

# Immunization Reporting and Clinical Decision Support via SOA

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## Introduction

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- Public health agencies have unique assets (e.g. data and algorithms) that can and should be leveraged via SOA by other healthcare organizations and systems.
- This project was is an example of how this can be done by exposing existing capabilities as web services.

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## Providers Are Struggling to Keep Their Patients Up-To-Date on Their Immunizations

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## Challenges for Providers

- Patients change providers and/or have multiple providers
- Documentation of immunization history is fragmented
- Complicated & changing immunization rules
- Difficult to ensure that patients complete their immunizations

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## Providers Need to Avoid...

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- Missed opportunities to provide needed immunizations
- Duplicate/unnecessary immunizations
- Vaccine preventable disease/death

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## Immunization Registries Can Help

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## Mission of the Citywide Immunization Registry (CIR)

“To improve the immunization status of all NYC children by consolidating immunization information and sharing it with health care providers, families, and agencies concerned with children's health.”

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## Unique Benefits of the CIR

- Consolidated Immunization Histories
  - 3.6m patient records
  - 40.5m immunization records
- Clinical Decision Support
  - For 13 routinely administered vaccines
  - Evaluations (e.g. was the immunization valid?)
  - Recommendations (e.g. when is next dose due?)
  - Implementation of 50+ pages of rules
  - Updated for new vaccines, changing guidelines

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Event	1	2	3	4	Next Due
<b>HepB</b> 4 Event/s	09/07/2006 HepB (+20 yrs 3-dose) 0w 0d	09/07/2006 Hib/HepB (COMVAX) 13w 1d	11/20/2006 DTaP/HepB/IPV (Pediarix) 23w 5d	03/22/2007 DTaP/HepB/IPV (Pediarix) 9m 2w	Completed Vaccine Series
<b>Rotavirus</b> 3 Event/s	09/07/2006 Rotavirus RV5 (RotaTeq, 3 dose) 13w 1d	11/20/2006 Rotavirus RV5 (RotaTeq, 3 dose) 23w 5d	03/22/2007 Rotavirus RV5 (RotaTeq, 3 dose) 9m 2w		Not recommended after 33 weeks
<b>DTP</b> 5 Event/s	09/07/2006 DTaP 13w 1d	10/20/2006 DTaP 19w 2d	11/20/2006 DTaP/HepB/IPV (Pediarix) 23w 5d	03/22/2007 DTaP/HepB/IPV (Pediarix) 9m 2w	06/07/2010 DTaP
<b>Hib</b> 3 Event/s	09/07/2006 Hib/HepB (COMVAX) 13w 1d	11/20/2006 Hib-PRP-OMP (PedvaxHIB) 23w 5d	07/11/2007 Hib-PRP-OMP (PedvaxHIB) 13m 0w		Completed Vaccine Series
<b>Pneumo. Conjugate</b> 4 Event/s	09/07/2006 Pneumococcal conjugate (Prevnar) 13w 1d	11/20/2006 Pneumococcal conjugate (Prevnar) 23w 5d	03/22/2007 Pneumococcal conjugate (Prevnar) 9m 2w	07/11/2007 Pneumococcal conjugate (Prevnar) 13m 0w	Completed Vaccine Series
<b>Polio</b> 3 Event/s	10/20/2006 IPV 19w 2d	11/20/2006 DTaP/HepB/IPV (Pediarix) 23w 5d	03/22/2007 DTaP/HepB/IPV (Pediarix) 9m 2w		06/07/2010 IPV
<b>Influenza</b> 1 Event/s	11/20/2006 Influenza-injectable 23w 5d				DUE NOW Influenza-injectable
<b>MMR</b> 1 Event/s	07/11/2007 MMR 13m 0w				06/07/2010 MMR
<b>Varicella</b> 1 Event/s	05/31/2007 Disease/Immunity Reported				Completed Vaccine Series
<b>HepA</b> 0 Event/s					Recommended for high risk groups
<b>Meningococcal</b> 0 Event/s					06/07/2017 Mening conj (MCV4 Menactra 2-55 yrs.)
<b>Human Papilloma Virus</b> 0 Event/s					Not recommended for males

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## Problem: Integrating the CIR into the Clinical Setting

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## Traditional Mechanisms for Accessing the CIR

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- Web application
  - May not fit well into provider's workflow
  - Provider may not receive decision support until after the patient was treated
  - Requires duplicate data entry into medical chart and web application
- Electronic files, manually extracted by CIR staff
  - Primarily used by MCO's
  - Data quickly becomes out of date
  - Difficult to make use of

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## Adoption of EHR Systems Presents an Opportunity!

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## New York City Launches the (PCIP) Primary Care Information Project

“Supports the adoption and use of Electronic Health Records (EHRs) among primary care providers in NYC's underserved communities. Its mission is to improve population health through appropriate technology and health information exchange.”

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## PCIP's EHR System

- PCIP is enhancing a commercial EHR-S
- The new EHR-S addresses public health goals such as preventing disease, managing chronic disease
- PCIP provides licenses, training, support to providers who have >30% of patients on Medicaid or uninsured
- Other providers can buy the EHR-S
- 1,700 providers have signed up
- >750 providers have gone live

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## The Vision for CIR / EHR-S Integration

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- EHR-S automatically reports the patient's immunization history to the CIR
- EHR-S automatically obtains the patient's *consolidated* immunization history and clinical decision support from the CIR in real time
- EHR-S automatically adds any *missing* immunization history to the patient's EHR and presents the decision support to the provider at the time of treatment
- EHR-S automatically reports any *new* immunizations to the CIR

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Solution:  
Expose the CIR's Unique Capabilities  
as Web Services

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## The CIR Web Services

- Get Immunization History and Clinical Decision Support
- Report New Immunizations

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## Standards

Transport	■ SOAP
Messaging	■ HL7 2.3.1
Semantics	■ CIR Implementation Guide ■ CDC Implementation Guide ■ CDC Codebook

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## Service #1: Get Immunization History and Clinical Decision Support

- Parses standard HL7 VXQ message and retrieves patient identifying information
- Performs deterministic search for the patient
- If necessary, performs probabilistic search for the patient using AI search engine
- Gets patient's immunization history and calculates the evaluations of those immunizations
- Calculates patient's recommendations for all 13 routinely administered vaccines
- Constructs HL7 response message

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## Service #2: Report New Immunizations

- Parses standard HL7 VXU message and retrieves patient identifying information
- Validates all of the demographic data
- Performs deterministic search for the patient
- If necessary, performs probabilistic search for the patient using AI search engine
- If necessary, creates a new patient record in the CIR, otherwise updates patient demographic data in the CIR
- Validates all of the immunization data
- Inserts into the CIR any immunizations for which there is not already a record
- Constructs HL7 acknowledgement or error message

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## Implementation of the CIR Web Services

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## Architecture

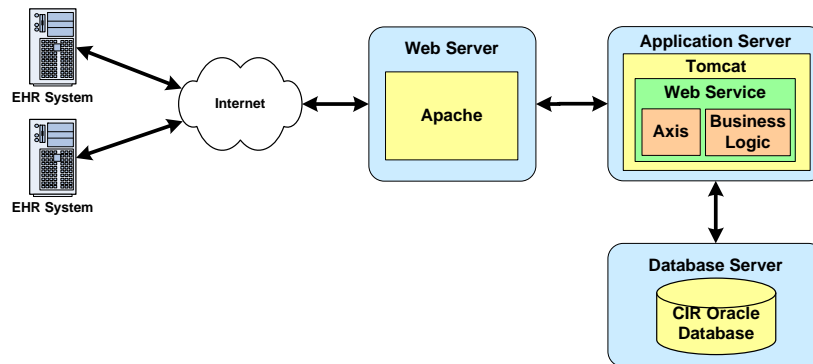
Components	
Web Server	Apache
Application Server	Tomcat
SOAP Implementation	AXIS
Business Logic	Java & Stored Procedures
Database Server	Oracle

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## Architecture (part 2)



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## Implementation Process

- Created WSDL for the services
- AXIS automatically generated skeleton java classes
- Implemented the public methods of those classes to process the SOAP calls

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## SOAP Communication Automatically Handled by AXIS

- Receives and parses SOAP call
- Invokes the java methods that were indicated by the SOAP call and defined by the CIR's WSDL
- Wraps the raw response of the java method within a valid SOAP response
- Transmits the SOAP response back to the initiating system that originated the SOAP call
- Note: This is a synchronous process

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## Implementation Process (part 2)

- Wove together the execution of previously existing functions
  - Searching for the matching patient
  - Loading immunization history
  - Calculating clinical decision support
- Created/expanded middle tier objects for data validation and business logic

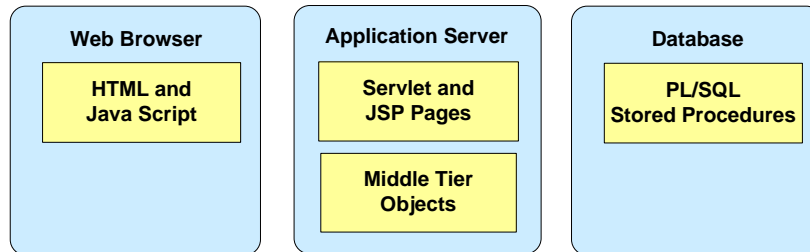
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## CIR's Distributed Data Validation and Business Logic



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## Deployment of the CIR Web Services

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## Completed Activities

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- ✓ Requirements
- ✓ Design Document
- ✓ Implementation
- ✓ System Testing
- ✓ Integration Guide

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## Next Steps

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- EHR-S vendors are integrating their systems with the HL7 Web Service
- Vendors and providers are testing the EHR-S systems
- CIR staff will review the quality of the submitted data
- CIR will authorize provider facilities to begin submitting production data via the Web Service

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## Providers/EHR-S Integrating with the CIR Web Services

EHR-S	Providers
eClinicalWorks	Primary Care Information Project
Epic	Institute for Urban Family Health
Office Practicum	<i>various</i>
	Columbia Presbyterian Hospital

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## Lessons Learned

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## Build Loosely Coupled Systems

- The effort required to expose existing capabilities as services is proportional to the degree of coupling with other applications
- Data validation and business logic that was tightly coupled with one web application, had to be either recreated or re-factored
- Plan for an SOA future - Build loosely coupled systems with true middle tiers
- Database stored procedures can be highly reusable as well

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## Leverage Existing Standards for Semantic Interoperability

- Availability of standards?
- Which one do you choose?
- Commitment by all parties to conform
- Beware: standards change...

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## Develop a Clear, Detailed Integration Guide

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- Made a large investment creating a very detailed Integration Guide
- Critical resource for
  - partners who integrate with the web services
  - internal testers of the services
- Constantly growing and improving
- EHR-S integrating with the web services have needed very little additional support!
- Worth the effort

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