

## Using NIST Tools for Evaluation of Immunization Clinical Decision Support Systems

### *FITS – Forecasting for Immunization Test Suite*

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*April 13<sup>th</sup>, 2017*

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# Agenda

- ❑ Why are we doing this?
- ❑ FITS Overview
  - ❑ Test Case Creation
  - ❑ Test Case Execution
  - ❑ FHIR Interface
- ❑ FITS Demonstration
- ❑ Plans for Assessment
- ❑ What's next
- ❑ Resources and Wrap up

# Acknowledgements

- ❑ Collaborative Effort

- ❑ AIRA

- ❑ CDC

- ❑ NIST

- ❑ NIST Team

- ❑ Mike Indovina – Lead, Analyst, and IG Development

- ❑ Hossam Tamri – Tool Architect and Developer

- ❑ Andrew McCaffrey – FHIR Implementation



# Purpose and Need

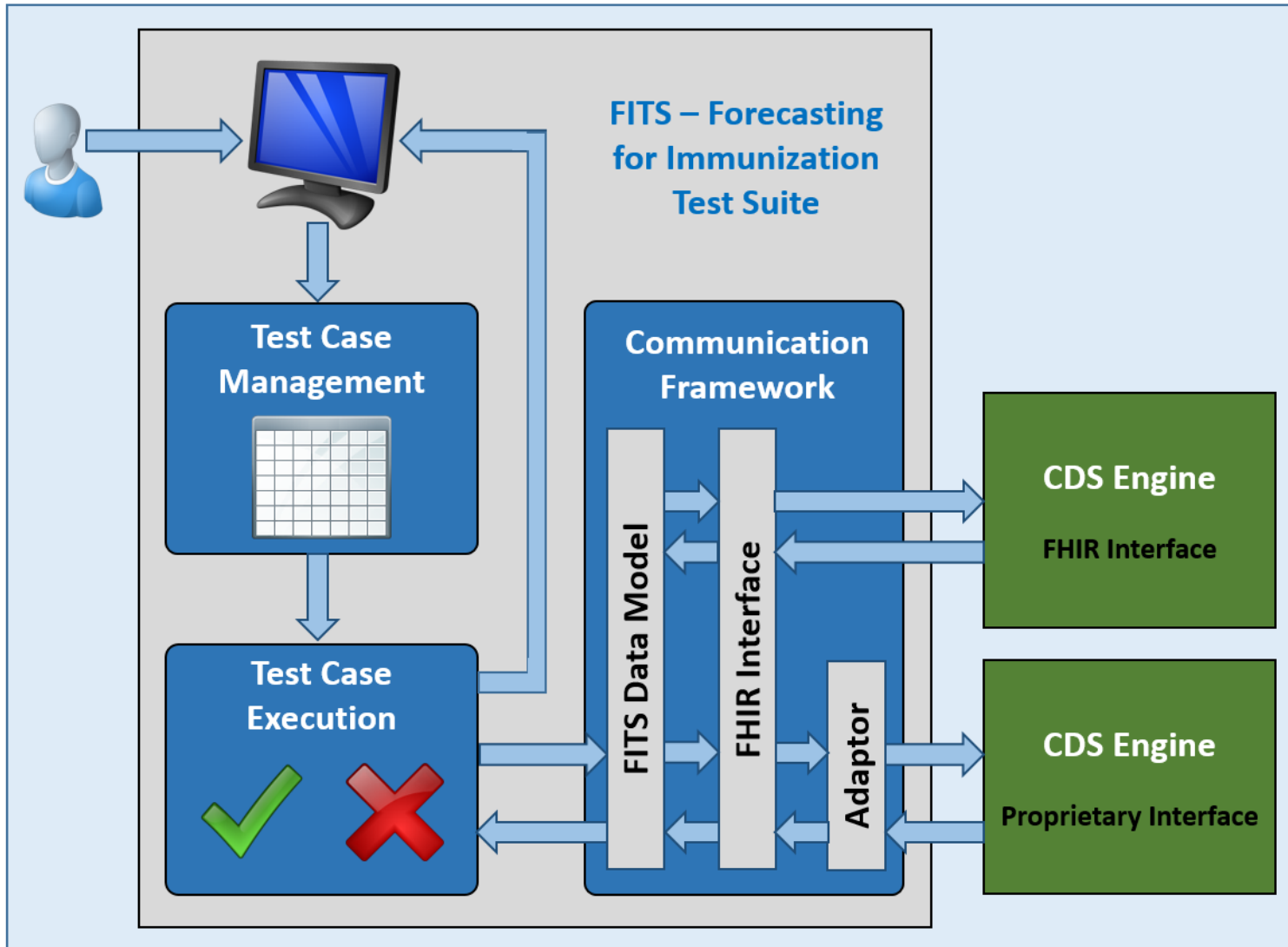
## ☐ Current Challenges

- ☐ CDSi Test Cases use primitive tooling
- ☐ Time consuming
- ☐ Easy to make an error
- ☐ Difficult to keep timely
- ☐ Only published in one format

## ☐ Benefits of Future Tooling

- ☐ Fixes the current challenges
- ☐ Available for all to use and develop their own CDS test cases
- ☐ Shareable test cases
- ☐ Allows for real time execution
- ☐ Useable by AIRA for CDS Assessment

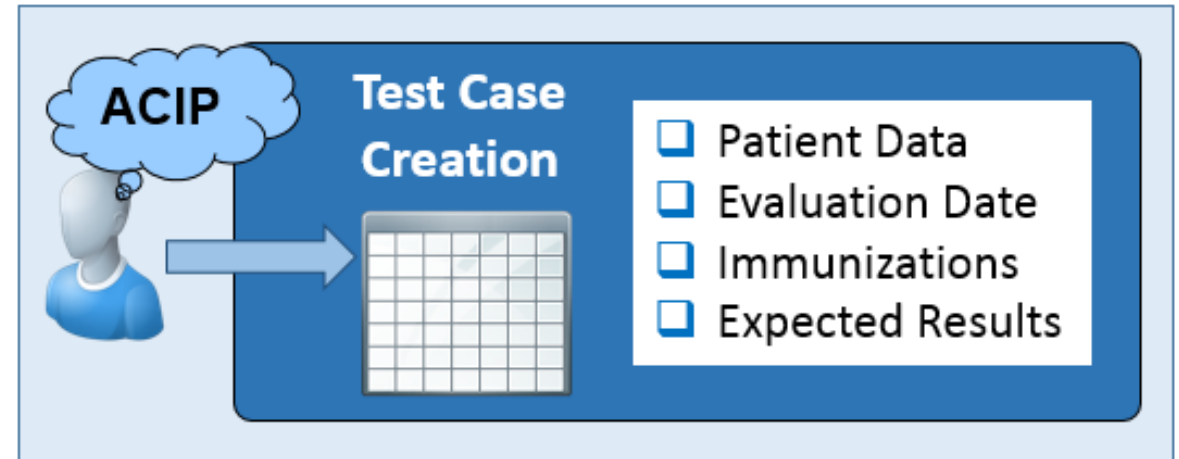
# FITS Overview



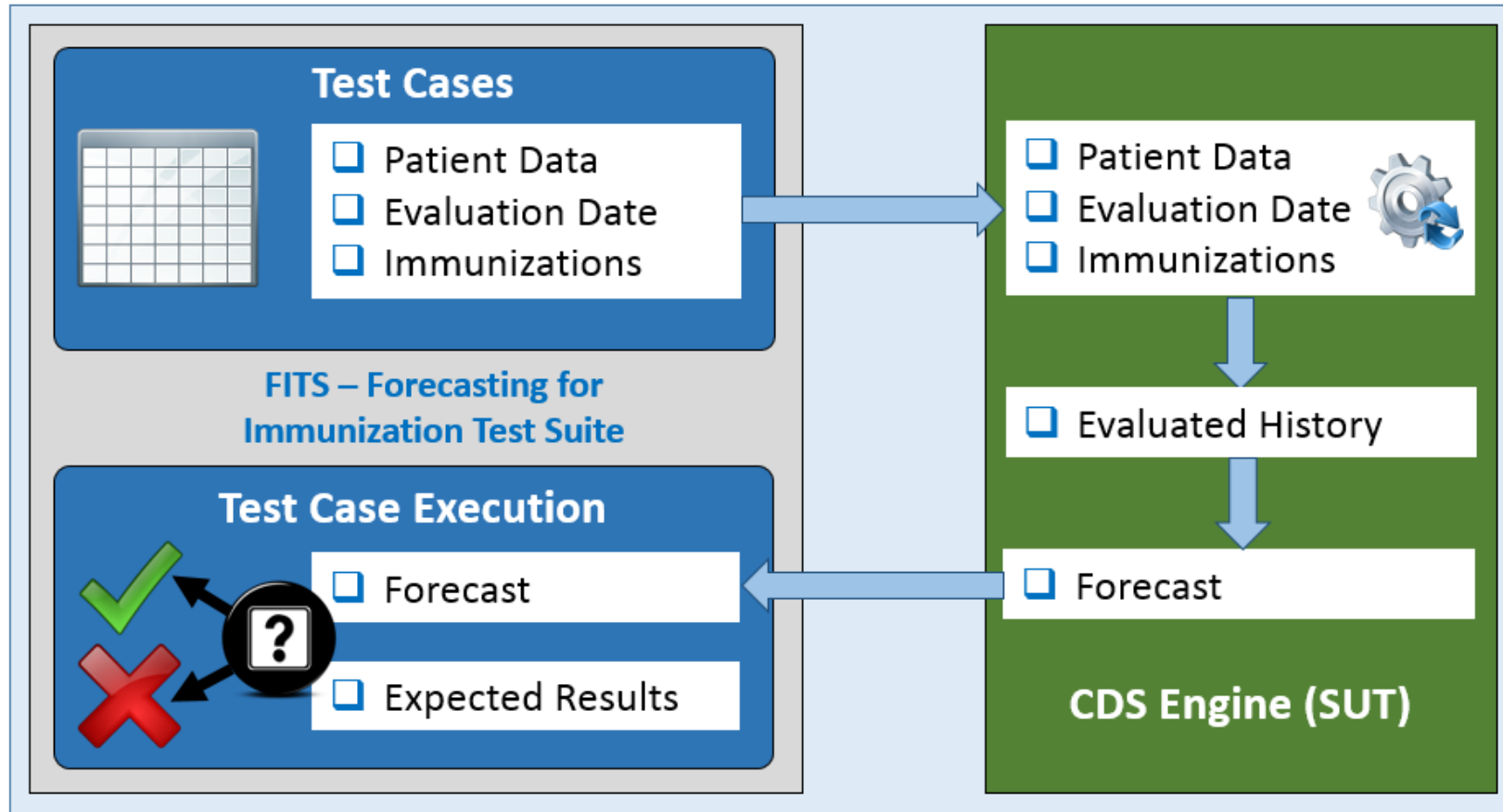
- ❑ Measures immunization CDS engines against the ACIP recommendations
- ❑ Create and manage immunization CDS test cases
- ❑ Validates test cases and reports the results in a standardized format
- ❑ Standardize FHIR interface

# Test Cases

- ❑ Allows user to create test cases
- ❑ Users provide the expertise based on ACIP recommendations
- ❑ FITS Provides:
  - ❑ Organization
  - ❑ Management
  - ❑ Look-up Assistance
  - ❑ Test Case Summaries
- ❑ Import and Export Capabilities
  - ❑ Import CDC Excel Spreadsheet format
  - ❑ Import XML format
  - ❑ Export XML format and CDC Excel Spreadsheet Format
  - ❑ Export PDF of test cases



# Validation

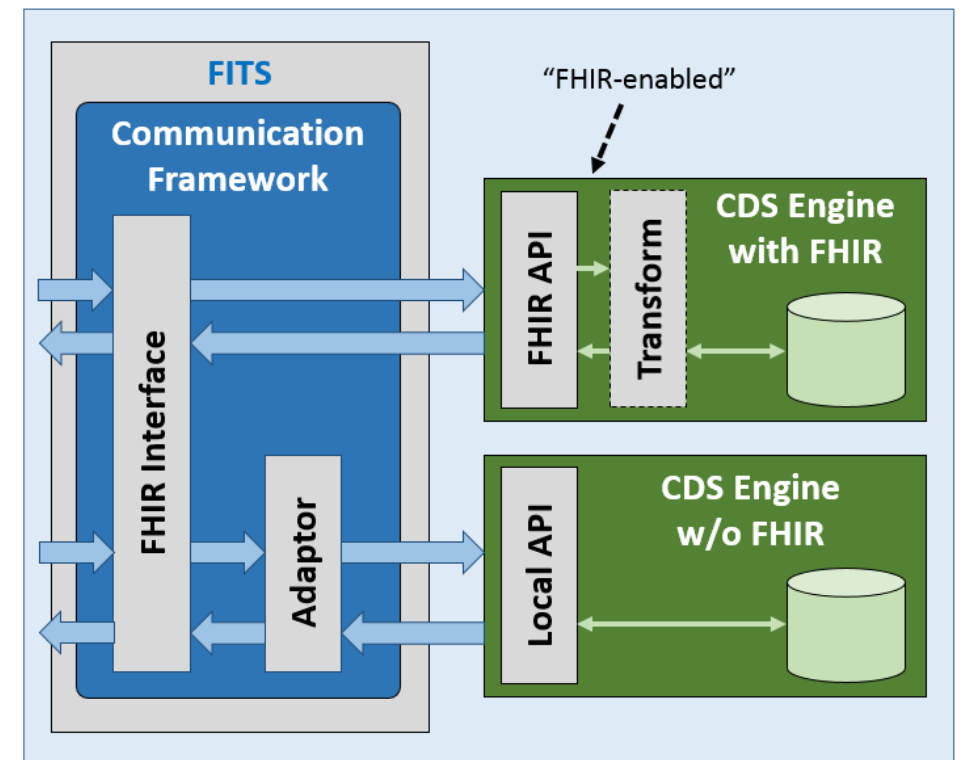


- ☐ Executes test cases
- ☐ Provides summary and detail validation reports
- ☐ Filtering capabilities
- ☐ Maintains history of validation reports
- ☐ Export reports in XML



# Standardize API for Immunization CDS Engines

- ❑ Current CDS engines use proprietary interfaces
- ❑ Standardized interface using HL7 FHIR
  - ❑ FHIR – Fast Healthcare Interoperability Resources
    - ❖ Data formats and elements (known as "resources") and an API for exchanging healthcare data using HTTP-based RESTful protocol
  - ❑ Based on:
    - ❖ Patient base resource
    - ❖ Immunization base resource
    - ❖ Immunization Recommendation base resource
  - ❑ Profiled for testing Immunization CDS Engines
    - ❖ Patient resource for Gender and DOB
    - ❖ Immunization resource for history
    - ❖ Immunization recommendation for evaluation
  - ❑ Organized as a FHIR Implementation Guide
    - ❖ Describes scope and purpose
    - ❖ Describes how to use the FHIR API





# FITS Demonstration

# NIST - Forecasting for Immunization Test Suite (FITS)

[Home](#) [Test Plans](#) [Execution](#) [Documentation](#) [About](#) [Glossary](#) [Issues](#)

[Test Plan](#) / [New Test Plan](#) / [Test Case](#) # 2 (Tdap) to child age 7. DTaP # 1 at ≥ 12 months. Forecast dose 3 for 6 months.

**Test Browser**


- New Test Plan (3 TC)
  - HEP Group (1 TC)
    - DTaP (2 TC)
      - #2013-0008- # 2 (Tdap) to child age 7. DTaP # 1 at ≥ 12 mont
      - #2013-0011- #3 at age 14 weeks-5 days

**Assessment Date and Patient Information**

Assessment Date	09/16/2011
Date Of Birth	09/16/2004
Gender	Female

**Vaccination History and Expected Evaluations**

ID #	Vaccine	Description	Date
ID # 0	CVX 107	DTaP, unspecified formulation	09/16/2005
ID # 1	CVX 115 MVX SKB	BOOSTRIX	09/16/2011

**Dashboard**

**TEST CASE INFORMATION**
**SUMMARY**

Name \*

# 2 (Tdap) to child age 7. DTaP # 1 at ≥ 12 months. Forecast dose 3 for 6 months.

Group ID

DTaP 2013-0008

Description

# 2 (Tdap) to child age 7. DTaP # 1 at ≥ 12 months. Forecast dose 3 for 6 months.

Type Date Created

Imported 4/3/2017

Version

1.0

Change Log



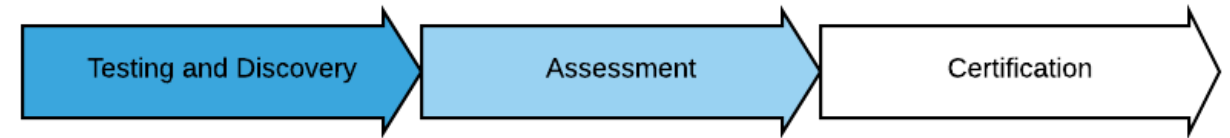
# AIRA Assessment Process

## ❑ MACAW

- ❑ Measurement for Assessment and Certification Advisory Workgroup
- ❑ Responsible for
  - ❖ providing direction
  - ❖ creating measures

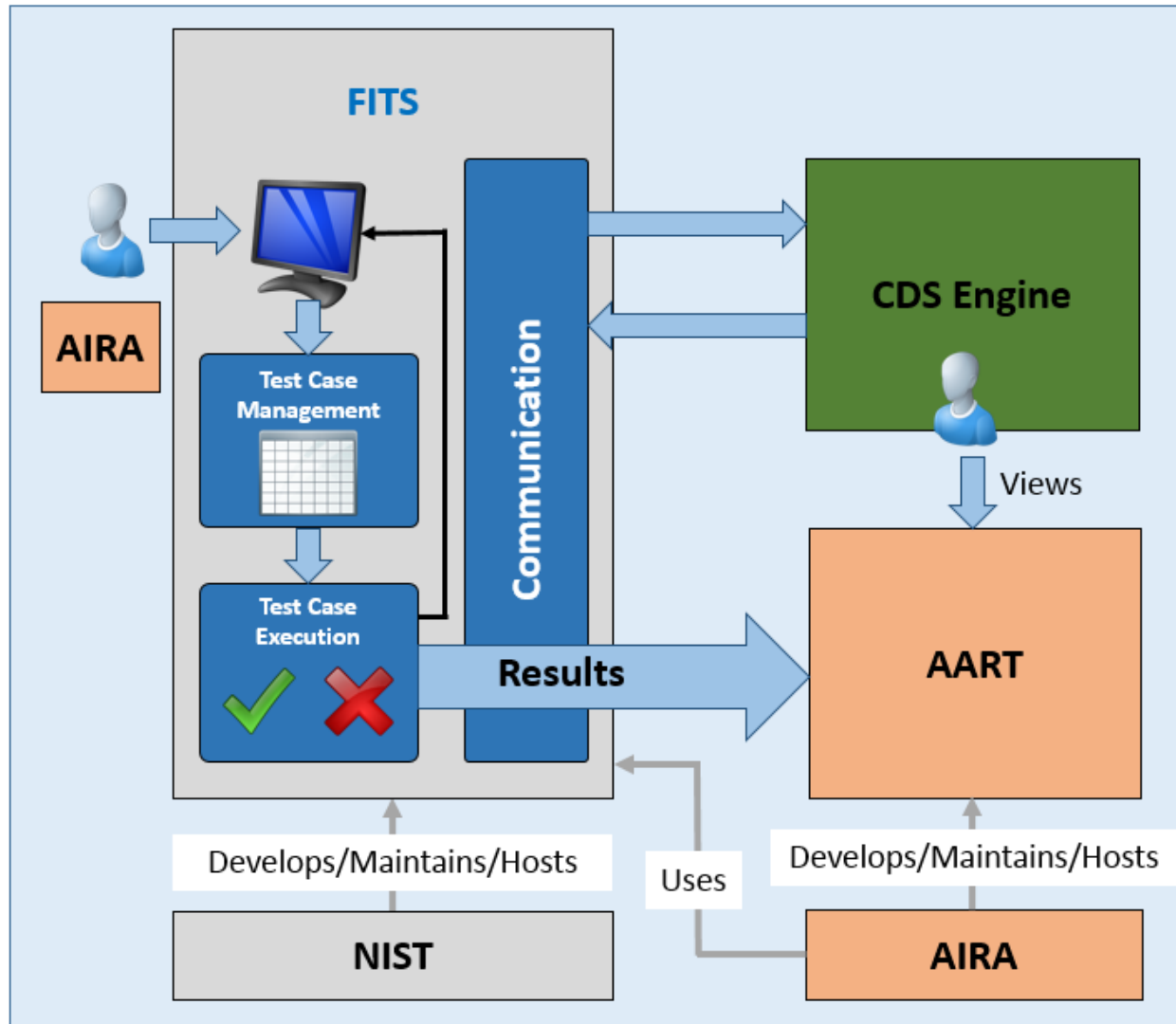
## ❑ AART

- ❑ Aggregate Analysis Reporting Tool
- ❑ Maintained by AIRA
- ❑ Community uses to access reports



Transport	Complete	Quarterly	Developing
Submission	Monthly	Complete	
Query	Monthly	Complete	
CDSi	Conducting Now	Developing	
Data Quality	Developing		
Participation/Saturation			
Deduplication			
Functionality			
Policy/Security			

# AIRA Assessment of Forecasting Engines



- ❑ NIST provides platform for self-testing or test programs
- ❑ MACAW to develop test cases for assessment
- ❑ AIRA uses FITS to conduct CDS Engine testing
- ❑ Community will access results via AART
- ❑ CDS Engine developers can view assessment results
- ❑ AART maintains history and progress reports



# What's Next?

- ❑ Beta release available now—1<sup>st</sup> official release by mid-Summer
- ❑ Give it a try!
  - ❑ Create test cases
  - ❑ Evaluate your engine
  - ❑ Build a FHIR interface to your engine
- ❑ Operationalize
  - ❑ Plan for creating and managing test cases
  - ❑ Updates and versioning
  - ❑ Adopted by the CDSi project
- ❑ Future capabilities
  - ❑ Test Case Verification Assistance
  - ❑ Support for collaboration
  - ❑ HL7 v2 End-to-end Testing

# Resources

- ❑ Tool Link:

<https://fits.nist.gov>



- ❑ Google Group – List Server for Discussion/Questions

- ❑ Google Group Site Link:

<https://groups.google.com/d/forum/fits-immunization-testing>

- ❑ Send messages to:

[fits-immunization-testing@googlegroups.com](mailto:fits-immunization-testing@googlegroups.com)



# FITS Demo – Home Page

**NIST** – Forecasting for Immunization Test Suite (FITS) 0.0.1-SNAPSHOT

Home Test Plans Validation Documentation About Issues My Account Logout

Welcome to the NIST Forecasting for Immunization Test Suite (FITS)

### FITS Overview

FITS (Forecasting for Immunization Test Suite) is a web-based application for testing immunization CDS engines against ACIP recommendations. FITS creates and manages test cases, runs and validates the test cases, creates reports in standardized formats, and provides standardized (FHIR) and non-standardized (proprietary) interfaces to the CDS engines.

FITS can be used to validate immunization CDS engines independently of the system in which the CDS resides or is associated (e.g., an EHR or IIS). FITS will contain a set of test cases authored and maintained by the CDC CDSi project (<https://www.cdc.gov/vaccines/programs/iis/cdsi.html>) that are available to be used to test CDS engines. Additionally, a user can create and persist their own test cases.

FITS is developed by the NIST in collaboration with the CDC and AIRA.

### Have a Question?


A Google Group **FITS** has been established for discussion/questions about the tool. No membership is required. A Google account is required for posting.

- Site: <https://groups.google.com/forum/#!forum/fits-immunization-testing>
- Email: [fits-immunization-testing@googlegroups.com](mailto:fits-immunization-testing@googlegroups.com)

### Supported Browsers

The following browsers are supported:

- Chrome (Recommended)
- Firefox
- Safari



NIST  
National Institute of  
Standards and Technology  
U.S. Department of Commerce

Application Information


Date: 04/05/2017 18:06:00, Application Version: 0.0.1-SNAPSHOT

Supported Browsers

Firefox Chrome Safari IE 9+

External Links

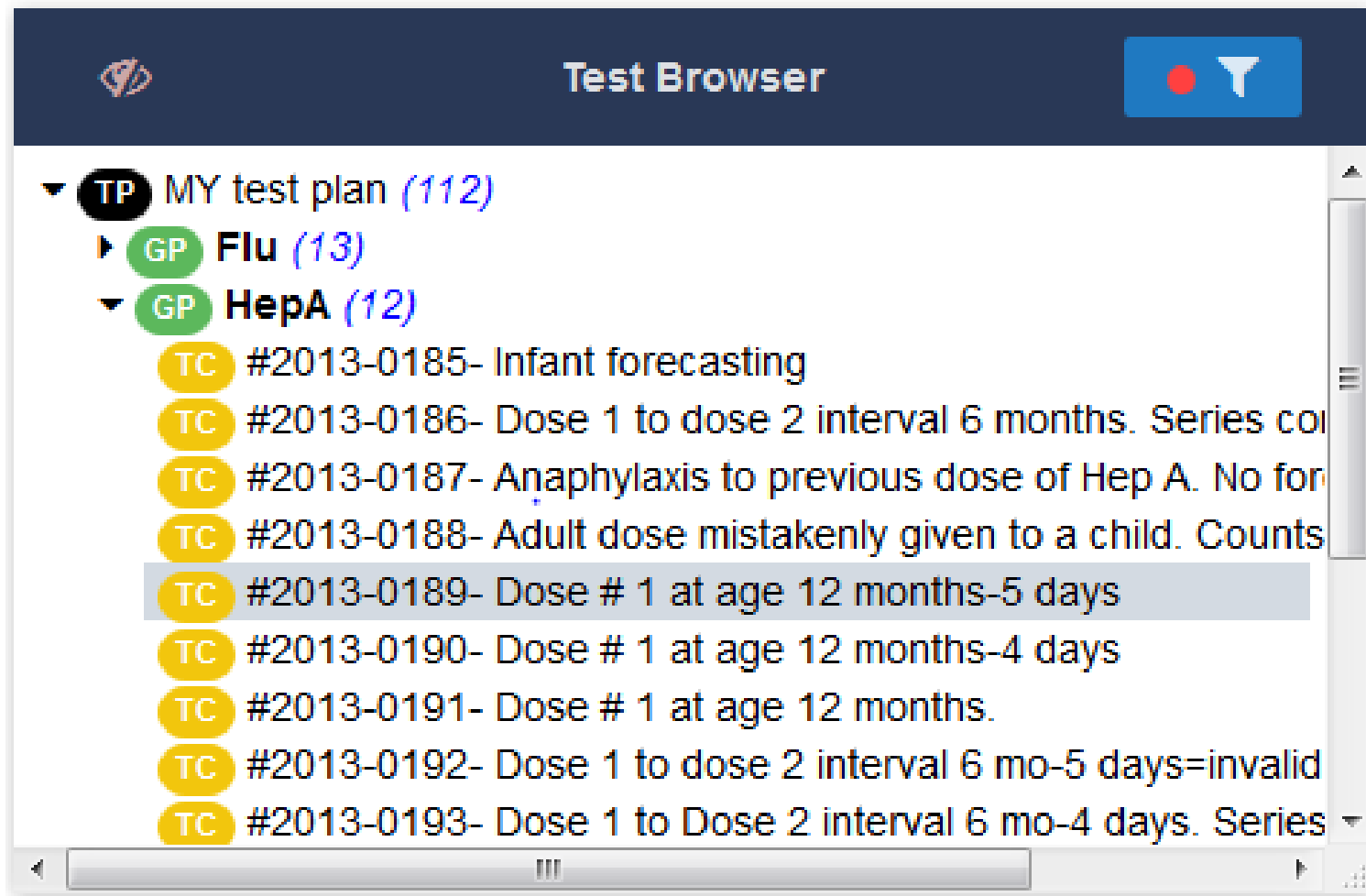
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INFORMATION  
TECHNOLOGY  
LABORATORY



# FITS Demo: Test Case Browser



# FITS Demo: Test Case Meta Data

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Test Plan

MY test plan /

Test Case

Dose # 1 at age 12 months-5 days

Test Browser

TP MY test plan (112)

GP Flu (13)

GP HepA (12)

TC #2013-0185- Infant forecasting

TC #2013-0186- Dose 1 to dose 2 interval 6 months. Series co

TC #2013-0187- Anaphylaxis to previous dose of Hep A. No for

TC #2013-0188- Adult dose mistakenly given to a child. Counts

TC #2013-0189- Dose # 1 at age 12 months-5 days

TC #2013-0190- Dose # 1 at age 12 months-4 days

TC #2013-0191- Dose # 1 at age 12 months.

TC #2013-0192- Dose 1 to dose 2 interval 6 mo-5 days=invalid

TC #2013-0193- Dose 1 to Dose 2 interval 6 mo-4 days. Series

Assessment Date and Patient Information

Assessment Date

11/26/2006

Date Of Birth

12/01/2005

Gender

Female

Vaccination History and Expected Evaluations

ID # 0

CVX 85

Hep A, unspecified formulation

11/26/2006

Expected Forecasts

Dashboard

TEST CASE INFORMATION

SUMMARY

Name \*

Dose # 1 at age 12 months-5 days

Group

HepA

ID

2013-0189

Date Type \*

Fixed Dates

Description

Dose # 1 at age 12 months-5 days

Type

Imported

Date Created

4/5/2017

Date Last Updated

4/5/2017

Last Changed in Test Plan Version

1.0

Change Log

LIST

IMPORT

EXPORT

SAVE

Summary

Info

File

Save

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# FITS Demo: Creating Test Cases

Dashboard

SUMMARY

ASSESSMENT DATE AND PATIENT INFORMATION

Gender\*

Female

Assessment Date

11/26/2006

Sunday, November 26, 2006

Date Of Birth

12/1/2005

Thursday, December 1, 2005


Dashboard

SUMMARY

VACCINATION EVENT

EXPECTED EVALUATIONS

Vaccine



Generic

CVX#85

Hep A, unspecified formulation  
hepatitis A vaccine, unspecified formulation

Date Of Vaccination

11/26/2006


Sunday, November 26, 2006

Dashboard

SUMMARY

FORECAST

Target



Generic

CVX#85

Hep A, unspecified formulation  
hepatitis A vaccine, unspecified formulation

Series Status

Dose Number

Forecast Reason

Not complete

1

Earliest

12/1/2006

Friday, December 1, 2006

Recommended

12/1/2006




Friday, December 1, 2006

Past Due

12/28/2007

Friday, December 28, 2007

Latest





# FITS Demo: Vaccination Browser

Vaccine Browser

Q Search

SELECT VACCINE GROUP

☐ Unspecified Formulation

<div><div>CVX 88</div><div>Influenza, Unspecified Formulation</div><div>Influenza Virus Vaccine, Unspecified Formulation</div></div> <div><div>👍</div><div>🔍</div></div>	<div><div>CVX 89</div><div>Polio, Unspecified Formulation</div><div>Poliovirus Vaccine, Unspecified Formulation</div></div> <div><div>👍</div><div>🔍</div></div>
<div><div>CVX 01</div><div>DTP</div><div>Diphtheria, Tetanus Toxoids And Pertussis Vaccine</div></div> <div><div>👍</div><div>🔍</div></div>	<div><div>CVX 02</div><div>OPV</div><div>Poliovirus Vaccine, Live, Oral</div></div> <div><div>👍</div><div>🔍</div></div>
<div><div>CVX 03</div><div>MMR</div><div>Measles, Mumps And Rubella Virus Vaccine</div></div> <div><div>👍</div><div>🔍</div></div>	<div><div>CVX 04</div><div>M/R</div><div>Measles And Rubella Virus Vaccine</div></div> <div><div>👍</div><div>🔍</div></div>
<div><div>CVX 05</div><div>Measles</div><div>Measles Virus Vaccine</div></div> <div><div>👍</div><div>🔍</div></div>	<div><div>CVX 06</div><div>Rubella</div><div>Rubella Virus Vaccine</div></div> <div><div>👍</div><div>🔍</div></div>
<div><div>CVX 07</div><div>Mumps</div><div>Mumps Virus Vaccine</div></div> <div><div>👍</div><div>🔍</div></div>	<div><div>CVX 08</div><div>Hep B, Adolescent Or Pediatric</div><div>Hepatitis B Vaccine, Pediatric Or Pediatric/adolescent Dosage</div></div> <div><div>👍</div><div>🔍</div></div>
<div><div>CVX 09</div><div>Td (Adult), Adsorbed</div><div>Tetanus And Diphtheria Toxoids, Adsorbed, For Adult Use</div></div> <div><div>👍</div><div>🔍</div></div>	<div><div>CVX 110</div><div>DTaP-Hep B-IPV</div><div>DTaP-hepatitis B And Poliovirus Vaccine</div></div> <div><div>👍</div><div>🔍</div></div>

# FITS Demo: Test Case Summary

Dose # 1 at age 12 months-5 da

## Test Case Data

### Test Case Metadata

Name	Dose # 1 at age 12 months-5 days
ID	2013-0189
Group	HepA
Description	Dose # 1 at age 12 months-5 days
Last Changed in Test Plan Version	1.0
Change Log	
Date Created	04/05/2017
Date Last Updated	04/05/2017
Type	Imported

### Assessment Date and Patient Information

Assessment Date	11/26/2006 - Sunday, November 26, 2006
Date Of Birth	12/01/2005 - Thursday, December 1, 2005
Gender	Female

### Vaccination History and Expected Evaluations

#### # 0 - Hep A, unspecified formulation - CVX : 85

Date Administred	11/26/2006 - Sunday, November 26, 2006			
Evaluations	CVX	Name	Status	Reason
	85	Hep A, unspecified formulation	Not Valid	

### Expected Forecasts

#### Hep A, unspecified formulation # 85

Series Status	Not complete
Reason	
Earliest Date	12/01/2006 - Friday, December 1, 2006
Recommended Date	12/01/2006 - Friday, December 1, 2006
Past Due Date	12/28/2007 - Friday, December 28, 2007
Latest Date	

# FITS Demo: Loading to Test Cases to Validate

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Software

TCH

+

Assessment Date for Relative Dates

4/6/2017

Thursday, April 6, 2017

Name	Actions
#2013-0185 - Infant forecasting	<div>×</div>
#2013-0186 - Dose 1 to dose 2 interval 6 months. Series complete.	<div>×</div>
#2013-0187 - Anaphylaxis to previous dose of Hep A. No forecast.	<div>×</div>
#2013-0188 - Adult dose mistakenly given to a child. Counts as valid.	<div>×</div>
#2013-0189 - Dose # 1 at age 12 months-5 days	<div>×</div>
#2013-0190 - Dose # 1 at age 12 months-4 days	<div>×</div>

Test Cases

TP AIRA Demo

TP SLT Test Plan

TP MY test plan

GP Flu (13)

GP HepA (12)

- TC #2013-0185- Infant forecasting
- TC #2013-0186- Dose 1 to dose 2 interval 6 months. Series complete.
- TC #2013-0187- Anaphylaxis to previous dose of Hep A. No forecast.
- TC #2013-0188- Adult dose mistakenly given to a child. Counts as valid.
- TC #2013-0189- Dose # 1 at age 12 months-5 days
- TC #2013-0190- Dose # 1 at age 12 months-4 days
- TC #2013-0191- Dose # 1 at age 12 months.
- TC #2013-0192- Dose 1 to dose 2 interval 6 mo-5 days=inv

Test View

No TestCase Selected

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# FITS Demo: Validation Results I

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100%

SAVE REPORTS

TCH at http://tchforecasttester.org/fv/forecast ...

Filters

Name	Evaluations				Forecasts				Actions
	Results	Requirements	Correctness	Completion	Results	Requirements	Correctness	Completion	
#2013-0191 - Dose # 1 at age 12 months.	1	1	100%	100%	22	4	100%	100%	<div></div> <div></div>
#2013-0192 - Dose 1 to dose 2 interval 6 mo-5 days=invalid	2	2	100%	100%	22	4	100%	100%	<div></div> <div></div>
#2013-0193 - Dose 1 to Dose 2 interval 6 mo-4 days. Series complete.	2	2	100%	100%	1	1	100%	100%	<div></div> <div></div>
#2013-0194 - Dose # 2 at 18 months=series complete.	2	2	100%	100%	1	1	100%	100%	<div></div> <div></div>
#2013-0196 - Dose 1 to dose 2 interval 6 mo-5 days	2	2	100%	100%	22	4	100%	100%	<div></div> <div></div>
#2013-0197 - Dose 1 to dose 2 interval 6 months-4 days. Series complete.	2	2	100%	100%	1	1	100%	100%	<div></div> <div></div>

CORRECT

ERRORS

WARNINGS

INCOMPLETE

Results

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# FITS Demo: Validation Results Filters

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100%

SAVE REPORTS

TCH at http://tchforecasttester.org/fv/forecast ...

Filters

Execution Success Only

100% Complete

< 100% Complete

100% Success

Contains Errors

Contains Warnings

100% Complete

< 100% Complete

Complete Success

Incorrect Earliest Date

Incorrect Recommended

Contains Errors

Contains Warnings

Incorrect Past Due Date

Incorrect Latest Date

RESET

TOTAL 1

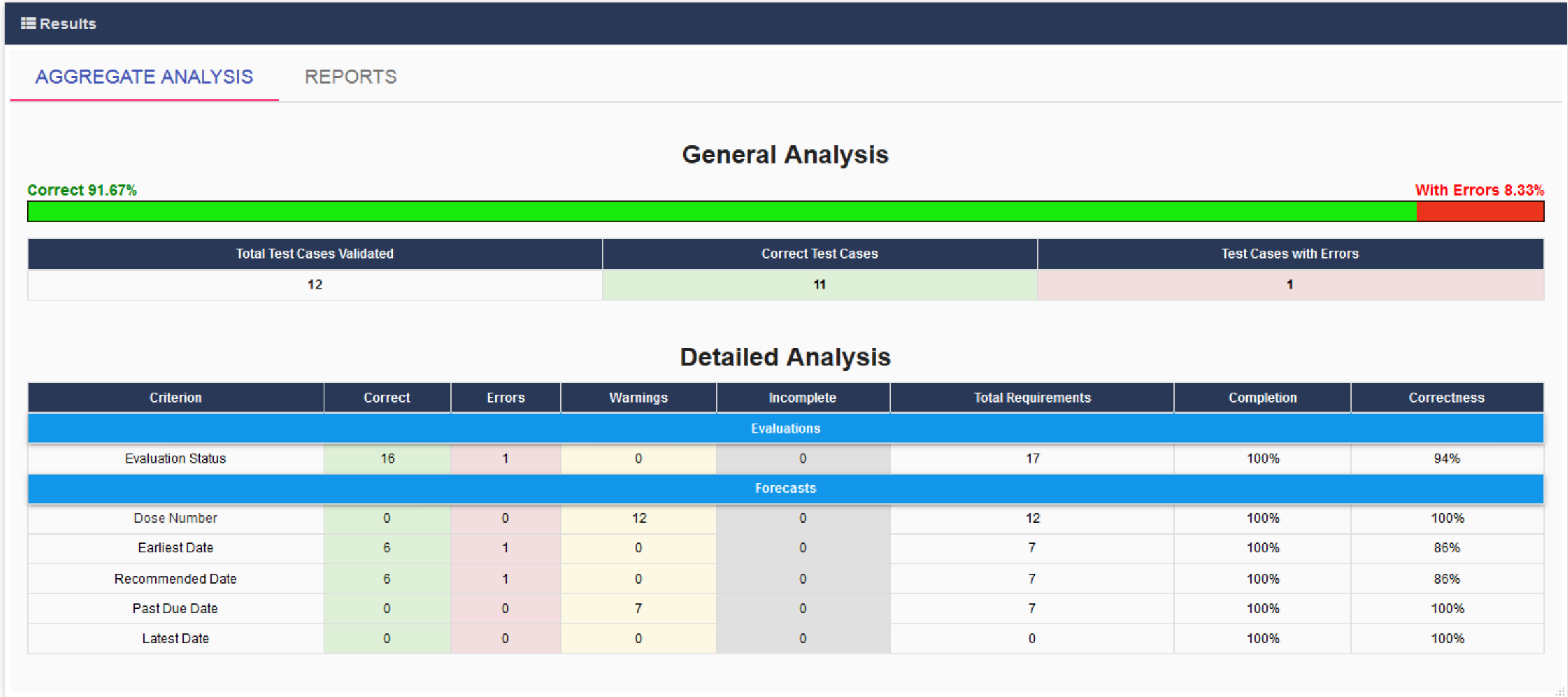
Name	Evaluations				Forecasts				Actions
	Results	Requirements	Correctness	Completion	Results	Requirements	Correctness	Completion	
#2013-0188 - Adult dose mistakenly given to a child. Counts as valid.	1	1	0%	100%	22	4	0%	100%	<div>✕</div> <div>🔍</div>

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# FITS Demo: Aggregate Analysis



# FITS Demo: Individual Test Case Results

TestCase Data

Assessment Date	02/02/2012
Patient Date Of Birth	02/02/2011
Patient Gender	F

Summary

	Evaluations	Forecasts
CORRECT	0	0
ERRORS	1	2
WARNINGS	0	2
INCOMPLETE	0	0
CORRECTNESS	0 %	0 %
COMPLETION	100 %	100 %

EventsForecasts

Criterion	Expected	Actual	Assessment
<div><div><div>S</div><div>CVX#52</div><div>MVX#SKB</div></div><div>Hep A, adult By GlaxoSmithKline HAVRIX-ADULT Date Administred : 02/02/2012</div></div>			
#52 - Hep A, adult	VALID	INVALID	FAILED

Criterion	Expected	Actual	Assessment
<div>CVX#85</div>	Hep A, unspecified formulation		
Dose	2	#	WARNING
Earliest	08/02/2012	02/02/2012 ( minus 182 days )	FAILED
Recommended	08/02/2012	02/02/2012 ( minus 182 days )	FAILED
Past Due	03/01/2013	02/02/2013 ( minus 27 days )	WARNING

XML Response