

# Electronic Health Record Query-Response: Building on Our Success

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**AIRA 2018 National Meeting**

**August 16, 2018**

**Electronic Health Record Query-Response Workshop**

*Amy Metroka, Monica Sull, Greg Faber, Angel Aponte, Nathan Bunker*

# What is Query-Response and Why is it Important?

- Provider sends a request, i.e., a query, for a patient's immunizations to an Immunization Information System (IIS) from within a patient's electronic health record (EHR)
  - Often occurs during visit
  - Query sent electronically via HL7 message (QBP)
- IIS sends a response to EHR in <5 seconds with immunizations and forecast (i.e., recommendations based on patient's age, immunization history)
  - Response sent electronically via HL7 message (RSP)
- EHR absorbs, reconciles, displays information in patient's record
- Provider remains in EHR workflow
  - Administers and reports immunizations to IIS via HL7 message (VXU)
  - Brings patient up-to-date; avoids missed opportunity or extra, unnecessary immunizations

# Workshop Objective

- Learn how IISs and EHRs are implementing query-response interfaces
  - Success: IISs and EHRs across the nation are actively supporting query-response
    - A large and growing volume of information is being exchanged in support of immunizing providers
  - Challenge: Most IIS interfaces not fully aligned with national standards
    - Increases complexity, workload, costs for IIS, EHR, provider
- Engage in community problem-solving to promote EHR-IIS query-response and IIS alignment with standards

# Structure of Workshop

- Panelists give short presentations - 35 minutes
  - Includes representatives of New York City IIS, Epic, AIRA
- Participants break into small groups - 18 minutes
  - Randomly assign participants to tables
    - Choose a person(s) to take notes, report out
  - Identify challenges in your jurisdiction and how AIRA can help
- Reconvene for interactive discussion - 20 minutes
  - Small groups report out and interact with panel and other groups
  - Share challenges and engage in problem-solving
- Closing and next steps – 2 minutes

# Query-Response Onboarding in New York City

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**Monica Sull, MPH**

Interoperability Unit Chief

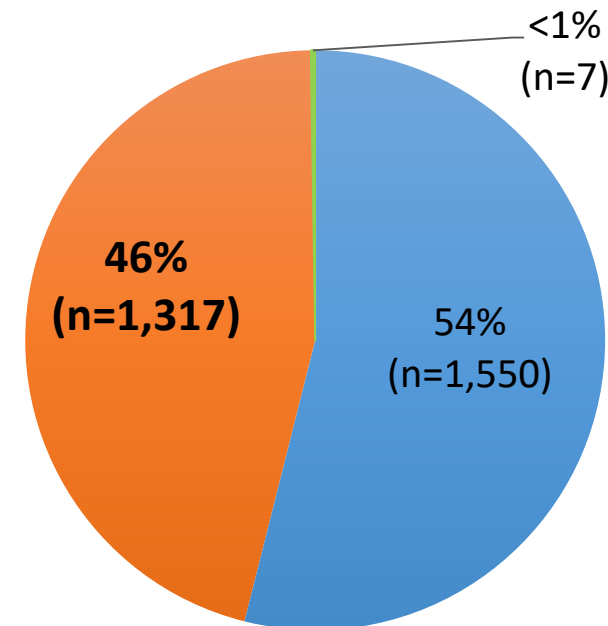
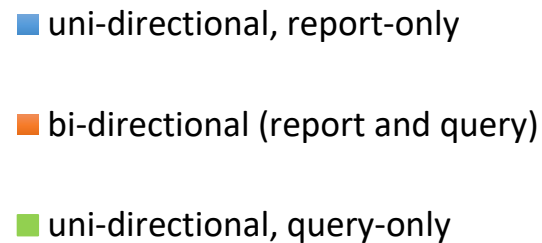
Bureau of Immunization

New York City Department of Health and Mental Hygiene

[msull@health.nyc.gov](mailto:msull@health.nyc.gov)

# Citywide Immunization Registry (CIR) HL7 Web Service

- CIR's HL7 Web Service was established in 2009
  - First facility connected in 2011
- Interoperability Team established to onboard providers and manage the quality and completeness of data reported via the HL7 Web Service
- 2,874 facilities ever connected\*



\* As of 5/21/18

# Query Interface Onboarding Overview

- Phase 1: Initial Discussions
- Phase 2: Connection Development
- Phase 3: Testing
- Phases 4/5: Pre-Production/Production Deployment

# Phase 1: Initial Discussions

## Steps

- 1. Initial call/email:** EHR vendor requests to start bi-directional testing
- 2. Kick-off call:** EHR/CIR discuss query-response project and implementation process
- 3. Implementation documents:** EHR vendor receives CIR HL7 Implementation Guide and other supporting documentation

**Best Practice:** Ask your questions during the kick-off call.



# Kick-off Call Questions

- How and where will the query triggers be implemented?
  - Automatic triggers
  - Manual triggers
- How will the immunizations be uploaded?
  - Entire immunization record consumed at once using a select all method
  - One vaccine group at a time
  - One vaccine at a time
- Will the EHR display the CIR's immunization evaluation and forecasting?

# Phase 2: Connection Development

Before beginning Phase 2, the EHR vendor and health care facility(ies) that are being connected for query-response must have submitted their signed confidentiality agreements.

## Steps

**1. CIR staff provide test account credentials:** Test account credentials are provided via phone or via upload to a secure, Web file repository account to EHR vendor

**2. Set up HL7 interface:** EHR vendor can start setting up their HL7 2.5.1 query interface

# Phase 3: Testing

## Steps

**1. Query testing preparation:** Submit VXUs to the CIR's test environment and notify the CIR to confirm receipt and quality of submissions

**2. Query testing:** EHR vendor will set up structure for QBPs and will send QBPs for the previously reported data

- Well-formed queries
- Accept response messages for: single matching patient, no patients found, and more than one patient found
- Validate immunization history and forecasting returned in RSP

**Best Practice:** Schedule weekly or bi-weekly calls to touch base on progress and any questions that may arise.

# CIR Administration Tool (CAT)

C.A.T.

Production

Signed on: msull [\[Preferences\]](#) [\[Logout\]](#)

CAT Manager

CIR Admin

Facility/Provider

HL7

OR Admin

Patient

HL7 VXQ/QBP QA

Enter or select search criteria, then click the Search button to perform your search.

Facility Code:

9999Q99

Start Date:

02/01/2018

Stop Date:

07/13/2018

Patient Match Count:

☐ 0

☐ 1

☐ 2 or more

☒ All Matches

Search

Clear

Facility - CIR Testing Facility (9999Q99) - Patient Match Count: ALL

Facility Name

CIR Testing Facility

Facility Code

9999Q99

Account Name

CIRINTEROPHL7

Contact Name

Contact Number

Contact Email

Error Stats

All Messages

Returned Single Match

Success (No Errors)

Success (Non-Fatal Errors)

Failed

61

10

55

5

1

All Messages

Id	Msg Ctrl ID	Type	Received	Patient Matches	Message Status	Fatal Errors	Non-Fatal Errors
96736568	NO-QRF-02	VXQ	02/20/2018 3:26 PM	0	FAILURE	REQUIREDFIELD (1), MISMA TCH (1)	VALUEMISSING (1)
96736618	NO-QRF-02	VXQ	02/20/2018 3:26 PM	0	SUCCESS_NONFATAL		VALUEMISSING (1)
96737148	ATHENA-02	VXQ	02/20/2018 3:30 PM	0	SUCCESS_NONFATAL		VALUEMISSING (1)
96738500	2826385M13126	QBP	02/20/2018 3:39 PM	1	SUCCESS_NONFATAL		VALUEMISSING (1)

NYC

Health

# Phase 4/5: Pre-Production/Production Deployment

## Steps

- 1. Demo:** After successful querying of test data, EHR vendor will demo query interface, including the workflow and display of immunization history and forecasting
- 2. Closeout call and enable querying:** CIR will provide production account credentials and enable querying in production
- 3. Monitor match rate and query errors/failures:** CIR and EHR vendor will communicate any errors/issues with the query-response to ensure data accuracy and completeness

**Best Practice:** Discuss expectations at the closeout call.

# Onboarding Challenges

- Conforming to national standards for query-response
  - Variations in implementations across jurisdictions can lead to more staff time and effort onboarding vendors
- A lot of data to validate (patient match, immunization data, and forecasting)
  - Organization for testing is critical to moving the process along
  - Test by age group for specific vaccines and expected recommendations

# Vaccination Query: An EHR Perspective

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**Greg Faber, PhD**

Integration Engineer

Epic

[gfaber@epic.com](mailto:gfaber@epic.com)



# Overview of Epic

- Located in Verona, WI
- ~9800 Employees
- Founded in 1979
- ~400 Total Live Organizations





# EHR Goals

- Healthy Patient Population
  - Complete and Accurate Patient Immunization Record
- Streamlined and Intuitive End User Workflows
- Support and Promote Interoperability Standards
- Standard “Out-of-the-Box” Interfaces
  - Easy Integration with Registries
  - Simplified Support of Interfaces

# Epic and Vaccination Query Interfaces – 12 Year Retrospective

- Sept. 2006 – Epic's first designs and development for VXQ/VXR
- Sept. 2009 – First Epic customer to go-live with VXQ/VXR (1)
- Feb. 2010 – Meaningful Use Stage 1 Development (1)
- Aug. 2010 – CDC HL7 2.5.1 Implementation Guide (1)
- Jan. 2011 – Develop proprietary Web Service (1)
- Feb. 2011 – Develop proprietary Web Service (2)
- Aug. 2011 – Develop proprietary Web Service (7)
- Sept. 2012 – Add support for QBP/RSP (MU Stage 2) (20)

\* Number in parentheses (#) are the total number of query interfaces Live

# Epic and Vaccination Query Interfaces – 12 Year Retrospective (cont.)

- Jan. 2013 – Automated querying (30)
- Jul. 2013 – Support for the CDC WSDL (36)
- Mar. 2015 – Reconcile Outside Immunizations (58)
- Mar. 2016 – MU Stage 3 Development (81)
- May 2017 – Store the registry MRN (103)
- Sept. 2017 – Location based filtering for queries (126)
- August 2018 – Today (236)

\* Number in parentheses (#) are the total number of query interfaces Live

# Epic and Vaccination Query Interfaces – 12 Year Retrospective (cont.)

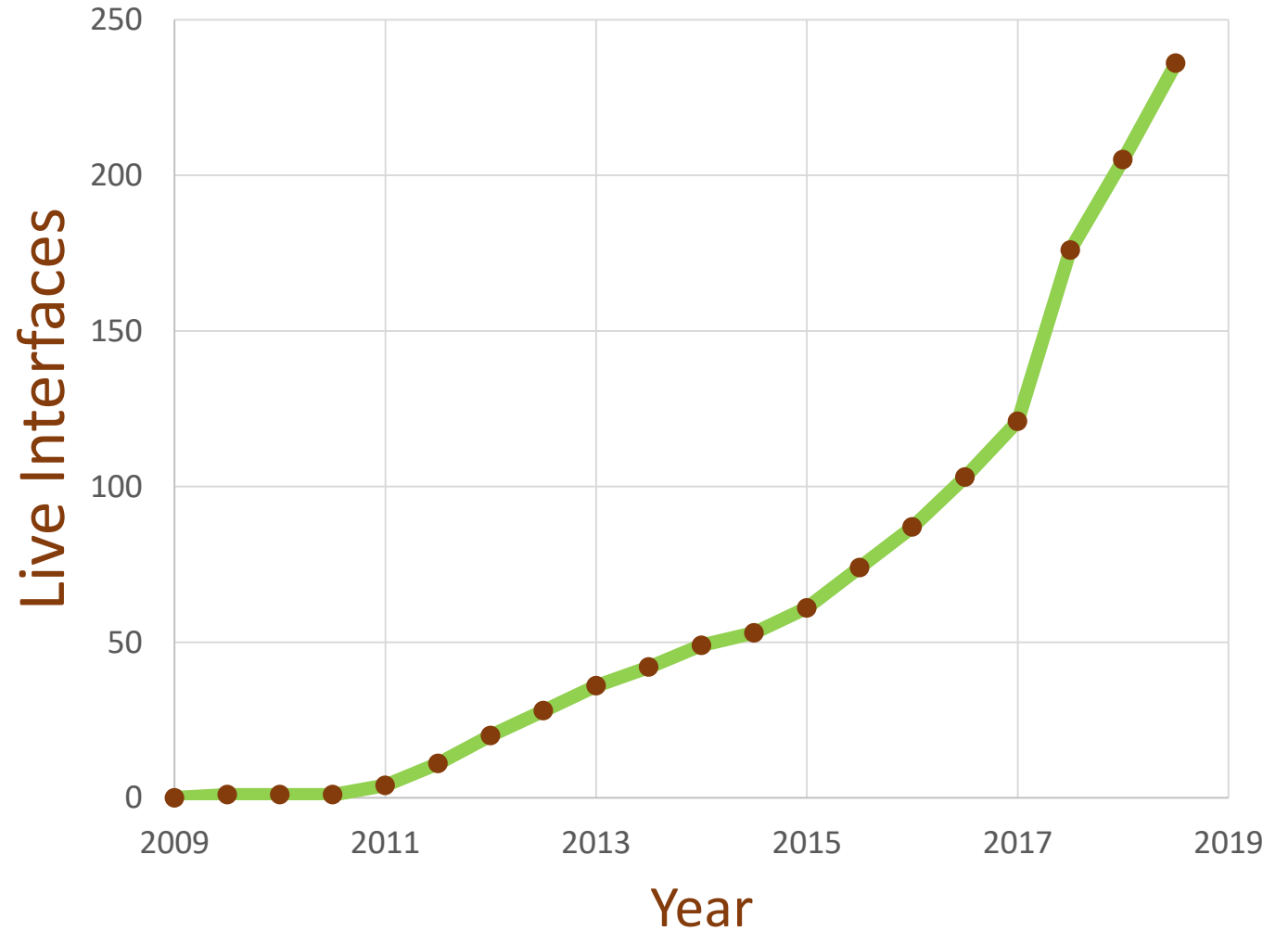
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- Sept. 2017 – Location based filtering for queries (126)
- August 2018 – Today (236)



\* Number in parentheses (#) are the total number of query interfaces Live

# Vaccination Query Interface Statistics

- 236 Live Interfaces
- 35 State Registries
- 1 City Registry
- >200 million queries sent a year



# Drivers for EHR Interface Development

- Fixes
- Updates to National Standards
  - CDC HL7 Implementation Guides
  - ONC and Meaningful Use Guidelines
- Customer enhancement requests
- Company wide initiatives

# Implementation Process – Project Team

- MU Lead (**Customer**)
- Application Analyst (**Customer**)
- Application Technical Support (**EHR**)
- Interface Analyst (**Customer**)
- Interface Technical Support (**EHR**)
- Server Systems (**Customer**)
- Server Systems (**EHR**)
- IIS Resource (**IIS**)



# Implementation Process – Phases and Timelines

- Groundwork (aka Onboarding)
  - Collect project team
  - Kickoff call
- Interface Design and Install – 1-3 months
  - Implementation guides
  - Interface configuration
- Testing – 1-3 months
  - Connectivity
  - Workflow testing
  - Mapped record testing





# Implementation Process – Phases and Timelines (cont.)

- Go-live
  - Cutover planning
  - Staff training
  - On-site support (\*sometimes)
- Post-live Support
  - Error management
  - Technical support
  - Upgrade assistance
  - Continuous improvement




# Example Workflow – Chart Review

Bryson Crawford

4yo, 1/10/2014

MRN: 55103



Care Team

PCP: Seeger, Marty, MD

Immunizations - All Types

All Admin Types

Incomplete Admins

Historical Admins

New Admin

Immunization Report

E-Sign

Imm Registry

More

?

X

Administration History

Administered On

Next Due

☐ Show Deleted

☒ Show Deferred

Immunizations

DTAP-IPV-HEP B

7/10/2014, 5/10/2014, 3/10/2014

+ New

Hib (PRP-T)

1/10/2015, 5/10/2014, 3/10/2014

+ New

Influenza Whole

10/18/2017

MMR

1/10/2015

+ New

Pcv13

1/10/2015, 5/10/2014, 3/10/2014

+ New

Varicella

1/10/2015

+ New

Immunizations from Immunization Registries

No registry information available

☒ Mark as Reviewed


Never reviewed.

# Example Workflow – Initiate Query

Bryson Crawford

4yo, 1/10/2014

MRN: 55103



Care Team

PCP: Seeger, Marty, MD

Immunizations - All Types

All Admin Types

Incomplete Admins

Historical Admins

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Hib (PRP-T)

1/10/2015, 5/10/2014, 3/10/2014

+ New

Influenza Whole

10/18/2017

MMR

1/10/2015

+ New

Pcv13

1/10/2015, 5/10/2014, 3/10/2014

+ New

Varicella

1/10/2015

+ New

Immunizations from Immunization Registries

State Immunization Registry


A request was initiated today at 3:23 PM

☒ Mark as Reviewed

Never reviewed.

# Example Workflow – Initiate Query

**Bryson Crawford**  
4yo, 1/10/2014  
MRN: 55103



Care Team  
PCP: Seeger, Marty, MD

**Immunizations - All Types** | All Admin Types | Incomplete Admins | Historical Admins | New Admin | Immunization Report | E-Share | **Imm Registry** | More | ? | X

### Administration History

	Administered On	Next Due	<input type="checkbox"/> Show Deleted	<input checked="" type="checkbox"/> Show Deferred
Immunizations				
DTAP-IPV-HEP B	7/10/2014, 5/10/2014, 3/10/2014			<a href="#">+ New</a>
Hib (PRP-T)	1/10/2015, 5/10/2014, 3/10/2014			<a href="#">+ New</a>
Influenza Whole	10/18/2017			
MMR	1/10/2015			<a href="#">+ New</a>
Pcv13	1/10/2015, 5/10/2014, 3/10/2014			<a href="#">+ New</a>
Varicella	1/10/2015			<a href="#">+ New</a>

### Immunizations from Immunization Registries

State Immunization Registry

A request was initiated today at 3:23 PM

☒ Mark as Reviewed | Never reviewed.

# Example Workflow – Triggers

- Manual query
  - Point of care
- Automated query
  - At appointment check-in
  - At appointment scheduled
  - Upon admission
  - Next day appointments



# Example Workflow – Query Response

⚠ New immunizations from outside sources are available for reconciliation.

🔗 Reconcile Outside Immunizations with the immunizations on the patient's chart.

## 📁 Administration History

	Administered On	Next Due	<input type="checkbox"/> Show Deleted	<input checked="" type="checkbox"/> Show Deferred
Immunizations				
> Dtap/hepb/ipv (Pediarix)	7/10/2014, 5/10/2014, 3/10/2014			+ New
> HiB	1/10/2015, 5/10/2014, 3/10/2014			+ New
> Influenza Whole	10/18/2017			
> MMR	1/10/2015			+ New
> Pcv13	1/10/2015, 5/10/2014, 3/10/2014			+ New
> Varicella	1/10/2015			+ New

## 📁 Immunizations from Immunization Registries

### 📁 State Immunization Registry

#### 📁 Immunizations as of today at 4:35 PM

	Administered On
> DTAP (Dtap/hepb/ipv (Pediarix))	7/10/2014, 5/10/2014, 3/10/2014
> Flu (Influenza Whole)	10/18/2017
> Hib	1/10/2015, 5/10/2014, 3/10/2014
> MMR	1/10/2015
> Pcv13	1/10/2015, 5/10/2014, 3/10/2014
> Tdap	7/10/2015
> Varicella	7/10/2015, 1/10/2015

#### ⚠ Recommended immunizations as of today at 4:35 PM

	Recommended Due Date
> MMR	5/1/2018
> Var (Varicella)	5/1/2018
> IPV	5/1/2018
> Influenza (Influenza Whole)	9/1/2018

# Example Workflow – Query Response

⚠ New immunizations from outside sources are available for reconciliation.

🔗 Reconcile Outside Immunizations with the immunizations on the patient's chart.

## 📁 Administration History

	Administered On	Next Due	<input type="checkbox"/> Show Deleted	<input checked="" type="checkbox"/> Show Deferred
Immunizations				
> Dtap/hepb/ipv (Pediarix)	7/10/2014, 5/10/2014, 3/10/2014			+ New
> HiB	1/10/2015, 5/10/2014, 3/10/2014			+ New
> Influenza Whole	10/18/2017			
> MMR	1/10/2015			+ New
> Pcv13	1/10/2015, 5/10/2014, 3/10/2014			+ New
> Varicella	1/10/2015			+ New

## 📁 Immunizations from Immunization Registries

### 📁 State Immunization Registry

#### 📁 Immunizations as of today at 4:35 PM

	Administered On
> DTAP (Dtap/hepb/ipv (Pediarix))	7/10/2014, 5/10/2014, 3/10/2014
> Flu (Influenza Whole)	10/18/2017
> Hib	1/10/2015, 5/10/2014, 3/10/2014
> MMR	1/10/2015
> Pcv13	1/10/2015, 5/10/2014, 3/10/2014
> Tdap	7/10/2015
> Varicella	7/10/2015, 1/10/2015

#### ⚠ Recommended immunizations as of today at 4:35 PM

	Recommended Due Date
> MMR	5/1/2018
> Var (Varicella)	5/1/2018
> IPV	5/1/2018
> Influenza (Influenza Whole)	9/1/2018

Registry  
History



# Example Workflow – Query Response

 New immunizations from outside sources are available for reconciliation.

 [Reconcile Outside Immunizations with the immunizations on the patient's chart.](#)

## Administration History

	Administered On	Next Due	<input type="checkbox"/> Show Deleted	<input checked="" type="checkbox"/> Show Deferred
Immunizations				
> Dtap/hepb/ipv (Pediarix)	7/10/2014, 5/10/2014, 3/10/2014			 New
> HiB	1/10/2015, 5/10/2014, 3/10/2014			 New
> Influenza Whole	10/18/2017			
> MMR	1/10/2015			 New
> Pcv13	1/10/2015, 5/10/2014, 3/10/2014			 New
> Varicella	1/10/2015			 New

## Immunizations from Immunization Registries

### State Immunization Registry

#### Immunizations as of today at 4:35 PM

	Administered On
> DTAP (Dtap/hepb/ipv (Pediarix))	7/10/2014, 5/10/2014, 3/10/2014
> Flu (Influenza Whole)	10/18/2017
> Hib	1/10/2015, 5/10/2014, 3/10/2014
> MMR	1/10/2015
> Pcv13	1/10/2015, 5/10/2014, 3/10/2014
> Tdap	7/10/2015
> Varicella	7/10/2015, 1/10/2015

#### Recommended immunizations as of today at 4:35 PM

	Recommended Due Date
> MMR	5/1/2018
> Var (Varicella)	5/1/2018
> IPV	5/1/2018
> Influenza (Influenza Whole)	9/1/2018

Registry  
History




Registry  
Forecast






# Example Workflow – Query Response

Reconcile  
Outside  
Imms

 New immunizations from outside sources are available for reconciliation.

 [Reconcile Outside Immunizations with the immunizations on the patient's chart.](#)

## Administration History

	Administered On	Next Due	<input type="checkbox"/> Show Deleted	<input checked="" type="checkbox"/> Show Deferred
Immunizations				
> Dtap/hepb/ipv (Pediarix)	7/10/2014, 5/10/2014, 3/10/2014			 New
> HiB	1/10/2015, 5/10/2014, 3/10/2014			 New
> Influenza Whole	10/18/2017			
> MMR	1/10/2015			 New
> Pcv13	1/10/2015, 5/10/2014, 3/10/2014			 New
> Varicella	1/10/2015			 New

## Immunizations from Immunization Registries

### State Immunization Registry

#### Immunizations as of today at 4:35 PM

	Administered On
> DTAP (Dtap/hepb/ipv (Pediarix))	7/10/2014, 5/10/2014, 3/10/2014
> Flu (Influenza Whole)	10/18/2017
> Hib	1/10/2015, 5/10/2014, 3/10/2014
> MMR	1/10/2015
> Pcv13	1/10/2015, 5/10/2014, 3/10/2014
> Tdap	7/10/2015
> Varicella	7/10/2015, 1/10/2015

#### Recommended immunizations as of today at 4:35 PM

	Recommended Due Date
> MMR	5/1/2018
> Var (Varicella)	5/1/2018
> IPV	5/1/2018
> Influenza (Influenza Whole)	9/1/2018

Registry  
History

Registry  
Forecast

# Example Workflow – Reconcile Outside Immunizations

Bryson Crawford

4yo, 1/10/2014

MRN: 55103



Care Team

PCP: Seeger, Marty, MD

## Reconcile Outside Info

? Close

Allergies Medications Problems **Immunizations**

### Outside of Local Medical Record

Immunization	Administered On
--------------	-----------------

> Tdap	7/10/2015
--------	-----------

Add All Discard All

> Varicella	7/10/2015
-------------	-----------

Add All Discard All

### Current Immunizations in Local Medical Record

Immunization	Administered On
--------------	-----------------

> Dtap/hepb/ipv (Pediarix)	7/10/2014, 5/10/2014, 3/10/2014
----------------------------	---------------------------------

> HiB	1/10/2015, 5/10/2014, 3/10/2014
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> Influenza Whole	10/18/2017
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> MMR	1/10/2015
-------	-----------

> Pcv13	1/10/2015, 5/10/2014, 3/10/2014
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> Varicella	1/10/2015
-------------	-----------


→ Next File & Close Close

# Example Workflow – Reconcile Outside Immunizations

Bryson Crawford

4yo, 1/10/2014

MRN: 55103



Care Team

PCP: Seeger, Marty, MD

Reconcile Outside Info

?

Close

Allergies

Medications

Problems

Immunizations


Outside of Local Medical Record

Immunization	Administered On	
> Tdap	7/10/2015	<div>Add AllDiscard All</div>
> Varicella	7/10/2015	<div>Add AllDiscard All</div>

Current Immunizations in Local Medical Record

Immunization	Administered On
> Dtap/hepb/ipv (Pediarix)	7/10/2014, 5/10/2014, 3/10/2014
> HiB	1/10/2015, 5/10/2014, 3/10/2014
> Influenza Whole	10/18/2017
> MMR	1/10/2015
> Pcv13	1/10/2015, 5/10/2014, 3/10/2014
> Varicella	1/10/2015

→ Next

 File & Close


Close

# Example Workflow – Administer Vacccs

Bryson Crawford

4yo, 1/10/2014

MRN: 55103



Care Team

PCP: Seeger, Marty, MD

Immunizations - All Types

All Admin Types

Incomplete Admins

Historical Admins

New Admin

Immunization Report

E-Sign

Imm Registry

More

?

Administration History

	Administered On	Next Due	<input type="checkbox"/> Show Deleted	<input checked="" type="checkbox"/> Show Deferred
Immunizations				
> Dtap/hepb/ipv (Pediarix)	7/10/2014, 5/10/2014, 3/10/2014			+ New
> HiB	1/10/2015, 5/10/2014, 3/10/2014			+ New
> Influenza Whole	10/18/2017			
> IPV	5/8/2018			+ New
> MMR	5/8/2018, 1/10/2015			+ New
> Pcv13	1/10/2015, 5/10/2014, 3/10/2014			+ New
> Tdap	7/10/2015			+ New
> Varicella	5/8/2018, 7/10/2015, 1/10/2015			+ New

Immunizations from Immunization Registries

State Immunization Registry

Immunizations as of today at 4:35 PM

	Administered On
> DTAP (Dtap/hepb/ipv (Pediarix))	7/10/2014, 5/10/2014, 3/10/2014
> Flu (Influenza Whole)	10/18/2017
> Hib	1/10/2015, 5/10/2014, 3/10/2014
> MMR	1/10/2015
> Pcv13	1/10/2015, 5/10/2014, 3/10/2014
> Tdap	7/10/2015
> Varicella	7/10/2015, 1/10/2015

# Example Workflow – Administer Vacccs

**Bryson Crawford**  
4yo, 1/10/2014  
MRN: 55103

Care Team  
PCP: Seeger, Marty, MD

**Immunizations - All Types** | All Admin Types | Incomplete Admins | Historical Admins | New Admin | Immunization Report | E-Sign | Imm Registry | More | ?

**Administration History**

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> HiB	1/10/2015, 5/10/2014, 3/10/2014			+ New
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> Pcv13	1/10/2015, 5/10/2014, 3/10/2014			+ New
> Tdap	7/10/2015			+ New
> Varicella	5/8/2018, 7/10/2015, 1/10/2015			+ New

**Immunizations from Immunization Registries**

State Immunization Registry

Immunizations as of today at 4:35 PM

	Administered On
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> Hib	1/10/2015, 5/10/2014, 3/10/2014
> MMR	1/10/2015
> Pcv13	1/10/2015, 5/10/2014, 3/10/2014
> Tdap	7/10/2015
> Varicella	7/10/2015, 1/10/2015

← Immunizations added from the  
← Reconcile Outside Info activity



# Example Workflow – Administer Vacccs

**Bryson Crawford**  
4yo, 1/10/2014  
MRN: 55103

Care Team  
PCP: Seeger, Marty, MD

**Immunizations - All Types** | All Admin Types | Incomplete Admins | Historical Admins | New Admin | Immunization Report | E-Sign | Imm Registry | More | ?

### Administration History

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> Tdap	7/10/2015			+ New
> Varicella	5/8/2018, 7/10/2015, 1/10/2015			+ New

← IIS recommended immunizations  
← administered during the encounter.  
← (Sent to the IIS as a VXU message)

### Immunizations from Immunization Registries

State Immunization Registry

Immunizations as of today at 4:35 PM

	Administered On
> DTAP (Dtap/hepb/ipv (Pediarix))	7/10/2014, 5/10/2014, 3/10/2014
> Flu (Influenza Whole)	10/18/2017
> Hib	1/10/2015, 5/10/2014, 3/10/2014
> MMR	1/10/2015
> Pcv13	1/10/2015, 5/10/2014, 3/10/2014
> Tdap	7/10/2015
> Varicella	7/10/2015, 1/10/2015

# Benefits of Bi-directional Query with IIS

- Access to the patient's complete immunization history
- Accurate immunization forecasting
- Easy reconciliation of outside immunizations to the medical record
- Patient outreach for overdue immunizations (using reporting tools)
- Patient access to a complete immunization record for school/work (via the patient portal)

# Future Enhancements

- VXR support for filing Contraindications, Adverse Reactions, and Presumed Immunity
- VXR support for multiple patient matching



# HL7 Web Service Performance Considerations for Real-time EHR Integration

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**Angel Aponte**

Computer Specialist, Division of Disease Control

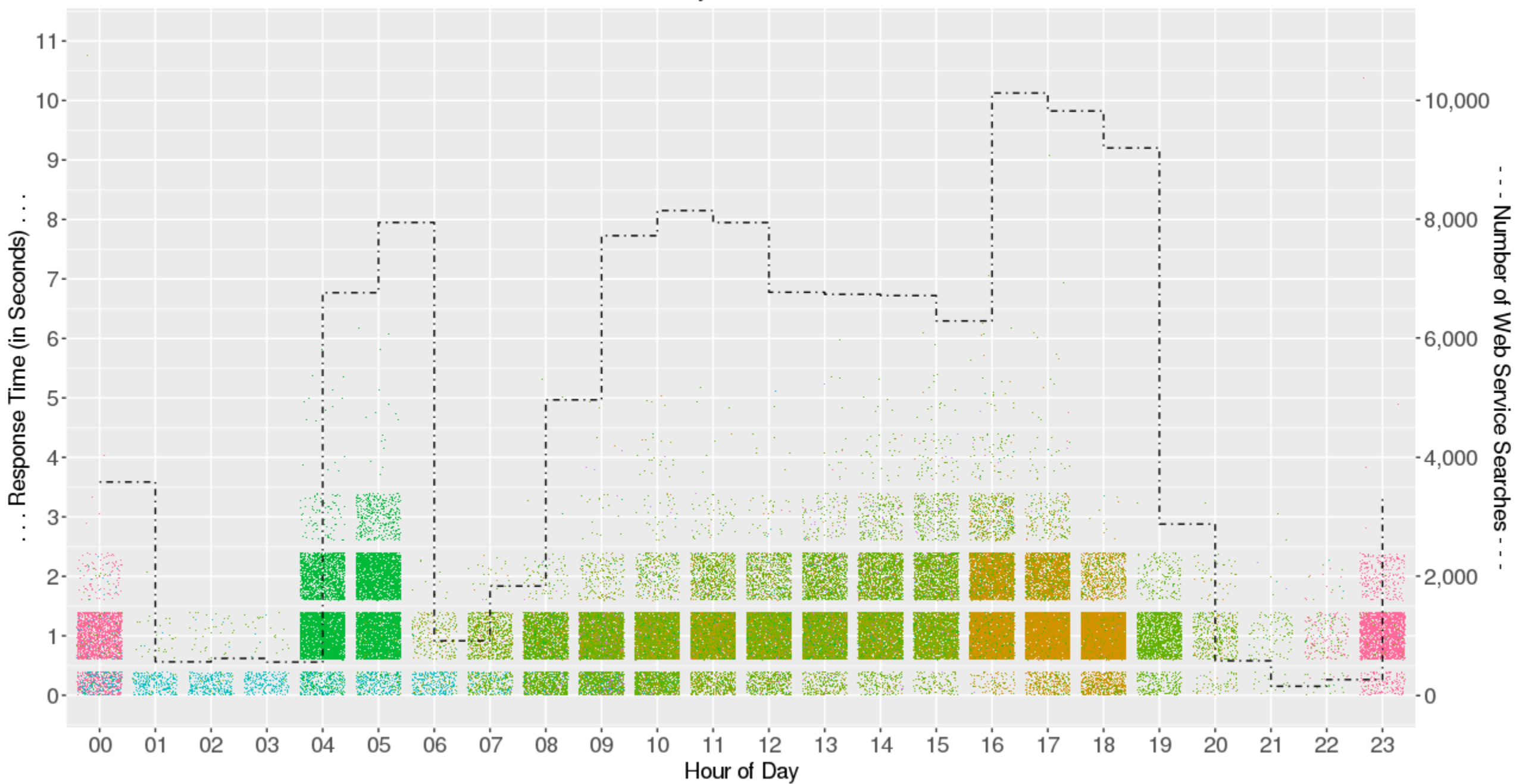
NYC Department of Health and Mental Hygiene

[aaponte@health.nyc.gov](mailto:aaponte@health.nyc.gov)

# CDC, AIRA, and NYC Response Time Targets

- CDC essential infrastructure functional standard 1.5
  - The IIS ensures that submitted vaccination and demographic data are processed and viewable **in a timely manner**
  - <https://www.cdc.gov/vaccines/programs/iis/functional-standards/func-stds-v4-0.pdf>
- AIRA measures and tests for assessment for query and response
  - The IIS responds to a query with an RSP **within 5 seconds** or less for 95% of the queries submitted
  - [http://repository.immregistries.org/files/resources/58ade9b1a72c7/iis\\_assessment\\_measures\\_and\\_tests\\_-\\_query\\_and\\_response\\_-\\_v1\\_1\\_new\\_logo.pdf](http://repository.immregistries.org/files/resources/58ade9b1a72c7/iis_assessment_measures_and_tests_-_query_and_response_-_v1_1_new_logo.pdf)
- NYC targets **less than 2 second** response time for all queries
  - Based on Akamai Technologies commissioned study from Forrester Consulting
  - <https://www.akamai.com/us/en/about/news/press/2009-press/akamai-reveals-2-seconds-as-the-new-threshold-of-acceptability-for-ecommerce-web-page-response-times.jsp>

Response time For HL7 Web service searches, colored by sending application  
July 31, 2018



# Descriptive Statistics of CIR HL7 Web Service Query Response Time, June 2018

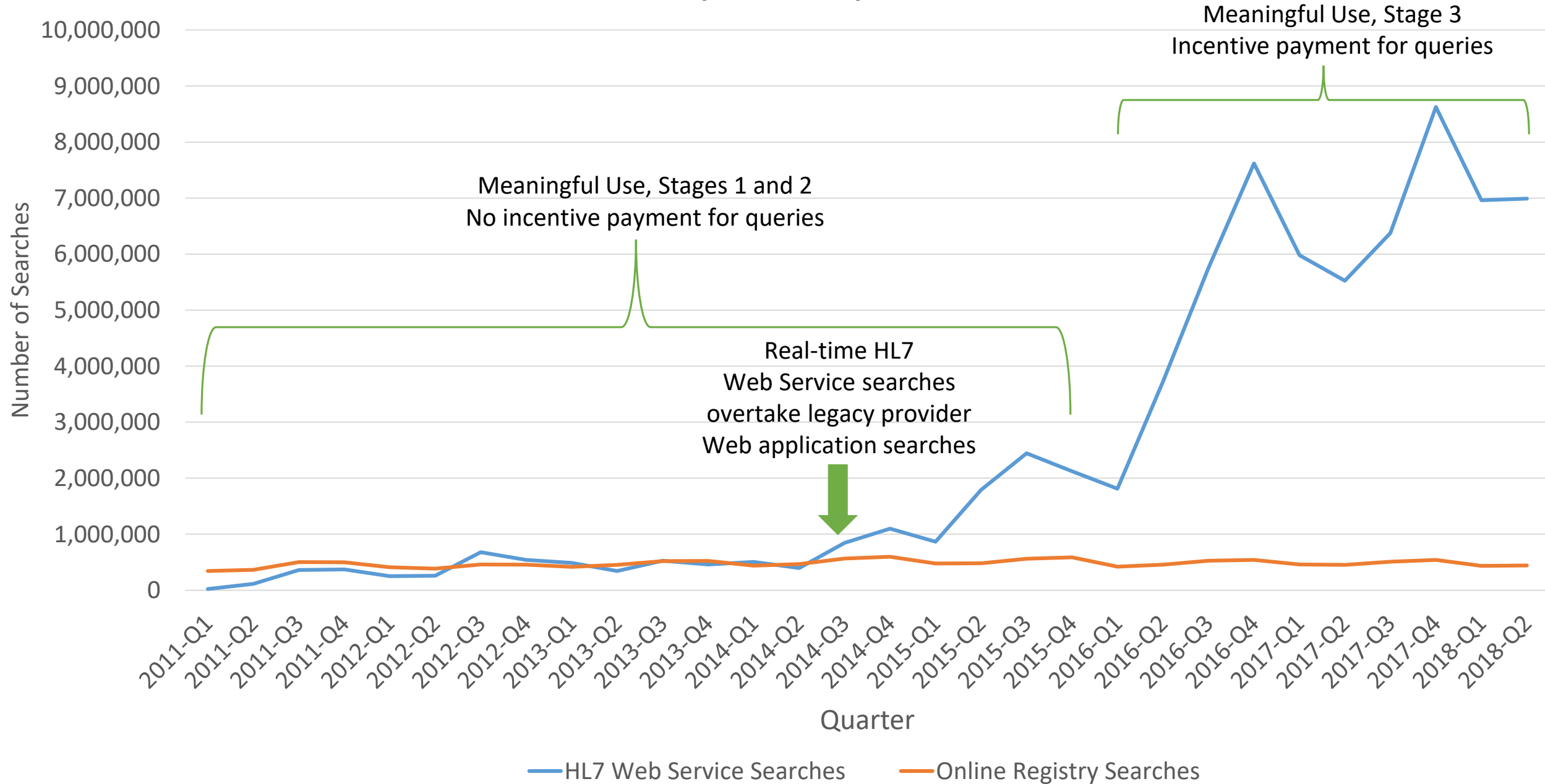


3dResponseTimeJuly2018.html

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- Simon Urbanek (2014). RJDBC: Provides access to databases through the JDBC interface. R package version 0.2-5. <https://CRAN.R-project.org/package=RJDBC>
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# Patient immunization record searches in CIR, quarterly, by real-time search method

## January 2011 to July 2018



# Computing Resources: Going well

- Network – Mid range specification
  - 3 tiers: Web, external application, internal application and database
  - 10 gigabit per second within each tier: Heavy lifting at bottom tier
  - 1 gigabit per second between tiers: Potential bottleneck, but no impact yet
- Database servers – High performance storage
  - Common bottleneck removed
  - Non Volatile Memory Express (NVMe) solid state storage is the right solution

# Computing Resources: Challenges

- Application servers – Design deliberately, monitor closely, adapt quickly
  - Processors can be an issue when load is not distributed: need multiple application servers
  - No such thing as too much RAM
  - Swap has massive impact: Avoid at any cost
- Web Service Software: profile running services to identify and resolve bottlenecks
- Cloud still more expensive than owning hardware; maybe someday

# State of Queries: How Well are IIS implementing Query Interfaces?

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# AIRA Testing Discovery Project

- Measuring alignment between IIS and standards
- Connecting to IIS pre-production systems
  - Sending sample messages (not real data)
- Voluntary participation
- Three step process:
  - Discovery: Informs the Assessment process, run every month
  - Assessment: Formal measures developed by community, run every quarter
  - Validation: Based on Assessment results, released every year

# AIRA Testing Discovery Project

- Process for development of Assessment and Validation measures:
  - Measurement for Assessment and Certification Advisory Workgroup (MACAW) initiates development of assessment metrics
  - Guided by the IIS Functional Standards and Operational Guidance Statements
  - Vetted and approved by IIS community
- Metrics are organized under a content area:
  1. Transport
  2. Submission and Acknowledgement
  3. Query and Response
  4. Clinical Decision Support

# AIRA Testing Discovery Project

- Results are stored in the Aggregate Analysis Reporting Tool (AART)
  - IIS can opt-in for participation and set sharing settings
  - IIS can see recent and past results
  - IIS can see results from other IIS who have agreed to share
- Testing leverages the National Institute of Standards and Technology (NIST) Immunization Test Suite Validation Tool
  - Test suite is very mature HL7 v2 testing service
  - Can accurately determine how well IIS responses meet standards for format
  - Think “spell check for HL7 messages”

# Query and Response Measures

1. The IIS processes a query requesting a patient's immunization record.
2. The IIS processes a query requesting a patient's evaluated immunization record and forecast.
3. The IIS responds to a query for a known patient (one-to-one match).
4. The IIS responds to a query for a patient who is not in the IIS.
5. The IIS responds to a query that results in multiple possible patients.
6. The IIS responds to a query that has a significant error that cannot be accepted.
7. The IIS responds to a query for a known patient and returns known CDC endorsed data elements.
8. The IIS responds to a query with a response (RSP) within 5 seconds or less for 95% of the queries submitted.

# Query and Response Test Cases

- One or more test cases are used to support a measure
- Principles of measurement:
  - Isolate the test case to the measure
  - Expectations for a test case should be few not many
  - Test for good behavior
- Measure and test case outcomes:
  - Fully Meets
  - Deviates
  - Does not Meet

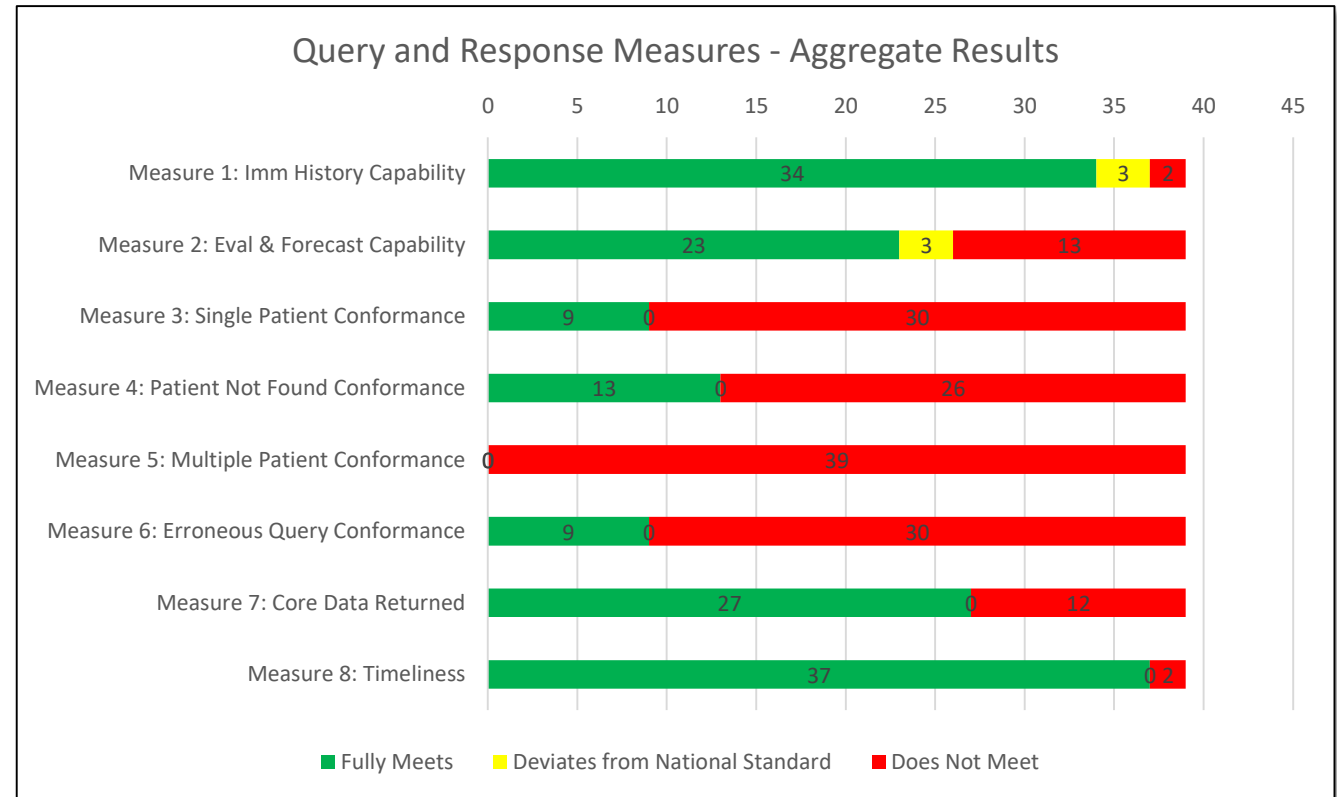
# Query and Response Results

- IIS interest has been high
  - IIS want to participate
- Some barriers remain:
  - HIE does not support compatible transport standard
  - IIS in transition to a new system
  - State IT policies do not allow for AIRA to connect to IIS test system

By the Numbers	
IIS who were encouraged to participate: (all 50 states, plus the Commonwealth of the Northern Mariana Islands, the District of Columbia, Guam, New York City, Philadelphia, Puerto Rico, San Diego, and the Virgin Islands)	58
Opted to participate	55
Could be measured during the most recent measurement quarter	39
Unable to connect during the most recent measurement quarter	16

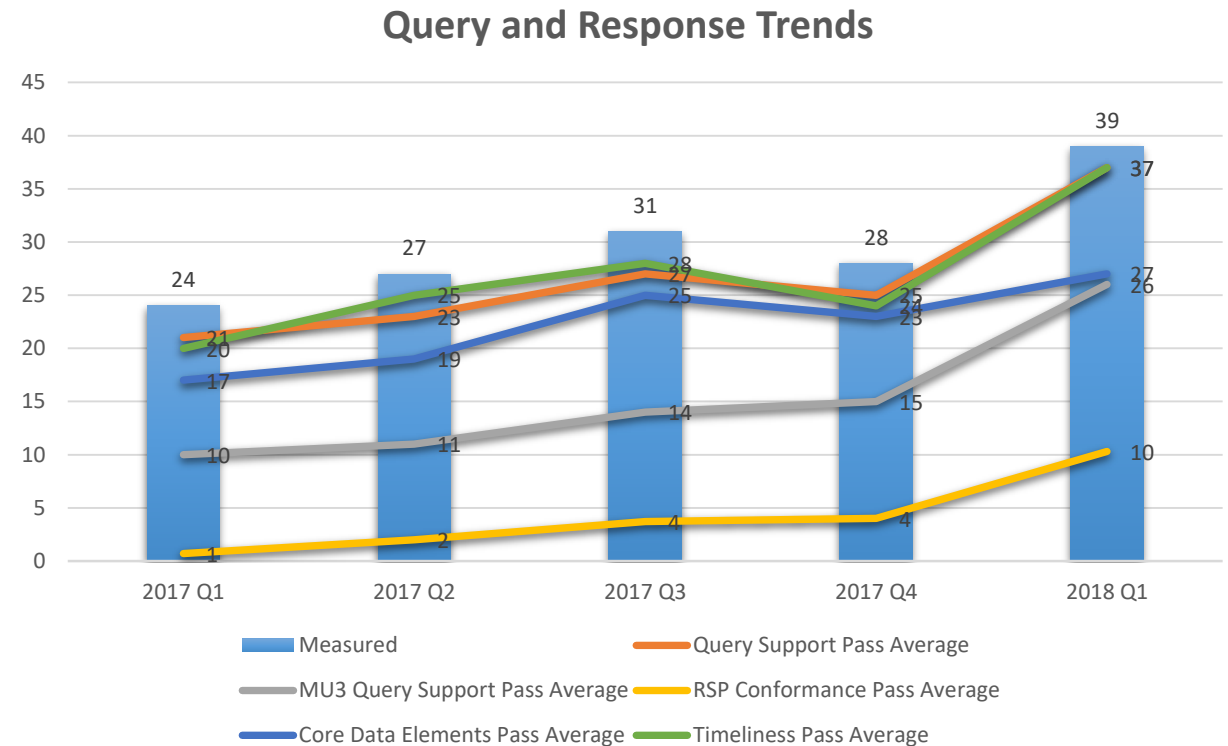
# Query and Response Results

- Measures 1 & 2
  - Imm History query is original
  - Eval & Forecast query is new
- Measures 3, 4, & 6
  - IIS often responded with the correct profile
  - But format was not technically correct
- Measures 5
  - Unable to consistently measure response for more than one match
- Patient Never Found
  - Two IIS were unable to return a patient match under any circumstance



# Query and Response Results

- Significant progress can be seen:
  - Participation has increased
  - Single Patient Found Conformance increased from 0 to 9
  - Patient Not Found Conformance increased from 2 to 13
  - Support for Meaningful Use query (Z44) increased from 38% to 59%





# Recommendations for IIS

- Improve ACK message returned
  - Only way to know if submitted data was accepted
- Improve RSP message returned
  - Most contain technical violations
  - Use NIST tool: <https://hl7v2-iz-r1.5-testing.nist.gov/iztool/#/home>
- Improve matching
  - Some IIS were too strict on matches
- Coordinate any changes with interface partners
  - Important to communicate changes to format early and often with partners

# Questions for the Group

- What is your process for onboarding providers with query?
  - What is working well?
  - What problems are you facing to onboard query support?
- Are the number of queries staying the same, increasing?
  - Are you having any issues with the number of queries?
- What security policies and practices do you have in place to ensure the query interface is being used properly?
  - Do you face challenges in getting signed agreements from vendors and/or health care providers?
- What can prevent an EHR from being able to query back patients they have successfully submitted?

# Questions for the Group

- Granting query access
  - What is your criteria for granting query access?
- Triggers for query
  - When it is appropriate for EHRs to query the IIS?
  - When is it not appropriate?
  - Have you had problems with sites doing too many queries or at the wrong times?
- Merging vaccinations into EHR
  - Are there any issues in merging IIS immunizations properly in the EHR?

# Questions for the Group

- Cleaning up records in the EHR:
  - What is the correct process for EHRs to clean up their records and remove duplicate vaccinations:
    - Vaccinations that are duplicates only on EHR side
    - Vaccinations that are duplicates on the IIS side as well
- What are the challenges to reporting the querying site (child facility)?