Web Service Components: EHR Workstation

- Provides “Care Assistant” – a custom plug-in that can be inserted in the clinical workflow
 - In Epic terms: “Visit Navigator Section” and “Activity”
- Acts as a relay station to forward the “data payload” from the EHR server to the web service

Web Service Components: EHR Workstation

- Completely asynchronous – does not interrupt workflow
- Our style choice: no pop-ups – just prominent positioning
- Dynamic HTML methods are used to display the guideline content


Workstation Integration

- Care Assistant can provide links to launch
 - Order Sets
 - Standard reports
 - Data capture forms
 - Additional web services
- Our style choice: all data storage is provided by the EHR
 - The web-services are “stateless”

The Web Service Itself

- The Care Assistant framework as we have defined it is primarily a message protocol
- The web service itself:
 - Listens for “requests” to process data payloads (e.g. an immunization history)
 - Responds with HTML content, formatting, and JavaScript functionality to render the user interface (e.g. a forecast of upcoming immunizations)


Asthma Assistant



[Office Neb](#)
[Billing](#)
[Asthma PFE](#)

- ✔ **Control Tool:** [Filed today \(click to access form\)](#) Asthma Assessment:
previous asthma severity: **MILD-PERSISTENT**
symptoms indicate **MODERATE-PERSISTENT** severity based on:
asthma symptoms while asleep at night 1 OR 2 TIMES PER WEEK
- ✔ **Severity:** Mild-Persistent ([problem list noted 07/27/2010](#))
- ✔ **Tests:** [CXR: 11/20/2009](#)
- ⊖ **Medication:** [On treatment step #1: SABA only \(click for CCI SmartSet\)](#)
- ⊖ **Care Plan:** [not on file \(click to access form\)](#)

Immunization Assistant



Vaccines Due Now

Order Today

Next Doses: ★ **Coming Soon!** ★


- DTaP
- IPV
- Hib (4-dose)
- Pneumococcal Conjugate-13
- Hepatitis B
- MMR

Some vaccines not indicated

Diagnoses **VARICELLA** not indicated due to **POSTVARICELLA ENCEPHALITIS**

Resources [ACIP schedule](#) [Catch-up schedule](#) [VIS-multiple languages](#)

Growth and Development Assistants

		Height	%ile	My confidence in parent response			height not known
				very confident	close estimate	large guess	
	<input checked="" type="checkbox"/> Mother:	<input)"="" type="text" value="160 cm (5' 3"/>	= 30%	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input checked="" type="checkbox"/> Father:	<input)"="" type="text" value="173 cm (5' 8"/>	= 28%	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Mid-Parent:	173 cm (5' 8.1")	= 29%				
	Patient:	84 cm (2' 9")	= 17%				

	Study Arm:	TEDES PCP arm, developmental screening due:
<input checked="" type="checkbox"/>	ASQ:	filed today (click to access form) FAILED: Gross motor ; PASSED: Communication, Fine motor, Problem solving, Personal-social
<input checked="" type="checkbox"/>	MCHAT:	(click to file new form)

From Guideline to Executable Rules via GEM

- Retinopathy of prematurity guidelines
 - Section on Ophthalmology, American Academy of Pediatrics
 - American Academy of Ophthalmology
 - American Association for Pediatric Ophthalmology and Strabismus
 - Pediatrics 2006

Retinopathy of Prematurity

Infants with a birth weight of less than 1500 g or gestational age of 32 weeks or less (as defined by the attending neonatologist) and selected infants with a birth weight between 1500 and 2000 g or gestational age of more than 32 weeks with an unstable clinical course, including those requiring cardiorespiratory support and who are believed by their attending pediatrician or neonatologist to be at high risk, should have retinal screening examinations performed after pupillary dilation using binocular indirect ophthalmoscopy to detect ROP. One examination is sufficient only if it unequivocally shows the retina to be fully vascularized in each eye. Effort should be made to minimize the discomfort and systemic effect of this examination by pretreatment of the eyes with a topical anesthetic agent such as proparacaine; consideration also may be given to the use of pacifiers, oral sucrose, etc.

Part I: Not So Bad

Conditional: Infants with a birth weight of less than 1500 g or gestational age of 30 weeks or less (as defined by the attending neonatologist)

Decision Variable: birth weight

Value: less than 1500 g

Value: between 1500 and 2000 g

Decision Variable: gestational age

Value: 32 weeks or less

Value: more than 32 weeks

Action: should have retinal screening examinations performed

Reason: to detect ROP.

Logic: If birth weight \leq 1500 g AND gestational age \leq 30 weeks) Then should have retinal screening

Rules for Part I: Not So Bad! 😊

```
use recommend(rop_screen,$explain)
when
  birth_weight_gram($wt)
  check $wt < 1500
  $explain = "birth weight: " + str($wt) + "g"
```

```
use recommend(rop_screen,$explain)
when
  gestational_age_weeks($ga)
  check $ga < 33
  $explain = "gestational age: " + str($wt)
```

But Did You Notice? Gestation age 30 vs 32

- Guideline wording: “32 weeks or less”
 - We interpret as < 33 weeks (or $\leq 32 \frac{6}{7}$)
- Supporting table footnotes gestational age 31 and 32 weeks with the words
“[screen] if necessary”

Part II: Weasel Words

Conditional: birth weight between 1500 and 2000 g or gestational age of more than 30 weeks with an unstable clinical course, including those requiring cardiorespiratory support and who are believed by their attending pediatrician or neonatologist to be at high risk, should have retinal screening examinations performed after pupillary dilation using binocular indirect ophthalmoscopy to detect ROP.

Decision Variable: birth weight between 1500 and 2000 g

Decision Variable: gestational age of more than 30 weeks

Decision Variable: unstable clinical course

Decision Variable: requiring cardiorespiratory support

Decision Variable: who are believed by their attending pediatrician or neonatologist to be at high risk

Action: should have retinal screening examinations performed after pupillary dilation

Reason: To detect ROP

Logic: If ((birth weight > 1500 AND birth weight < 2000 g) AND gestational age > 30 weeks) AND unstable clinical course AND requiring cardiorespiratory support AND who are believed by their attending pediatrician or neonatologist to be at high risk Then should have retinal screening examinations performed after pupillary dilation

Rules for Part II: A Work in Progress

```
use recommend(rop_screen,$explain)
when
  birth_weight_gram($wt)
  check $wt >= 1500 and $wt <= 2000
  retinopathy_risk($risk)
  $explain = "birth weight: " + str($wt) + "g, and " + str($risk)

use retinopathy_risk("cardio respiratory support")
when
  ventilator_days($vent_time)
  check $vent_time > ???

use retinopathy_risk("unstable course")
when ???
```

Mutually Exclusive Criteria

- The guideline attempts to define two non-overlapping sets
 - $BW < 1500$ or $GA \leq 30$ or... 32 (depending on where you look in the guideline)
- vs.
- $BW 1500$ to 2000 or $GA > 30$
- They probably meant:
 - Cohort #1: $BW < 1500$ or $GA \leq 30 \frac{6}{7}$
 - Cohort #2: $BW 1500$ to 2000 and not in cohort 1

AND vs. OR

- Normal humans use “AND” to imply the union of two sets
 - Infants with gestational age 30 or less **AND** infants with birth weight under 1500 grams are at risk
- Programmers use “OR” to imply union
 - If (GA < 31 **OR** BW < 1500)
then recommend(ROP_SCREEN)