



# **Immunization Information System Web Services**

**Real-time integration using Microsoft .net  
software development technologies**

# Outline

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- **Define real-time**
- **Where are IISs now?**
- **How does real-time Web Service integration increase value of IIS data exchange?**
- **NYC model for real-time integration and results**
- **What technologies do IISs, EHRs, and other partners need for real-time integration benefits?**
- **Future work**

# Define real-time

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- **Car brakes as real-time computing example** ([http://en.wikipedia.org/wiki/Real-time\\_computing](http://en.wikipedia.org/wiki/Real-time_computing))
- **Akamai and JupiterResearch showed 4 second response time is threshold for web application user experience**  
([http://www.akamai.com/html/about/press/releases/2006/press\\_110606.html](http://www.akamai.com/html/about/press/releases/2006/press_110606.html))
- **In NYC real-time Web Service requires response time of less than 3 seconds to process a single HL7 message**

# Immunization Information Systems (IISs) today

## File transfers for data exchange with partner systems

- Manual and automated for reporting and querying
- Query primarily used by HMOs/MCOs
- Data from IISs not typically imported by partner
- EHR users don't typically have access to clinically significant data from IIS

## Web applications for real-time searching and reporting

- If provider has EHR , they have to open registry Web application
- Real-time reporting, query, and decision support
- Added-value functions in IIS Web applications for each jurisdiction

# How does real-time Web Service integration increase value of IIS data exchange?

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Provide value of IIS Web application within EHRs and other partner systems

- Real-time reporting, querying and decision support
- Similar to existing registry web application functions, within EHR or partner system
- All immunization clinical work done within EHR or partner application workflow

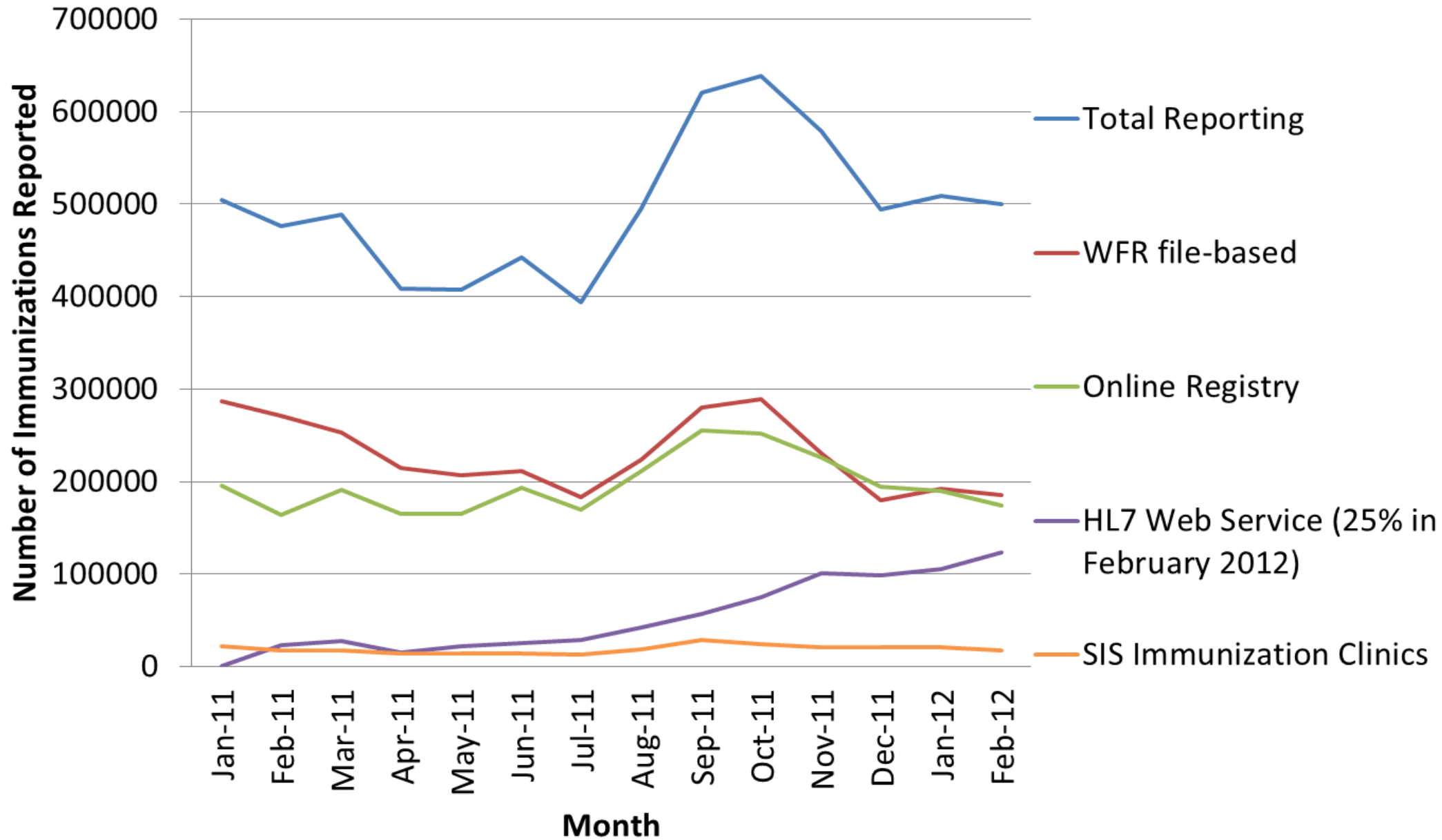
# Model for real-time reporting in NYC

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- **Require integration with real-time HL7 Web Service for "meaningful use" incentive**
- **Implement real-time reporting at EHR first, then phase in enhanced EHR at facilities/providers**
- **Preparing to implement Transport Layer Expert Panel standard for HL7 message delivery**

# NYC CIR Immunization Reporting Methods

## January 2011 to February 2012



# Model for real-time queries in NYC

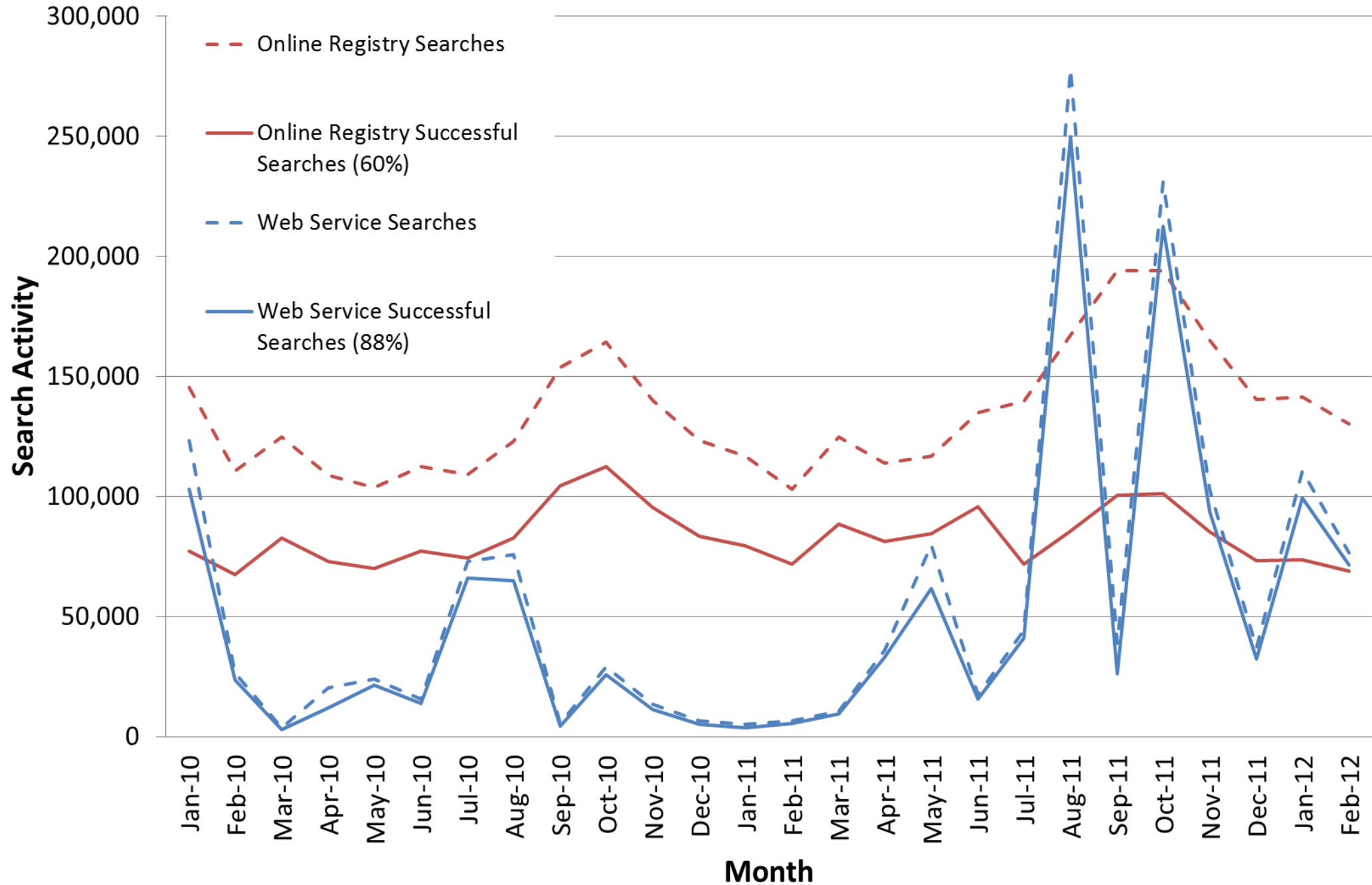
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- **The NYC Regional Extension Center, Primary Care Information Project (PCIP) EHR vendor contract requires querying**
- **Columbia Presbyterian hospital network and Addabbo FQHC chose real-time queries**
- **NYC Department of Education chose real-time queries**
- **HL7 query service combines all submitted data in searches to identify unique match**

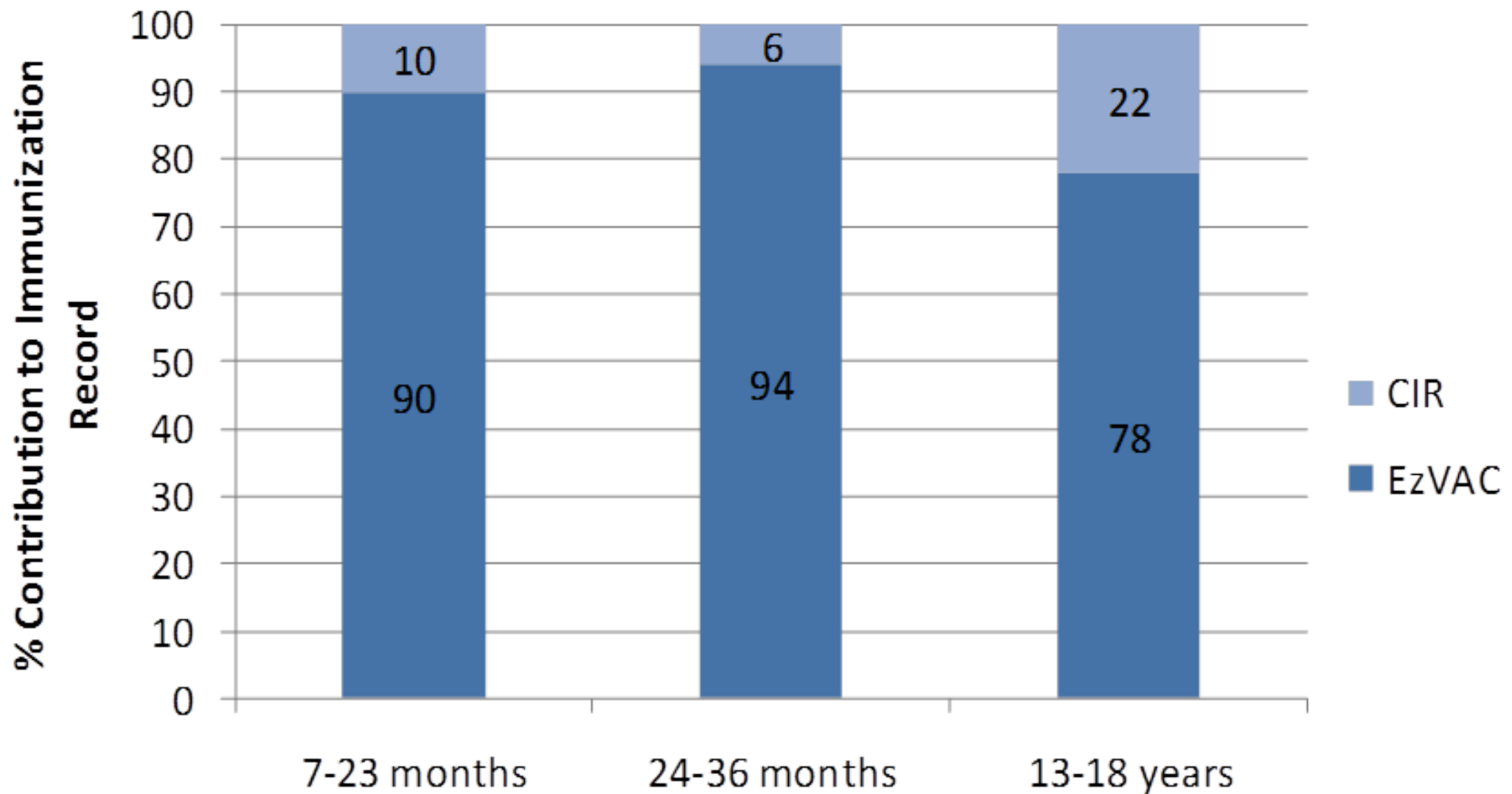


# NYC CIR Real-Time Search Activity Comparison

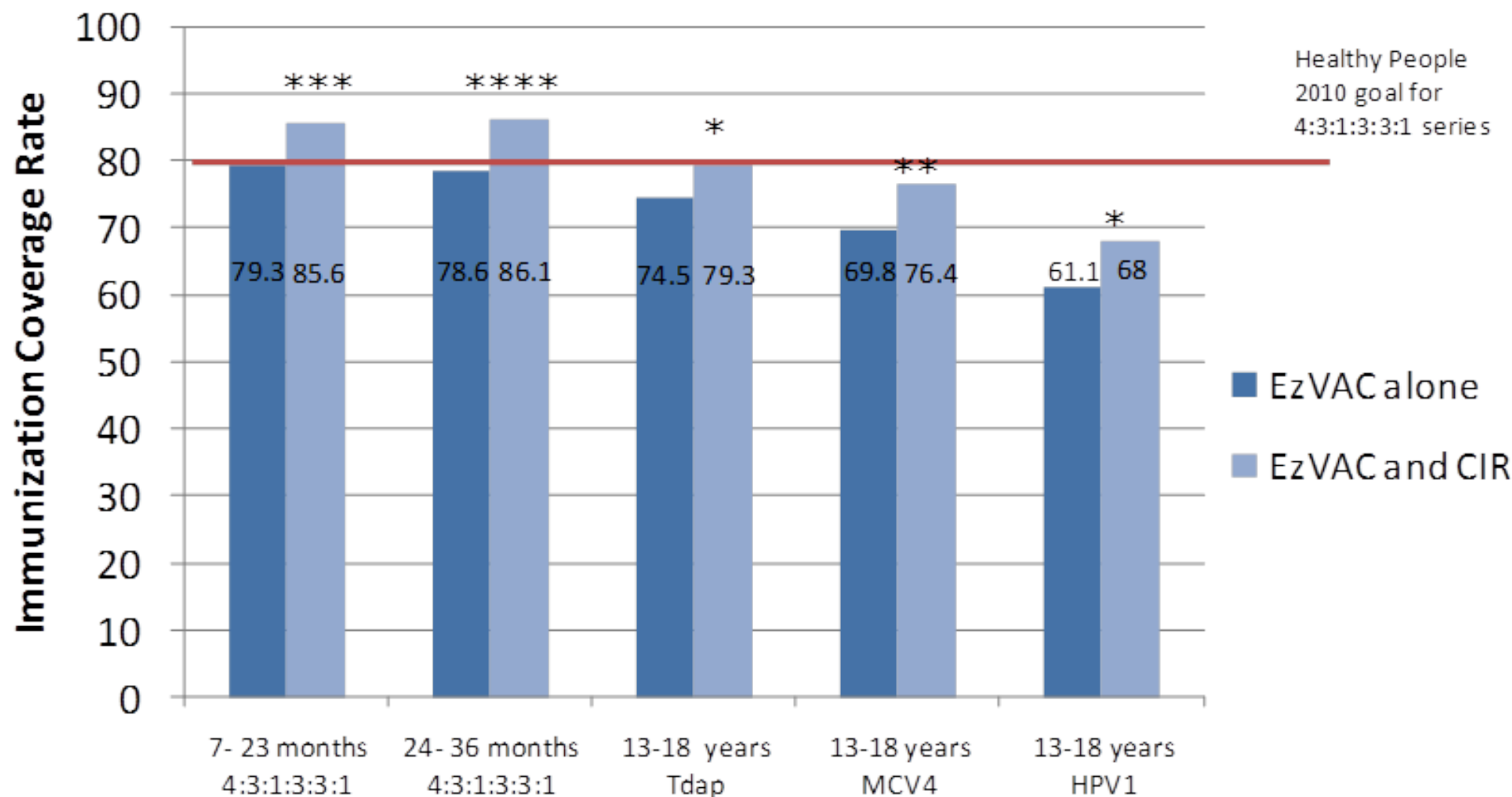
## January 2010 - February 2012



## Real-time Web Service contribution to records in Columbia Presbyterian's Healthcare Network



# Impact of real-time Web Service Integration on documented immunization coverage rate in Columbia Presbyterian's Healthcare Network



\* P < 0.05; \*\* P < 0.01; \*\*\* P < .001; \*\*\*\* P < .0001

Stockwell, et al, 2010.

<http://cdc.confex.com/cdc/nic2010/recordingredirect.cgi/id/6746>

# IIS real-time Web service implementation

# What do IISs need to implement to benefit from real-time integration?

- **At minimum real-time HL7 VXU and VXQ or QBP messages over Web Services**
- **Use the CDC Transport Layer Expert Panel (TLEP) standard Web Service interface**
  - **Supports all HL7 v2 messages**
  - **Interoperability tested between Microsoft's .net and Oracle's Java technologies**
  - **Helps streamline implementation with EHRs**
- **Development resources for data exchange partners:**
  - **IIS Web service integration guide**
  - **Code samples**
  - **Support staff**
  - **Regular calls and E-mails with EHRs and other partners**

# Implement IIS Web Service using Microsoft's .net framework technologies Using Web Service Description Language

Use TLEP WSDL to generate web service prototype

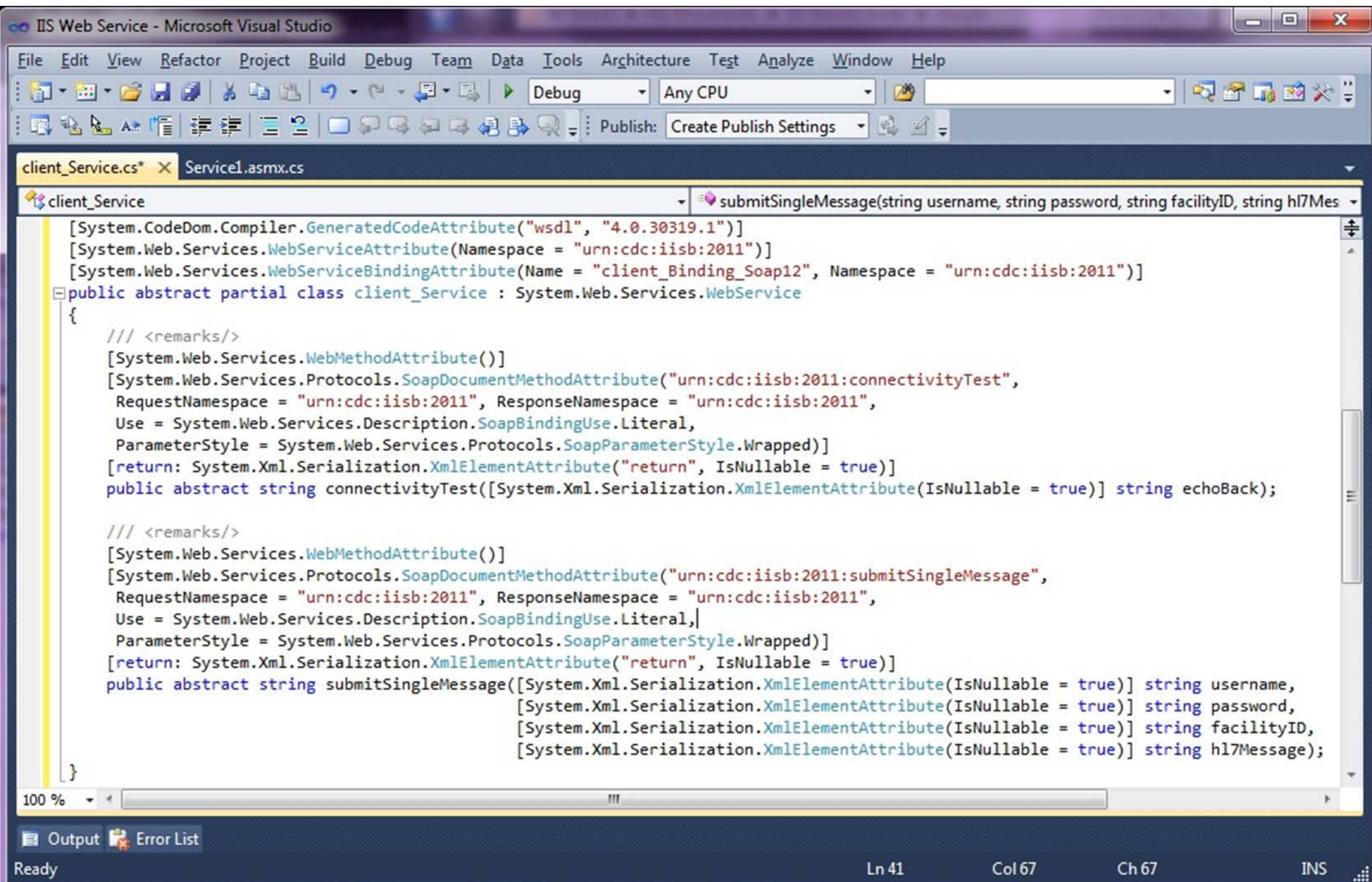
WSDL generates web service method stubs

- `wsdl <url or path of wsdl file> /language: /server`
  - `/language:` specifies the language to use for the generated proxy/stub class. Choose from CS, VB, JS, VJS. Default is CS (C#)
  - `/server:` generates an abstract class for an XML web service implementation. Default is to generate client proxy classes.

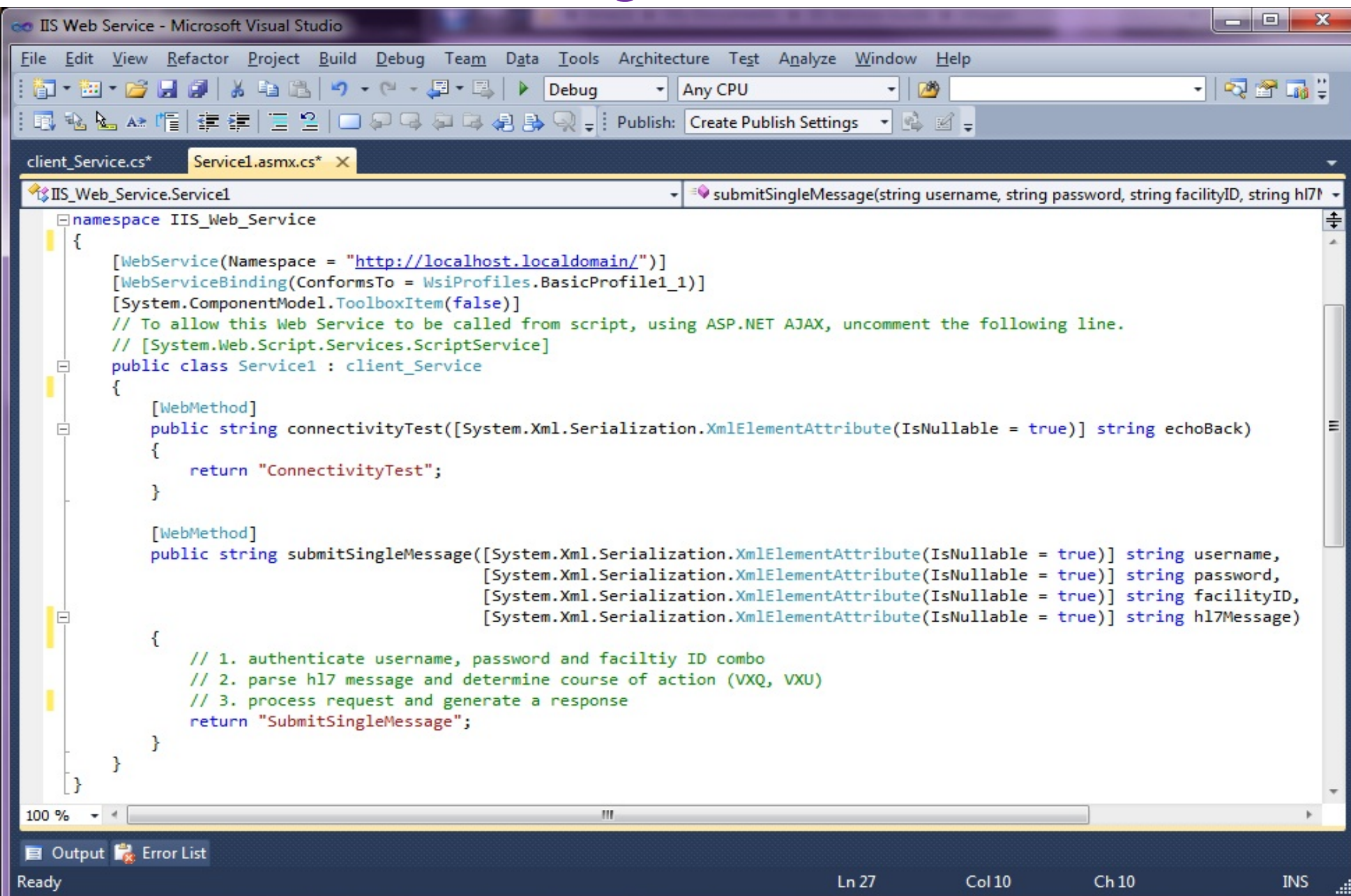
`wsdl http://openimmunizationsoftware.us:6394/ImmMessagingServer/client\_Service?wsdl /language:CS /server`



# Implement IIS Web service using Microsoft's .net framework technologies - Stubs in abstract class



# IIS Web Service implementation using Microsoft's .net framework technologies - Function definitions





# EHR and other partner system real-time integration with IIS Web service

# What do EHRs need to implement?

- **At minimum, HL7 VXU messages, preferably in real-time (Meaningful Use phase 1)**
- **Recommend HL7 VXQ or QBP messages**
  - **In NYC, half of all sites reporting via HL7 Web service also use it to query in real-time**
  - **Meaningful Use phase 3 draft requires IIS query**
  - **Most of the work is display and reconcile EHR and IIS data**
- **CDC TLEP standard interface reduces work on EHR side.**

# Integrating EHR with IIS

## New patient, provider queries IIS

Sign Out

Search Patient
Need Help? Click for Live Support Online now

Waiting Room
MOUSE, MIGHTY

Patient Home
Close

**MOUSE, MIGHTY** (01/20/2003 9y Female)
 Attending:
Referral:
Allergy

Save
Refresh
Follow Up Action
Return
Change Specialty(Internal Medicine)

Patient Home
Visit History
Medical History
Payment/Account
Message

**Vaccine**

New Vaccine
Past Vaccine
Vaccine Inventory
Record Up/Download
Delete Selected
Select All Vaccines

Vaccine Group	1	4	5	6	Next Due
DTaP/DT/Td/Tdap	<div> Upload Selected Vaccines  Download All Vaccines  View Up/Download History  Vaccine File  Njiis File  FLSHOTS File  ImmTrac File  VIIS File  NYSIIS File  CIR File Form  IMMUNET File  NewJersey File </div>				
H1N1 Influenza					
Hep A					
Hep B					
Hib					
HPV					
Influenza					
Meningococcal					
MMR/Measles/Rubella					
Pneumococcal					
Pneumococcal PPV					
Polio					

# “Thanks again...a lot...such a wonderful feature for downloading and uploading Vaccines.”

## –Pediatrician using this EHR

Sign Out

Search Patient
Need Help? Click for Live Support Online now

Waiting Room
MOUSE, MIGHTY

Patient Home
Close

**MOUSE, MIGHTY** (01/20/2003 9y Female)
 Attending:
Referral:
Allergy

Save
Refresh
Follow Up Action
Return
Change Specialty(Internal Medicine)

Patient Home
Visit History
Medical History
Payment/Account
Message

**Vaccine**
Last CIR Upload: 2012-02-21(Today)

New Vaccine
Past Vaccine
Vaccine Inventory
Record Up/Download
Delete Selected
Select All Vaccines

Vaccine Group	1	2	3	4	5	6		Next Due
<b>DTaP/DT/Td/Tdap</b>	<b>11/01/2004</b> DTaP (20)	<b>02/04/2005</b> DTaP-Hep B-... (110)	<b>11/01/2005</b> DTaP-Hep B-... (110)	<b>12/02/2005</b> DTP-Hib (22)	<b>12/02/2005</b> Td (adult),... (09) <span>!</span>	<b>10/24/2011</b> Tdap (115)		<b>01/20/2014</b> Td (adult),... (09)
<b>H1N1 Influenza</b> No longer recommended								
<b>Hep A</b> Completed Vaccine Series	<b>02/03/2007</b> Hep A, ped/... (83)	<b>02/25/2007</b> Hep A, ped/... (83) <span>!</span>						
<b>Hep B</b> Completed Vaccine Series	<b>01/20/2003</b> Hep B (45)	<b>02/20/2003</b> Hep B Peds ... (08)	<b>02/04/2005</b> DTaP-Hep B-... (110)	<b>10/27/2005</b> Hib-Hep B (51)	<b>11/01/2005</b> DTaP-Hep B-... (110)	<b>12/02/2005</b> Hep B, adul... (43) <span>!</span>		
<b>Hib</b> Completed Vaccine Series	<b>10/27/2005</b> Hib-Hep B (51)	<b>12/02/2005</b> DTP-Hib (22)	<b>12/02/2005</b> Hib (PRP-OM... (49) <span>!</span>	<b>05/10/2006</b> Hib (17) <span>!</span>				
<b>HPV</b> May be given on/after								<b>01/20/2012</b> HPV (137)
<b>Influenza</b>	<b>11/04/2005</b> influenza, ... (15)	<b>11/03/2007</b> influenza, ... (111)	<b>11/07/2011</b> influenza, ... (111)					<b>09/01/2012</b> influenza (88)
<b>Meningococcal</b> Recommended for high risk groups								<b>01/21/2019</b> meningococc... (114)
<b>MMR/Measles/Rubella</b>								
<b>Pneumococcal</b> Not generally recommended at/after 5 years								
<b>Pneumococcal PPV</b>								<b>01/20/2068</b> pneumococca... (33)
<b>Polio</b>	<b>02/04/2005</b>	<b>11/01/2005</b>						

# Reconcile EHR record with IIS

[F8] Patient Chart: MICKEY MOUSE (4512) Sex: M DOB: 01/04/1997 Age: 15 yrs. 1 mos.

Choose

No privacy restrictions noted

Include confidential items

Overview

Quick Entry

Sync Registry

Consent Form

Enter Immunization

Synchronize Immunization Records

Import

Send

Reconcile

Delete

Refresh

Select

UnSelect

Ping

Exit

Immunizations

Indicators

IIS Forecast

Chart Demographics

Sel	Vaccine Name	Family	CVX	Vac Date	Chart/Registry Match	Site	Route	VFC	Prov	Staff
<input checked="" type="checkbox"/>	ANTHRAX	ANTHRAX	24	01/01/2008	In Chart, NOT Registry			9	0	305
<input type="checkbox"/>	DTP	DTP	01	04/01/1997	In Registry, NOT Chart			9	0	305
<input type="checkbox"/>	DTP	DTP	01	05/29/1997	In Registry, NOT Chart			9	0	305
<input type="checkbox"/>	DTP	DTP	01	02/25/2000	In Registry, NOT Chart			9	0	305
<input type="checkbox"/>	DTP/HIB	DTP/HIB	22	02/11/1998	In Registry, NOT Chart			9	0	305
<input type="checkbox"/>	DTaP-HIB-IPV		120	07/01/2011	In Registry, NOT Chart			9	0	0
<input type="checkbox"/>	DTaP-HepB-IPV+	PEDIARIX	110	01/29/2010	In Registry, NOT Chart			9	0	305
<input type="checkbox"/>	FLU - 3yrs+	FLU 4yr+	15	01/28/2012	In Registry, NOT Chart			9	0	305
<input type="checkbox"/>	HIB	HIB	17	04/01/1997	In Registry, NOT Chart			9	0	305
<input type="checkbox"/>	HIB	HIB	17	05/29/1997	In Registry, NOT Chart			9	0	305
<input type="checkbox"/>	HIB	HIB	17	02/28/2000	In Registry, NOT Chart			9	0	305
<input type="checkbox"/>	HepA Adult,NOS		85	02/24/2012	In Registry, NOT Chart			9	0	305
<input type="checkbox"/>	HepA Ped,NOS		31	02/24/2012	In Registry, NOT Chart			9	0	305
<input type="checkbox"/>	HepB	HEPB	08	01/14/1997	In Registry, NOT Chart			9	0	305
<input type="checkbox"/>	HepB	HEPB	08	04/01/1997	In Registry, NOT Chart			9	0	305
<input type="checkbox"/>	HepB	HEPB	08	08/29/1997	In Registry, NOT Chart			9	0	305
<input type="checkbox"/>	HepB Dialysis	HEPB	44	02/24/2012	In Registry, NOT Chart			9	0	305
<input type="checkbox"/>	MMR	MMR	03	02/25/2000	In Registry, NOT Chart			9	0	0
<input type="checkbox"/>	OPV	OPV	02	04/01/1997	In Registry, NOT Chart			9	0	305
<input type="checkbox"/>	OPV	OPV	02	05/29/1997	In Registry, NOT Chart			9	0	305
<input type="checkbox"/>	RotaVirus	ROTAVIRU	116	04/21/2006	In Registry, NOT Chart			9	0	305

Color Key:

Chart/Registry Match

In Chart, NOT in Registry

In Registry, NOT in Chart

Drop

Registry ID: 127926224

Show HL7

4512 MICKEY MOUSE [M] [DOB:01/04/1997 Age DOV:15 yrs. 1 mos.] SELF-PAY

# Import selected IIS vaccines into EHR

[F8] Patient Chart: MICKEY MOUSE (4512) Sex: M DOB: 01/04/1997 Age: 15 yrs. 1 mos.

Synchronize Immunization Records

Import selected immunization records from registry into chart

Immunizations Indicators IIS Forecast Chart Demographics IIS Demographics

Sel	Vaccine Name	Family	CVX	Vac Date	Lot Number	Exp Date	Manuf	Site	Route	VFC	Prov	Staff
<input type="checkbox"/>	ANTHRAX	ANTHRAX	24	01/01/2008	1000		ALP			9	0	305
<input type="checkbox"/>	DTP	DTP	01	04/01/1997			UNK			9	0	305
<input type="checkbox"/>	DTP	DTP	01	05/29/1997			UNK			9	0	305
<input type="checkbox"/>	DTP	DTP	01	02/25/2000			UNK			9	0	305
<input type="checkbox"/>	DTP/HIB	DTP/HIB	22	02/11/1998	2345		MSD			9	0	305
<input checked="" type="checkbox"/>	DTaP-HIB-IPV		120	07/01/2011	112233		AD			9	0	0
<input type="checkbox"/>	DTaP-HepB-IPV+	PEDIARIX	110	01/29/2010	1122335577		BAH			9	0	305
<input type="checkbox"/>	FLU - 3yrs+	FLU 4yr+	15	01/28/2012						9	0	305
<input type="checkbox"/>	HIB	HIB	17	04/01/1997			UNK			9	0	305
<input type="checkbox"/>	HIB	HIB	17	05/29/1997			UNK			9	0	305
<input type="checkbox"/>	HIB	HIB	17	02/28/2000			UNK			9	0	305
<input type="checkbox"/>	HepA Adult,NOS		85	02/24/2012			UNK			9	0	305
<input type="checkbox"/>	HepA Ped,NOS		31	02/24/2012			UNK			9	0	305
<input type="checkbox"/>	HepB	HEPB	08	01/14/1997			UNK			9	0	305
<input type="checkbox"/>	HepB	HEPB	08	04/01/1997			UNK			9	0	305
<input type="checkbox"/>	HepB	HEPB	08	08/29/1997			UNK			9	0	305
<input type="checkbox"/>	HepB Dialysis	HEPB	44	02/24/2012			UNK			9	0	305
<input checked="" type="checkbox"/>	MMR	MMR	03	02/25/2000			UNK			9	0	0
<input type="checkbox"/>	OPV	OPV	02	04/01/1997			UNK			9	0	305
<input type="checkbox"/>	OPV	OPV	02	05/29/1997			UNK			9	0	305
<input type="checkbox"/>	RotaVirus	ROTAVIRU	116	04/21/2006			UNK			9	0	305

Color Key:     Registry ID: 127926224 ☐ Show HL7

4512 MICKEY MOUSE [M] [DOB:01/04/1997 Age DOV:15 yrs. 1 mos.] SELF-PAY



# Healthcare facility with incomplete record

Logout

Lookup by...  
[Record Number](#)  
[Name](#)

Enter...  
[New Vaccines/Shots](#)  
[Old Vaccine/Shots](#)  
[Height/Weight/HC](#)

View...  
[Immunizations](#)  
[Demographics](#)  
[Growth Charts](#)  
[Forms](#)  
[VIS Statements](#)

Change...  
[Vaccine Lot](#)  
[Facility](#)  
[Password](#)

Miscellaneous  
[Help](#)  
[Feedback](#)

Patient ID	Patient Name	DOB	Age	Facility Name	Org.
124850248	Duck Daffy	01/01/1996	16 yrs	Audubon Practice: Pediatrics	CPMC

Sync with CIR

Immunization History (Short View)  
Duck Daffy (124850248)

Short ViewLong View

Vaccine	Date Given	System
DTaP/DTP/Td		
HepB		
Hib		
Polio		
<a href="#">Polio (IPV)</a>	09/08/2010	Ezvac
Pneumo		
Rotavirus		
<a href="#">Rotarix (Rotavirus)</a>	02/28/2012	Ezvac
MMR		
Varicella		
HepA		
Influenza		
<a href="#">Influenza</a>	10/05/2010	Ezvac
<a href="#">Influenza</a>	02/28/2012	Ezvac
Human Reassortant Influenza (H1N1)		

PPD Measurements		
Date Given	Date Measured	Measurements

Karthik Natarajan - Audubon Practice: Pediatrics -- (02/28/2012)

“...the CIR synchronization has really made a significant impact on our patient care. We look forward to many more years continuing to work with you.” –Pediatrician using this EHR

<a href="#">Logout</a>
<b>Lookup by...</b> <a href="#">Record Number</a> <a href="#">Name</a>
<b>Enter...</b> <a href="#">New Vaccines/Shots</a> <a href="#">Old Vaccine/Shots</a> <a href="#">Height/Weight/HC</a>
<b>View...</b> <a href="#">Immunizations</a> <a href="#">Demographics</a> <a href="#">Growth Charts</a> <a href="#">Forms</a> <a href="#">VIS Statements</a>
<b>Change...</b> <a href="#">Vaccine Lot</a> <a href="#">Facility</a> <a href="#">Password</a>
<b>Miscellaneous</b> <a href="#">Help</a> <a href="#">Feedback</a>

Patient ID	Patient Name	DOB	Age
124850248	Daffy Duck	01/01/1996	16 yrs

<b>Polio</b>		
<a href="#">Polio (IPV)</a>	03/01/1996	Cir
<a href="#">Polio (IPV)</a>	05/01/1996	Cir
<a href="#">Polio (OPV)</a>	01/01/1997	Cir
<a href="#">Polio (IPV)</a>	09/08/2010	Ezvac
<b>Pneumo</b>		
<a href="#">Pneumo Polysaccharide</a>	02/25/2010	Cir
<a href="#">Pneumo Polysaccharide</a>	10/13/2010	Cir
<b>Rotavirus</b>		
<a href="#">Rotarix (Rotavirus)</a>	02/28/2012	Ezvac
<b>MMR</b>		
<a href="#">MMR</a>	01/01/1997	Cir
<a href="#">MMR</a>	09/09/2010	Cir
<a href="#">MMR</a>	10/13/2010	Cir
<b>Varicella</b>		
<a href="#">Varicella</a>	05/01/1996	Cir
<a href="#">Varicella</a>	09/09/2010	Cir
<b>HepA</b>		
<a href="#">Hep A (ADULT ONLY)</a>	02/25/2010	Cir
<b>Influenza</b>		
<a href="#">Influenza - unspecified</a>	01/10/2007	Cir
<a href="#">Influenza</a>	10/05/2010	Ezvac
<a href="#">Influenza</a>	02/28/2012	Ezvac



# EHR work to integrate with Web Service

## Add Web Reference

Add Web Reference

Navigate to a web service URL and click Add Reference to add all the available services.

URL:

**"client\_Service" Description**

**Methods**

- **connectivityTest** ( *connectivityTest* As *connectivityTestRequestType* ) As *connectivityTestResponseType*  
the connectivity test
- **submitSingleMessage** ( *submitSingleMessage* As *submitSingleMessageRequestType* ) As *submitSingleMessageResponseType*  
submit single message

Web services found at this URL:

1 Service Found:

- client\_Service

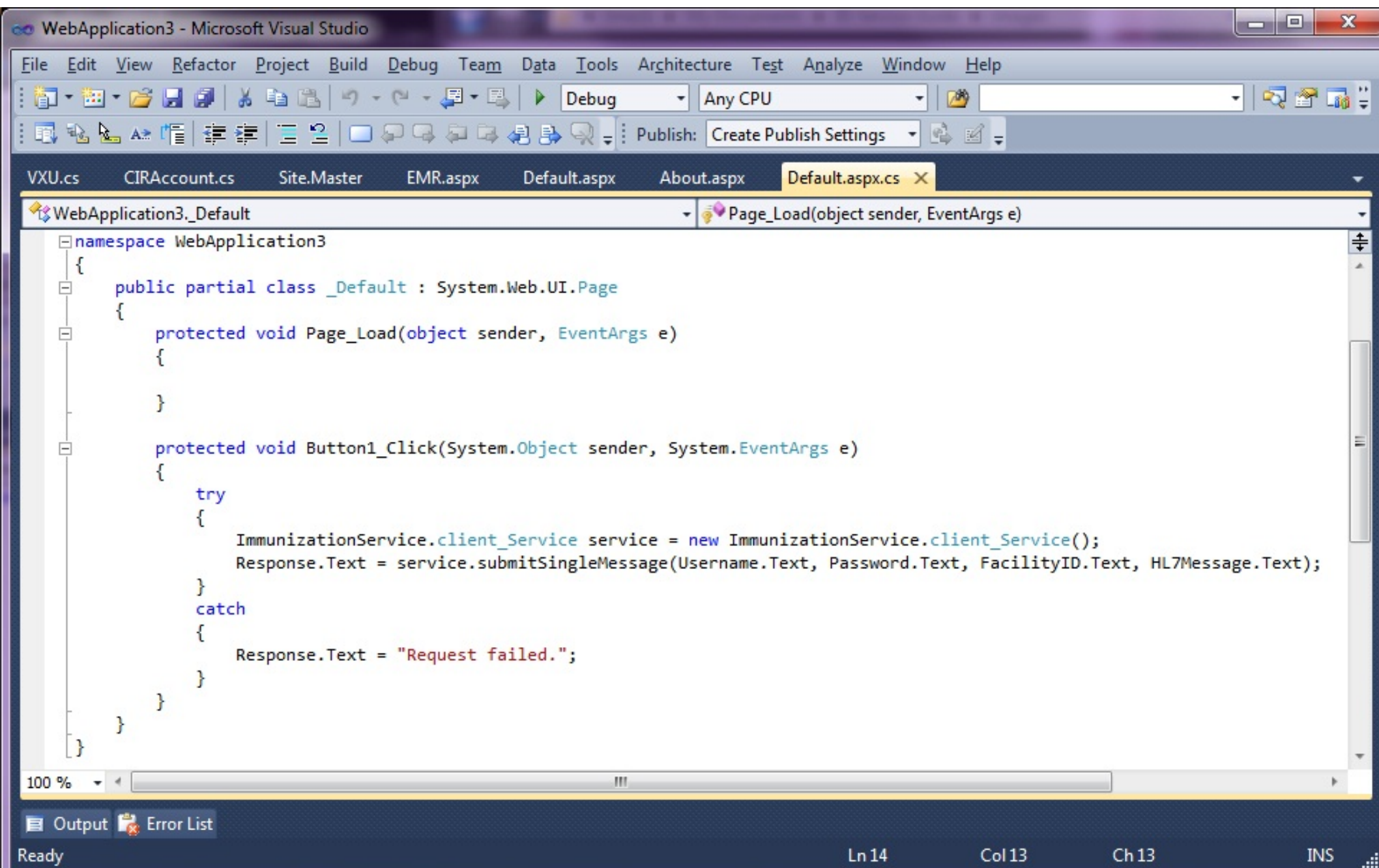
Web reference name:

**Add Reference**

Cancel

# EHR work to integrate with Web Service

## Code to report or query immunization in real-time



# Future work using HL7 Web Services

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- Real-time interstate data exchange to help increase IIS completeness when patients migrate or live near border
- IIS-to-IIS real-time queries in provider web applications and other software
- EHR and other real-time data exchange partners querying IIS across jurisdictional lines
- National immunization record locator service

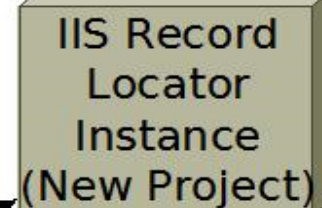


# Viable model for real-time immunization record locator service

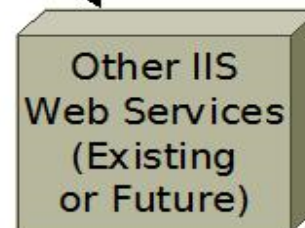
1. The IIS data exchange partner searches for immunization records, using an electronic system such as an EHR, the Immunization Registry Web application, or a school entry application.



2. The partner's search goes over the Internet to the IIS jurisdiction's real-time immunization locator instance, which has the network address and login credentials for its IIS Web Service and to other IIS Web Services on the Internet.



3. The IIS' RILS instance queries its IIS' own Web Service over its internal network, queries other IISs over the Internet, consolidates the immunization information from all IISs into a single patient record, and returns the full immunization record to the data exchange partner.



# Conclusions

- **IISs can successfully implement real-time Web services for bi-directional HL7 data exchange**
  - In February 2012, 25% of NYC CIR immunization reporting
  - 88% real-time Web service search success rate
  - 60% real-time Web application search success rate
- **Web Service integration between an IIS and EHR yields more immunizations in hospital network**
  - 22% of adolescent vaccines in Columbia Presbyterian come from NYC CIR's real-time service
  - 7.5% increase in vaccine coverage rate for 24-36 month olds
  - Healthcare providers love the real-time EHRs integration with NYC
- **IISs that implement real-time querying can participate in a real-time immunization record locator service nationally**

# Contacts

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- Angel Aponte ([aaponte@health.nyc.gov](mailto:aaponte@health.nyc.gov))
- Tony Mack ([tmack1@health.nyc.gov](mailto:tmack1@health.nyc.gov))
- Kristen Forney ([kforney@health.nyc.gov](mailto:kforney@health.nyc.gov))