



**AIRA**  
AMERICAN IMMUNIZATION  
REGISTRY ASSOCIATION

# Measures and Tests for Assessment

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**Clinical Decision Support**

June 18, 2017

## Background and Context

Immunization information systems (IIS) provide healthcare providers with immunization clinical decision support (CDS) tools designed to automatically determine the recommended immunizations needed when a patient presents for vaccination. These recommendations are developed by the Advisory Committee on Immunization Practices (ACIP). In an effort to harmonize the outcomes of existing CDS tools, the Immunization Information System Support Branch (IISSB) at the CDC funded the Clinical Decision Support for Immunization (CDSi) Project to develop new clinical decision support resources for each vaccine preventable disease in accordance with ACIP recommendations.<sup>1</sup>

In 2016, AIRA convened the Measurement for Assessment and Certification Advisory Workgroup (MACAW) to develop and propose measures for IIS Assessment. CDS measures and tests are the fourth phase to be developed. These measures and tests are shared with the AIRA Board of Directors and the full AIRA community to ensure broad community input and agreement.

The IIS Assessment and Certification Roadmap<sup>2</sup> states the purpose of the assessment stage is to provide IIS with information to more fully align with IIS Functional Standards<sup>3</sup> (FS), while also developing a summary of where IIS are as an overall network in meeting standards and best practices.

## Functional Standards

The use of standardized CDS tools are referenced throughout the newly developed IIS Functional Standards, v4.0<sup>4</sup> and Operational Guidance Statements (OGS). The revised IIS FS were developed by the IISSB, through a consensus-based process involving input from a variety of IIS managers and technical experts from across the U.S. They are intended to reflect the functionality an IIS should strive to attain to fully support program and stakeholder immunization-related goals. The OGS provide further guidance to the IIS community about how to achieve the FS and to inform the development of measures for achievement. The following FS and OGS are included – at some level – in the MACAW measures and tests defined in this document.

**FS 10.0:** The IIS forecasts pediatric, adolescent, and adult immunizations in a manner consistent with the Advisory Committee on Immunization Practices (ACIP) recommendations.

**OGS 10.1:** The IIS uses Clinical Decision Support (CDS) functionality that can be updated to reflect new or revised ACIP recommendations.

**OGS 10.2:** The IIS displays and sends an evaluated immunization history that adheres to ACIP recommendations for each vaccination event.

**OGS 10.3:** The IIS displays and sends a forecast that adheres to ACIP recommendations, with status indicators for each vaccine and vaccine family.

**OGS 10.4:** The IIS CDS functionality is updated for the IIS in a timely fashion after new ACIP recommendations are incorporated into the CDC Clinical Decision Support for immunization (CDSi) resources published on the CDC website.

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<sup>1</sup> <https://www.cdc.gov/vaccines/programs/iis/interop-proj/downloads/logic-spec-acip-rec.pdf> version 3.0 - pp. 8

<sup>2</sup> [http://www.immregistries.org/resources/aira-initiatives/IIS\\_Assessment\\_Consolidated\\_Roadmap.pdf](http://www.immregistries.org/resources/aira-initiatives/IIS_Assessment_Consolidated_Roadmap.pdf)

<sup>3</sup> <https://www.cdc.gov/vaccines/programs/iis/func-stds.html>

<sup>4</sup> <https://www.cdc.gov/vaccines/programs/iis/func-stds.html>

## Measures and Tests

MACAW defined the scope, measures, high-level test case strategies, measurement outcomes, and testing methods for measuring the accuracy of CDS engines. These recommendations will be shared with the community for input and presented to the AIRA Board of Directors for approval.

### Scope

The scope includes routine age-based recommendations for pediatric, adolescent, and adulthood. The scope does not include contraindications, immunities, or increased risk schedules.

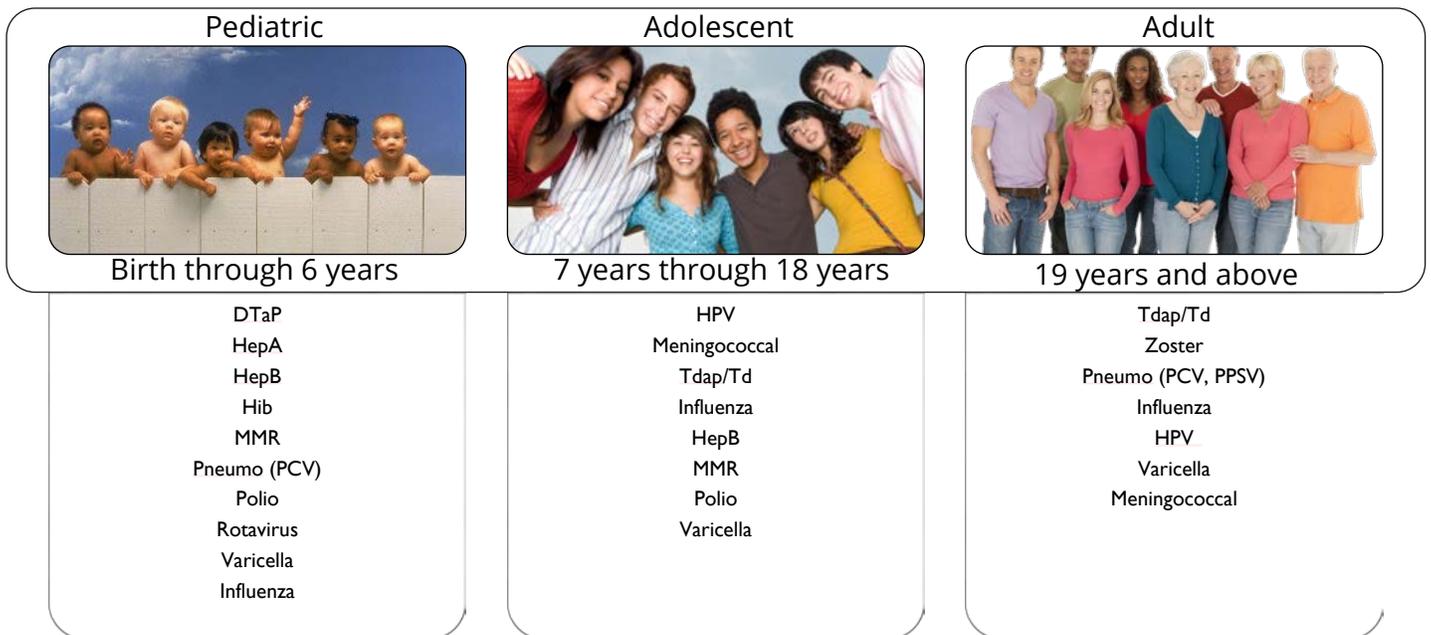


Figure 1: CDS Assessment Scope

### Measures

The measures focus on three CDS concepts which can be returned in a Health Level 7 (HL7) message are defined in the CDSi resources, and Functional Guide Volume on Query and Response. The concepts – defined below – are the Evaluation Status, Earliest Date, and Recommended Date. Each IIS is assessed on capability to return a concept and accuracy if the concept is returned. Please See [Appendix B](#) for discussion on Past Due Date and Series Status inclusion.

This results in a total of four measures for each CDS concept.

- One capability measure to measure if the concept is returned
- Three accuracy measures to measure the content returned, one each for pediatric, adolescent, and adult

The following CDS measures were consented and are further defined in the remainder of this document. Key terms and phrases have been defined in [Appendix A](#).

### Key Notes

- Not all jurisdictions or IIS CDS engines provide evaluation or forecasts for all ages. In these cases, the IIS will not be assessed on measures outside of their scope of CDS.

- If an IIS does not return a concept (e.g., Evaluation Status), the IIS will not fully meet the capability measure since it is not returned, but the IIS will not be assessed on the three accuracy measures for that concept (e.g., they will neither pass nor fail the accuracy measures).
- This testing focuses on age-groups and specific vaccine groups within those age groups. It does not focus on entire patient forecasts across all age groups. The Functional Guide Volume on Query and Response does address this issue and should be reviewed by all implementers outside of this CDS Assessment effort.

### Evaluation Status

**Definition:** The determination if the vaccine event “counted” (e.g., valid, not valid).

- 1) The IIS HL7 interface returns an Evaluation Status (e.g., dose validity) for each vaccination event.
- 2) The Evaluation Status returned by the IIS matches the CDC CDSi expected value for routine age-based pediatric recommendations.
- 3) The Evaluation Status returned by the IIS matches the CDC CDSi expected value for routine age-based adolescent recommendations.
- 4) The Evaluation Status returned by the IIS matches the CDC CDSi expected value for routine age-based adult recommendations.

### Earliest Date

**Definition:** The date at which point the patient could receive the next dose if the patient was likely to not return or has other reasons to accelerate the schedule quicker than the recommended date.

- 5) The IIS HL7 interface returns an Earliest Date for each forecasted dose.
- 6) The Earliest Date returned by the IIS matches the CDC CDSi expected value for routine age-based pediatric recommendations.
- 7) The Earliest Date returned by the IIS matches the CDC CDSi expected value for routine age-based adolescent recommendations.
- 8) The Earliest Date returned by the IIS matches the CDC CDSi expected value for routine age-based adult recommendations.

### Recommended Date

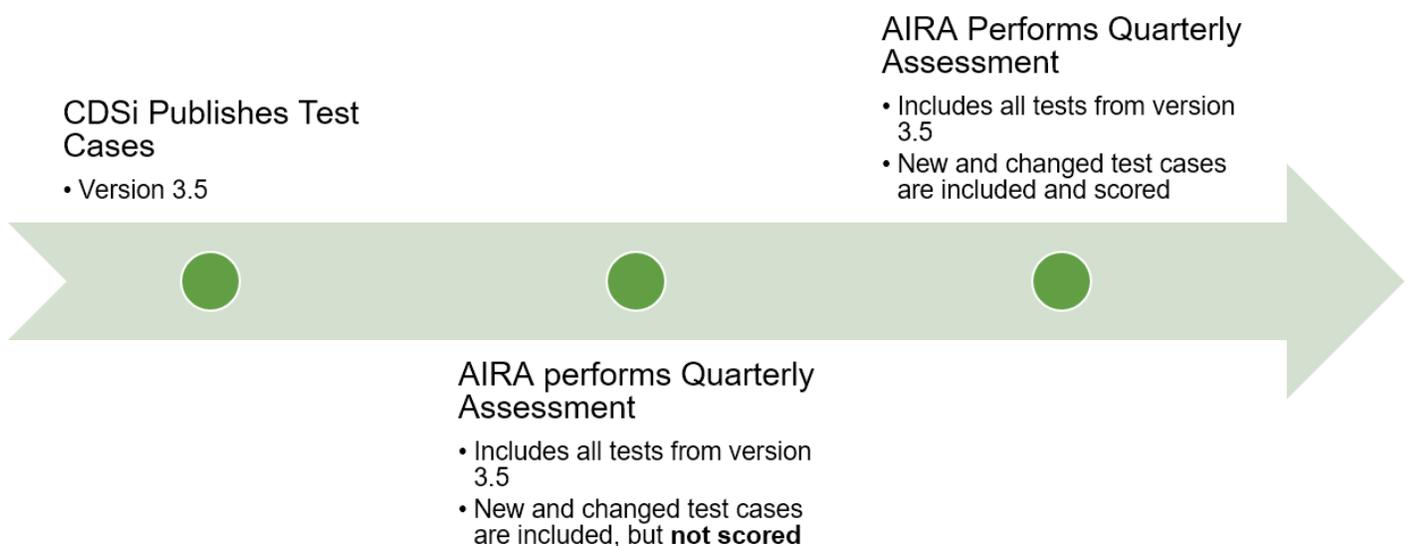
**Definition:** The date at which point the patient should receive the next dose.

- 9) The IIS HL7 interface returns a Recommended Date for each forecasted dose.
- 10) The Recommended Date returned by the IIS matches the CDC CDSi expected value for routine age-based pediatric recommendations.
- 11) The Recommended Date returned by the IIS matches the CDC CDSi expected value for routine age-based adolescent recommendations.
- 12) The Recommended Date returned by the IIS matches the CDC CDSi expected value for routine age-based adult recommendations.

## Tests

The MACAW members developed high-level strategies for developing test cases for each measure. These strategies were used to create detailed test cases for each measure. Test cases were developed with the following guiding principles in mind:

- **Isolate the Test Case to the measure:** Each test case should be isolated to the measure to ensure consistent measurement across all IIS.
- **Expectations for a test case should be few, not many:** Multiple expectations – either in number or variation – lead to inconsistencies in assessment across all IIS. For example, IIS “A” could fail for one reason while IIS “B” could fail for a different reason. When results are aggregated across all IIS, it becomes difficult to tease apart the variation and develop actionable improvement strategies.
- **Leverage current CDC CDSi test cases:** Community created and vetted test cases should be re-used if at all possible. CDS Assessment will use the CDSi published test cases as soon as they are available. With each published version of CDSi test cases, the CDS Assessment will test, but not score new or changed CDSi test cases during the first quarterly assessment. They will be included in scoring during subsequent quarters. This approach will allow IIS to see the new or changed test cases and address them prior to the next quarterly assessment.



- **Also measure the middle:** CDSi test cases focus on the edge – or boundary – between valid and invalid doses. This is an interesting area and much needed, but many vaccines are administered at the recommended time and forecasting should be tested in these cases as well. Additional test cases should be added to test typical administration patterns.

## Measure and Test Outcomes

Each test case has a defined Test Case Expectation. The test cases and test case expectations are used during testing to determine how well a CDS engine aligns with the CDC CDSi expectations. Each test is either marked as either “meets” or “does not meet” based on the CDC CDSi expectations.

Each measure is given a “Degree of Alignment” score by dividing the number of test cases passed divided by the number of total tests within a measure.

The Degree of Alignment score must be at or above the defined thresholds set within each measure to fully meet the measure.

### Testing Method

Several methods were discussed to carry out the testing ranging from leveraging existing HL7 interfaces to User Interface reviews. MACAW recommended leveraging the HL7 interface for several reasons including:

- Fully testing a CDS engine requires a considerable number of test cases so automation is critical.
- User Interface testing (and any other hybrid approach) was too time consuming and resource intensive given current resources.
- At the time of this decision, AIRA had connections to 25 IIS who return CDS within their HL7 engine with more building the capability in preparation for Meaningful Use Stage 3.
- No alternative national standard exists for direct communication to a CDS engine and very few CDS engines have explicit external communication endpoints. MACAW will revisit this if or when a National CDS standard is developed.
- Testing via HL7 continues to build on existing areas of assessment (e.g., transport, HL7). This reduces the effort by IIS programs to participate and continues to build on the real-world relationship between a provider and an IIS.

Each test case will be first submitted to the IIS via an HL7 VXU submission. A query (QBP) will then be issued for the patient and the response (RSP) will be analyzed. The query (QBP) will be either the Z34 (Complete History) or the Z44 (Evaluated History and Forecast) based on IIS preference. Both of those query responses can contain clinical decision support.

## Evaluation Status Measures

### Measure 1:

The IIS HL7 interface returns an Evaluation Status (e.g., dose validity) for each vaccination event.

Purpose	Supports
The purpose of this measure is to identify if an IIS returns evaluation status. The accuracy of the evaluation status is not measured within this measure.	<b>FS 10.0:</b> The IIS forecasts pediatric and adult immunizations in a manner consistent with ACIP recommendations. <b>OGS 10.2:</b> The IIS displays and/or sends an evaluated immunization history that adheres to ACIP recommendations for each vaccination event.

Test Case	Test Case Expectation
A patient with one valid dose and one invalid dose will be sent to the IIS and subsequently queried for.	The response explicitly includes an evaluation status for each dose administered through the use of the HL7 standard LOINC for dose validity (59781-5).

Measure Outcome	
<b>Fully Meets</b>	The IIS will Fully Meet this measure if the test case expectation is met.
<b>Deviates</b>	Deviation is not a possible measure outcome for this measure.
<b>Does Not Meet</b>	The IIS will Not Meet this measure if the test case expectation is not met.

## Measure 2:

The Evaluation Status returned by the IIS matches the CDC CDSi expected value for routine age-based pediatric recommendations.

Purpose	Supports
<p>The purpose of this measure is to measure the degree of alignment when an IIS returns evaluation status.</p> <p>When the CDSi project publishes new/updated test cases, they will be incorporated into the CDS Assessment 30 days after publication. This will help measure the uptake of new/changed ACIP recommendations and clarifications in a timely fashion (OGS 10.4).</p>	<p><b>FS 10.0:</b> The IIS forecasts pediatric and adult immunizations in a manner consistent with ACIP recommendations.</p> <p><b>OGS 10.2:</b> The IIS displays and/or sends an evaluated immunization history that adheres to ACIP recommendations for each vaccination event.</p> <p><b>OGS 10.4:</b> The IIS CDS functionality is updated for the IIS in a timely fashion after new ACIP recommendations are incorporated into the CDC CDSi resources published on the CDC website.</p>

Test Case Sets	Test Case Expectation																						
<p><b>CDSi Test Cases:</b> As CDSi publishes updates to their test cases, these numbers will change. This analysis is based on version 3.2 of the CDSi test cases published in March 2017.</p> <table border="1"> <thead> <tr> <th>Vaccine Family</th> <th>Number of Test Cases</th> </tr> </thead> <tbody> <tr><td>DTaP</td><td>118</td></tr> <tr><td>HepA</td><td>9</td></tr> <tr><td>HepB</td><td>54</td></tr> <tr><td>Hib</td><td>101</td></tr> <tr><td>MMR</td><td>37</td></tr> <tr><td>Pneumo (PCV)</td><td>47</td></tr> <tr><td>Polio</td><td>105</td></tr> <tr><td>Rotavirus</td><td>30</td></tr> <tr><td>Varicella</td><td>28</td></tr> <tr><td>Flu</td><td>9</td></tr> </tbody> </table>	Vaccine Family	Number of Test Cases	DTaP	118	HepA	9	HepB	54	Hib	101	MMR	37	Pneumo (PCV)	47	Polio	105	Rotavirus	30	Varicella	28	Flu	9	<p>The Evaluation Status returned by the IIS will match the published CDSi test case expectations.</p> <p>One limitation in using HL7 for this measurement is the HL7 response message is only able to message two outcomes of the vaccination event while the CDSi project has the potential for four outcomes. For the most part, this works well as nearly all CDSi test cases result in either valid or not valid. A limited number have other expectations. To accommodate for this, test cases with an Evaluation Status expectation of either Extraneous or Substandard will be excluded from assessment until clear interfacing guidance can be set by the Standards and Interoperability Steering Committee (SISC).</p>
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<p><b>Additional Test Cases:</b> A set of test cases will be added to focus on vaccination events occurring at the recommended age and/or intervals for vaccines in scope.</p>	<p>The Evaluation Status returned by the IIS will match the expectation per the published CDSi Supporting Data and Logic Specification.</p>																						

Measure Outcome
<p>NOTE: Actual Thresholds (MEETS%, DEV%, VAC_FAM%) will be confirmed following initial analysis performed in quarter 4, 2018</p>

<b>Fully Meets</b>	<p>The IIS will Fully Meet this measure if both of the following are true:</p> <ul style="list-style-type: none"> <li>• The IIS has a Degree of Alignment score at or above MEETS%.</li> <li>• Each individual vaccine family shall be at or above VAC_FAM%.</li> </ul>
<b>Deviates</b>	<p>The IIS will Deviate from this measure if both of the following are true:</p> <ul style="list-style-type: none"> <li>• The IIS has a Degree of Alignment score at or above DEV%, but less than MEETS%.</li> <li>• Each individual vaccine family shall be at or above VAC_FAM%.</li> </ul>
<b>Does Not Meet</b>	<p>The IIS will Not Meet this measure if either of the following are true:</p> <ul style="list-style-type: none"> <li>• The IIS has a Degree of Alignment score below DEV%</li> <li>• Any individual vaccine family is below VAC_FAM%</li> </ul>

### Measure 3:

The Evaluation Status returned by the IIS matches the CDC CDSi expected value for routine age-based adolescent recommendations.

Purpose	Supports
<p>The purpose of this measure is to measure the degree of alignment when an IIS returns evaluation status.</p> <p>When the CDSi project publishes new/updated test cases, they will be incorporated into the CDS Assessment 30 days after publication. This will help measure the uptake of new/changed ACIP recommendations and clarifications in a timely fashion (OGS 10.4).</p>	<p><b>FS 10.0:</b> The IIS forecasts pediatric and adult immunizations in a manner consistent with ACIP recommendations.</p> <p><b>OGS 10.2:</b> The IIS displays and/or sends an evaluated immunization history that adheres to ACIP recommendations for each vaccination event.</p> <p><b>OGS 10.4:</b> The IIS CDS functionality is updated for the IIS in a timely fashion after new ACIP recommendations are incorporated into the CDC CDSi resources published on the CDC website.</p>

Test Case Sets	Test Case Expectation																														
<p><b>CDSi Test Cases:</b> As CDSi publishes updates to their test cases these numbers will change. This analysis is based on version 3.2 of the CDSi test cases published in March 2017.</p> <table border="1"> <thead> <tr> <th>Vaccine Family</th> <th>Number of Test Cases</th> </tr> </thead> <tbody> <tr><td>HepA</td><td>1</td></tr> <tr><td>HepB</td><td>9</td></tr> <tr><td>HPV</td><td>79</td></tr> <tr><td>Meningococcal</td><td>18</td></tr> <tr><td>MMR</td><td>1</td></tr> <tr><td>Polio</td><td>8</td></tr> <tr><td>Tdap/Td</td><td>40</td></tr> <tr><td>Varicella</td><td>5</td></tr> <tr><td>Flu</td><td>1</td></tr> </tbody> </table>	Vaccine Family	Number of Test Cases	HepA	1	HepB	9	HPV	79	Meningococcal	18	MMR	1	Polio	8	Tdap/Td	40	Varicella	5	Flu	1	<p>The Evaluation Status returned by the IIS will match the published CDSi test case expectations.</p> <p>One limitation in using HL7 for this measurement is the HL7 response message is only able to message two outcomes of the vaccination event while the CDSi project has the potential for four outcomes. For the most part, this works well as nearly all CDSi test cases result in either valid or not valid. A limited number have other expectations. To accommodate for this difference the following CDSi Evaluation Statuses will map to following HL7 dose validity values.</p> <table border="1"> <thead> <tr> <th>CDSi Expected Evaluation Status</th> <th>HL7 Dose Validity Value</th> </tr> </thead> <tbody> <tr><td>Valid</td><td>Yes</td></tr> <tr><td>Not Valid</td><td>No</td></tr> <tr><td>Extraneous</td><td>Yes/No</td></tr> <tr><td>Substandard</td><td>No</td></tr> </tbody> </table>	CDSi Expected Evaluation Status	HL7 Dose Validity Value	Valid	Yes	Not Valid	No	Extraneous	Yes/No	Substandard	No
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**Measure Outcome**

NOTE: Actual Thresholds (MEETS%, DEV%, VAC\_FAM%) will be confirmed following initial analysis performed in quarter 4, 2018

<b>Fully Meets</b>	The IIS will Fully Meet this measure if both of the following are true: <ul style="list-style-type: none"><li>• The IIS has a Degree of Alignment score at or above MEETS%.</li><li>• Each individual vaccine family shall be at or above VAC_FAM%.</li></ul>
<b>Deviates</b>	The IIS will Deviate from this measure if both of the following are true: <ul style="list-style-type: none"><li>• The IIS has a Degree of Alignment score at or above DEV%, but less than MEETS%.</li><li>• Each individual vaccine family shall be at or above VAC_FAM%.</li></ul>
<b>Does Not Meet</b>	The IIS will Not Meet this measure if either of the following are true: <ul style="list-style-type: none"><li>• The IIS has a Degree of Alignment score below DEV%</li><li>• Any individual vaccine family is below VAC_FAM%</li></ul>

Measure 4:

The Evaluation Status returned by the IIS matches the CDC CDSi expected value for routine age-based adult recommendations.

Purpose	Supports
<p>The purpose of this measure is to measure the degree of alignment when an IIS returns evaluation status.</p> <p>When the CDSi project publishes new/updated test cases, they will be incorporated into the CDS Assessment 30 days after publication. This will help measure the uptake of new/changed ACIP recommendations and clarifications in a timely fashion (OGS 10.4).</p>	<p><b>FS 10.0:</b> The IIS forecasts pediatric and adult immunizations in a manner consistent with ACIP recommendations.</p> <p><b>OGS 10.2:</b> The IIS displays and/or sends an evaluated immunization history that adheres to ACIP recommendations for each vaccination event.</p> <p><b>OGS 10.4:</b> The IIS CDS functionality is updated for the IIS in a timely fashion after new ACIP recommendations are incorporated into the CDC CDSi resources published on the CDC website.</p>

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<p><b>CDSi Test Cases:</b> As CDSi publishes updates to their test cases these numbers will change. This analysis is based on version 3.2 of the CDSi test cases published in March 2017.</p> <table border="1"> <thead> <tr> <th>Vaccine Family</th> <th>Number of Test Cases</th> </tr> </thead> <tbody> <tr> <td>HPV</td> <td>3</td> </tr> <tr> <td>Pneumococcal</td> <td>3</td> </tr> <tr> <td>Varicella</td> <td>3</td> </tr> <tr> <td>Zoster</td> <td>6</td> </tr> </tbody> </table>	Vaccine Family	Number of Test Cases	HPV	3	Pneumococcal	3	Varicella	3	Zoster	6	<p>The Evaluation Status returned by the IIS will match the published CDSi test case expectations.</p> <p>One limitation in using HL7 for this measurement is the HL7 response message is only able to message two outcomes of the vaccination event while the CDSi project has the potential for four outcomes. For the most part, this works well as nearly all CDSi test cases result in either valid or not valid. A limited number have other expectations. To accommodate for this difference the following CDSi Evaluation Statuses will map to following HL7 dose validity values.</p> <table border="1"> <thead> <tr> <th>CDSi Expected Evaluation Status</th> <th>HL7 Dose Validity Value</th> </tr> </thead> <tbody> <tr> <td>Valid</td> <td>Yes</td> </tr> <tr> <td>Not Valid</td> <td>No</td> </tr> <tr> <td>Extraneous</td> <td>Yes/No</td> </tr> <tr> <td>Substandard</td> <td>No</td> </tr> </tbody> </table>	CDSi Expected Evaluation Status	HL7 Dose Validity Value	Valid	Yes	Not Valid	No	Extraneous	Yes/No	Substandard	No
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**Measure Outcome**

NOTE: Actual Thresholds (MEETS%, DEV%, VAC\_FAM%) will be confirmed following initial analysis performed in quarter 4, 2018

<b>Fully Meets</b>	The IIS will Fully Meet this measure if both of the following are true: <ul style="list-style-type: none"><li>• The IIS has a Degree of Alignment score at or above MEETS%.</li><li>• Each individual vaccine family shall be at or above VAC_FAM%.</li></ul>
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<b>Does Not Meet</b>	The IIS will Not Meet this measure if either of the following are true: <ul style="list-style-type: none"><li>• The IIS has a Degree of Alignment score below DEV%</li><li>• Any individual vaccine family is below VAC_FAM%</li></ul>

## Earliest Date Measures

### Measure 5:

The IIS HL7 interface returns an Earliest Date for each forecasted dose.

<b>Purpose</b>	<b>Supports</b>
The purpose of this measure is to identify if an IIS returns earliest date. The accuracy of the earliest date is not measured within this measure.	<b>FS 10.0:</b> The IIS forecasts pediatric and adult immunizations in a manner consistent with ACIP recommendations. <b>OGS 10.3:</b> The IIS displays and/or sends a forecast that adheres to ACIP recommendations, with status indicators for each vaccine and vaccine family.

<b>Test Case</b>	<b>Test Case Expectation</b>
A patient with an at birth HepB will be sent to the IIS and subsequently queried for.	The response explicitly includes an earliest date for each forecasted dose through the use of the HL7 standard LOINC for earliest date (30981-5).

<b>Measure Outcome</b>	
<b>Fully Meets</b>	The IIS will Fully Meet this measure if the test case expectation is met.
<b>Deviates</b>	Deviation is not a possible measure outcome for this measure.
<b>Does Not Meet</b>	The IIS will Not Meet this measure if the test case expectation is not met.

## Measure 6:

The Earliest Date returned by the IIS matches the CDC CDSi expected value for routine age-based pediatric recommendations.

Purpose	Supports
<p>The purpose of this measure is to measure the degree of alignment when an IIS returns earliest date.</p> <p>When the CDSi project publishes new/updated test cases, they will be incorporated into the CDS Assessment 30 days after publication. This will help measure the uptake of new/changed ACIP recommendations and clarifications in a timely fashion (OGS 10.4).</p>	<p><b>FS 10.0:</b> The IIS forecasts pediatric and adult immunizations in a manner consistent with ACIP recommendations.</p> <p><b>OGS 10.3:</b> The IIS displays and/or sends a forecast that adheres to ACIP recommendations, with status indicators for each vaccine and vaccine family.</p> <p><b>OGS 10.4:</b> The IIS CDS functionality is updated for the IIS in a timely fashion after new ACIP recommendations are incorporated into the CDC CDSi resources published on the CDC website.</p>

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Vaccine Family	Number of Test Cases																						
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Measure Outcome	
<p>NOTE: Actual Thresholds (MEETS%, DEV%, VAC_FAM%) will be confirmed following initial analysis performed in quarter 4, 2018</p>	
<p><b>Fully Meets</b></p>	<p>The IIS will Fully Meet this measure if both of the following are true:</p> <ul style="list-style-type: none"> <li>The IIS has a Degree of Alignment score at or above MEETS%.</li> </ul>

	<ul style="list-style-type: none"> <li>Each individual vaccine family shall be at or above VAC_FAM%.</li> </ul>
<b>Deviates</b>	<p>The IIS will Deviate from this measure if both of the following are true:</p> <ul style="list-style-type: none"> <li>The IIS has a Degree of Alignment score at or above DEV%, but less than MEETS%.</li> <li>Each individual vaccine family shall be at or above VAC_FAM%.</li> </ul>
<b>Does Not Meet</b>	<p>The IIS will Not Meet this measure if either of the following are true:</p> <ul style="list-style-type: none"> <li>The IIS has a Degree of Alignment score below DEV%</li> <li>Any individual vaccine family is below VAC_FAM%</li> </ul>

## Measure 7:

The Earliest Date returned by the IIS matches the CDC CDSi expected value for routine age-based adolescent recommendations.

Purpose	Supports
<p>The purpose of this measure is to measure the degree of alignment when an IIS returns earliest date.</p> <p>When the CDSi project publishes new/updated test cases, they will be incorporated into the CDS Assessment 30 days after publication. This will help measure the uptake of new/changed ACIP recommendations and clarifications in a timely fashion (OGS 10.4).</p>	<p><b>FS 10.0:</b> The IIS forecasts pediatric and adult immunizations in a manner consistent with ACIP recommendations.</p> <p><b>OGS 10.3:</b> The IIS displays and/or sends a forecast that adheres to ACIP recommendations, with status indicators for each vaccine and vaccine family.</p> <p><b>OGS 10.4:</b> The IIS CDS functionality is updated for the IIS in a timely fashion after new ACIP recommendations are incorporated into the CDC CDSi resources published on the CDC website.</p>

Test Case Sets	Test Case Expectation																		
<p><b>CDSi Test Cases:</b> As CDSi publishes updates to their test cases these numbers will change. This analysis is based on version 3.2 of the CDSi test cases published in March 2017.</p> <table border="1"> <thead> <tr> <th>Vaccine Family</th> <th>Number of Test Cases</th> </tr> </thead> <tbody> <tr> <td>Tdap/Td</td> <td>41</td> </tr> <tr> <td>Meningococcal</td> <td>11</td> </tr> <tr> <td>HPV</td> <td>56</td> </tr> <tr> <td>Flu</td> <td>1</td> </tr> <tr> <td>HepB</td> <td>7</td> </tr> <tr> <td>MMR</td> <td>1</td> </tr> <tr> <td>Polio</td> <td>7</td> </tr> <tr> <td>Varicella</td> <td>3</td> </tr> </tbody> </table>	Vaccine Family	Number of Test Cases	Tdap/Td	41	Meningococcal	11	HPV	56	Flu	1	HepB	7	MMR	1	Polio	7	Varicella	3	<p>The Earliest Date returned by the IIS will match the published CDSi test case expectations.</p>
Vaccine Family	Number of Test Cases																		
Tdap/Td	41																		
Meningococcal	11																		
HPV	56																		
Flu	1																		
HepB	7																		
MMR	1																		
Polio	7																		
Varicella	3																		
<p><b>Additional Test Cases:</b> A set of test cases will be added to focus on vaccination events occurring at the recommended age and/or intervals for vaccines in scope.</p>	<p>The Earliest Date returned by the IIS will match the expectation per the published CDSi Supporting Data and Logic Specification.</p>																		

Measure Outcome	
<p>NOTE: Actual Thresholds (MEETS%, DEV%, VAC_FAM%) will be confirmed following initial analysis performed in quarter 4, 2018</p>	
<p><b>Fully Meets</b></p>	<p>The IIS will Fully Meet this measure if both of the following are true:</p> <ul style="list-style-type: none"> <li>The IIS has a Degree of Alignment score at or above MEETS%.</li> <li>Each individual vaccine family shall be at or above VAC_FAM%.</li> </ul>
<p><b>Deviates</b></p>	<p>The IIS will Deviate from this measure if both of the following are true:</p>

	<ul style="list-style-type: none"> <li>• The IIS has a Degree of Alignment score at or above DEV%, but less than MEETS%.</li> <li>• Each individual vaccine family shall be at or above VAC_FAM%.</li> </ul>
<b>Does Not Meet</b>	<p>The IIS will Not Meet this measure if either of the following are true:</p> <ul style="list-style-type: none"> <li>• The IIS has a Degree of Alignment score below DEV%</li> <li>• Any individual vaccine family is below VAC_FAM%</li> </ul>

## Measure 8:

The Earliest Date returned by the IIS matches the CDC CDSi expected value for routine age-based adult recommendations.

Purpose	Supports
<p>The purpose of this measure is to measure the degree of alignment when an IIS returns earliest date.</p> <p>When the CDSi project publishes new/updated test cases, they will be incorporated into the CDS Assessment 30 days after publication. This will help measure the uptake of new/changed ACIP recommendations and clarifications in a timely fashion (OGS 10.4).</p>	<p><b>FS 10.0:</b> The IIS forecasts pediatric and adult immunizations in a manner consistent with ACIP recommendations.</p> <p><b>OGS 10.3:</b> The IIS displays and/or sends a forecast that adheres to ACIP recommendations, with status indicators for each vaccine and vaccine family.</p> <p><b>OGS 10.4:</b> The IIS CDS functionality is updated for the IIS in a timely fashion after new ACIP recommendations are incorporated into the CDC CDSi resources published on the CDC website.</p>

Test Case Sets	Test Case Expectation										
<p><b>CDSi Test Cases:</b> As CDSi publishes updates to their test cases these numbers will change. This analysis is based on version 3.2 of the CDSi test cases published in March 2017.</p> <table border="1"> <thead> <tr> <th>Vaccine Family</th> <th>Number of Test Cases</th> </tr> </thead> <tbody> <tr> <td>Pneumococcal</td> <td>3</td> </tr> <tr> <td>Zoster</td> <td>4</td> </tr> <tr> <td>Varicella</td> <td>3</td> </tr> <tr> <td>HPV</td> <td>4</td> </tr> </tbody> </table>	Vaccine Family	Number of Test Cases	Pneumococcal	3	Zoster	4	Varicella	3	HPV	4	<p>The Earliest Date returned by the IIS will match the published CDSi test case expectations.</p>
Vaccine Family	Number of Test Cases										
Pneumococcal	3										
Zoster	4										
Varicella	3										
HPV	4										
<p><b>Additional Test Cases:</b> A set of test cases will be added to focus on vaccination events occurring at the recommended age and/or intervals for vaccines in scope.</p>	<p>The Earliest Date returned by the IIS will match the expectation per the published CDSi Supporting Data and Logic Specification.</p>										

Measure Outcome	
NOTE: Actual Thresholds (MEETS%, DEV%, VAC_FAM%) will be confirmed following initial analysis performed in quarter 4, 2018	
<b>Fully Meets</b>	<p>The IIS will Fully Meet this measure if both of the following are true:</p> <ul style="list-style-type: none"> <li>The IIS has a Degree of Alignment score at or above MEETS%.</li> <li>Each individual vaccine family shall be at or above VAC_FAM%.</li> </ul>
<b>Deviates</b>	<p>The IIS will Deviate from this measure if both of the following are true:</p> <ul style="list-style-type: none"> <li>The IIS has a Degree of Alignment score at or above DEV%, but less than MEETS%.</li> <li>Each individual vaccine family shall be at or above VAC_FAM%.</li> </ul>
<b>Does Not Meet</b>	<p>The IIS will Not Meet this measure if either of the following are true:</p> <ul style="list-style-type: none"> <li>The IIS has a Degree of Alignment score below DEV%</li> </ul>

- |  |   |
|--|---|
|  | <ul style="list-style-type: none"><li>• Any individual vaccine family is below VAC_FAM%</li></ul> |
|--|---|

## Recommended Date Measures

### Measure 9:

The IIS HL7 interface returns a Recommended Date for each forecasted dose.

Purpose	Supports
The purpose of this measure is to identify if an IIS returns recommended date. The accuracy of the recommended date is not measured within this measure.	<p><b>FS 10.0:</b> The IIS forecasts pediatric and adult immunizations in a manner consistent with ACIP recommendations.</p> <p><b>OGS 10.3:</b> The IIS displays and/or sends a forecast that adheres to ACIP recommendations, with status indicators for each vaccine and vaccine family.</p>

Test Case	Test Case Expectation
A patient with an at birth HepB will be sent to the IIS and subsequently queried for.	The response explicitly includes a recommended date for each forecasted dose through the use of the HL7 standard LOINC for recommended date (30980-7).

Measure Outcome	
<b>Fully Meets</b>	The IIS will Fully Meet this measure if the test case expectation is met.
<b>Deviates</b>	Deviation is not a possible measure outcome for this measure.
<b>Does Not Meet</b>	The IIS will Not Meet this measure if the test case expectation is not met.

Measure 10:

The Recommended Date returned by the IIS matches the CDC CDSi expected value for routine age-based pediatric recommendations.

Purpose	Supports
<p>The purpose of this measure is to measure the degree of alignment when an IIS returns recommended date.</p> <p>When the CDSi project publishes new/updated test cases, they will be incorporated into the CDS Assessment 30 days after publication. This will help measure the uptake of new/changed ACIP recommendations and clarifications in a timely fashion (OGS 10.4).</p>	<p><b>FS 10.0:</b> The IIS forecasts pediatric and adult immunizations in a manner consistent with ACIP recommendations.</p> <p><b>OGS 10.3:</b> The IIS displays and/or sends a forecast that adheres to ACIP recommendations, with status indicators for each vaccine and vaccine family.</p> <p><b>OGS 10.4:</b> The IIS CDS functionality is updated for the IIS in a timely fashion after new ACIP recommendations are incorporated into the CDC CDSi resources published on the CDC website.</p>

Test Case Sets	Test Case Expectation																						
<p><b>CDSi Test Cases:</b> As CDSi publishes updates to their test cases these numbers will change. This analysis is based on version 3.2 of the CDSi test cases published in March 2017.</p> <table border="1"> <thead> <tr> <th>Vaccine Family</th> <th>Number of Test Cases</th> </tr> </thead> <tbody> <tr><td>DTaP</td><td>122</td></tr> <tr><td>HepA</td><td>7</td></tr> <tr><td>HepB</td><td>29</td></tr> <tr><td>Hib</td><td>65</td></tr> <tr><td>MMR</td><td>26</td></tr> <tr><td>Pneumococcal</td><td>34</td></tr> <tr><td>Polio</td><td>89</td></tr> <tr><td>Rotavirus</td><td>22</td></tr> <tr><td>Varicella</td><td>21</td></tr> <tr><td>Flu</td><td>10</td></tr> </tbody> </table>	Vaccine Family	Number of Test Cases	DTaP	122	HepA	7	HepB	29	Hib	65	MMR	26	Pneumococcal	34	Polio	89	Rotavirus	22	Varicella	21	Flu	10	<p>The Recommended Date returned by the IIS will match the published CDSi test case expectations.</p>
Vaccine Family	Number of Test Cases																						
DTaP	122																						
HepA	7																						
HepB	29																						
Hib	65																						
MMR	26																						
Pneumococcal	34																						
Polio	89																						
Rotavirus	22																						
Varicella	21																						
Flu	10																						
<p><b>Additional Test Cases:</b> A set of test cases will be added to focus on vaccination events occurring at the recommended age and/or intervals for vaccines in scope.</p>	<p>The Recommended Date returned by the IIS will match the expectation per the published CDSi Supporting Data and Logic Specification.</p>																						

Measure Outcome	
<p>NOTE: Actual Thresholds (MEETS%, DEV%, VAC_FAM%) will be confirmed following initial analysis performed in quarter 4, 2018</p>	
<p><b>Fully Meets</b></p>	<p>The IIS will Fully Meet this measure if both of the following are true:</p> <ul style="list-style-type: none"> <li>The IIS has a Degree of Alignment score at or above MEETS%.</li> </ul>

	<ul style="list-style-type: none"> <li>• Each individual vaccine family shall be at or above VAC_FAM%.</li> </ul>
<b>Deviates</b>	<p>The IIS will Deviate from this measure if both of the following are true:</p> <ul style="list-style-type: none"> <li>• The IIS has a Degree of Alignment score at or above DEV%, but less than MEETS%.</li> <li>• Each individual vaccine family shall be at or above VAC_FAM%.</li> </ul>
<b>Does Not Meet</b>	<p>The IIS will Not Meet this measure if either of the following are true:</p> <ul style="list-style-type: none"> <li>• The IIS has a Degree of Alignment score below DEV%</li> <li>• Any individual vaccine family is below VAC_FAM%</li> </ul>

## Measure 11:

The Recommended Date returned by the IIS matches the CDC CDSi expected value for routine age-based adolescent recommendations.

Purpose	Supports
<p>The purpose of this measure is to measure the degree of alignment when an IIS returns recommended date.</p> <p>When the CDSi project publishes new/updated test cases, they will be incorporated into the CDS Assessment 30 days after publication. This will help measure the uptake of new/changed ACIP recommendations and clarifications in a timely fashion (OGS 10.4).</p>	<p><b>FS 10.0:</b> The IIS forecasts pediatric and adult immunizations in a manner consistent with ACIP recommendations.</p> <p><b>OGS 10.3:</b> The IIS displays and/or sends a forecast that adheres to ACIP recommendations, with status indicators for each vaccine and vaccine family.</p> <p><b>OGS 10.4:</b> The IIS CDS functionality is updated for the IIS in a timely fashion after new ACIP recommendations are incorporated into the CDC CDSi resources published on the CDC website.</p>

Test Case Sets	Test Case Expectation																		
<p><b>CDSi Test Cases:</b> As CDSi publishes updates to their test cases these numbers will change. This analysis is based on version 3.2 of the CDSi test cases published in March 2017.</p> <table border="1"> <thead> <tr> <th>Vaccine Family</th> <th>Number of Test Cases</th> </tr> </thead> <tbody> <tr> <td>Tdap/Td</td> <td>41</td> </tr> <tr> <td>Mening</td> <td>11</td> </tr> <tr> <td>HPV</td> <td>56</td> </tr> <tr> <td>Flu</td> <td>1</td> </tr> <tr> <td>HepB</td> <td>7</td> </tr> <tr> <td>MMR</td> <td>1</td> </tr> <tr> <td>Polio</td> <td>7</td> </tr> <tr> <td>Varicella</td> <td>3</td> </tr> </tbody> </table>	Vaccine Family	Number of Test Cases	Tdap/Td	41	Mening	11	HPV	56	Flu	1	HepB	7	MMR	1	Polio	7	Varicella	3	<p>The Recommended Date returned by the IIS will match the published CDSi test case expectations.</p>
Vaccine Family	Number of Test Cases																		
Tdap/Td	41																		
Mening	11																		
HPV	56																		
Flu	1																		
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Polio	7																		
Varicella	3																		
<p><b>Additional Test Cases:</b> A set of test cases will be added to focus on vaccination events occurring at the recommended age and/or intervals for vaccines in scope.</p>	<p>The Recommended Date returned by the IIS will match the expectation per the published CDSi Supporting Data and Logic Specification.</p>																		

Measure Outcome	
<p>NOTE: Actual Thresholds (MEETS%, DEV%, VAC_FAM%) will be confirmed following initial analysis performed in quarter 4, 2018</p>	
<p><b>Fully Meets</b></p>	<p>The IIS will Fully Meet this measure if both of the following are true:</p> <ul style="list-style-type: none"> <li>The IIS has a Degree of Alignment score at or above MEETS%.</li> <li>Each individual vaccine family shall be at or above VAC_FAM%.</li> </ul>
<p><b>Deviates</b></p>	<p>The IIS will Deviate from this measure if both of the following are true:</p>

	<ul style="list-style-type: none"><li>• The IIS has a Degree of Alignment score at or above DEV%, but less than MEETS%.</li><li>• Each individual vaccine family shall be at or above VAC_FAM%.</li></ul>
<b>Does Not Meet</b>	<p>The IIS will Not Meet this measure if either of the following are true:</p> <ul style="list-style-type: none"><li>• The IIS has a Degree of Alignment score below DEV%</li><li>• Any individual vaccine family is below VAC_FAM%</li></ul>

## Measure 12:

The Recommended Date returned by the IIS matches the CDC CDSi expected value for routine age-based adult recommendations.

Purpose	Supports
<p>The purpose of this measure is to measure the degree of alignment when an IIS returns recommended date.</p> <p>When the CDSi project publishes new/updated test cases, they will be incorporated into the CDS Assessment 30 days after publication. This will help measure the uptake of new/changed ACIP recommendations and clarifications in a timely fashion (OGS 10.4).</p>	<p><b>FS 10.0:</b> The IIS forecasts pediatric and adult immunizations in a manner consistent with ACIP recommendations.</p> <p><b>OGS 10.3:</b> The IIS displays and/or sends a forecast that adheres to ACIP recommendations, with status indicators for each vaccine and vaccine family.</p> <p><b>OGS 10.4:</b> The IIS CDS functionality is updated for the IIS in a timely fashion after new ACIP recommendations are incorporated into the CDC CDSi resources published on the CDC website.</p>

Test Case Sets	Test Case Expectation										
<p><b>CDSi Test Cases:</b> As CDSi publishes updates to their test cases these numbers will change. This analysis is based on version 3.2 of the CDSi test cases published in March 2017.</p> <table border="1"> <thead> <tr> <th>Vaccine Family</th> <th>Number of Test Cases</th> </tr> </thead> <tbody> <tr> <td>Pneumococcal</td> <td>3</td> </tr> <tr> <td>Zoster</td> <td>4</td> </tr> <tr> <td>Varicella</td> <td>3</td> </tr> <tr> <td>HPV</td> <td>4</td> </tr> </tbody> </table>	Vaccine Family	Number of Test Cases	Pneumococcal	3	Zoster	4	Varicella	3	HPV	4	<p>The Recommended Date returned by the IIS will match the published CDSi test case expectations.</p>
Vaccine Family	Number of Test Cases										
Pneumococcal	3										
Zoster	4										
Varicella	3										
HPV	4										
<p><b>Additional Test Cases:</b> A set of test cases will be added to focus on vaccination events occurring at the recommended age and/or intervals for vaccines in scope.</p>	<p>The Recommended Date returned by the IIS will match the expectation per the published CDSi Supporting Data and Logic Specification.</p>										

Measure Outcome	
NOTE: Actual Thresholds (MEETS%, DEV%, VAC_FAM%) will be confirmed following initial analysis performed in quarter 4, 2018	
<b>Fully Meets</b>	<p>The IIS will Fully Meet this measure if both of the following are true:</p> <ul style="list-style-type: none"> <li>The IIS has a Degree of Alignment score at or above MEETS%.</li> <li>Each individual vaccine family shall be at or above VAC_FAM%.</li> </ul>
<b>Deviates</b>	<p>The IIS will Deviate from this measure if both of the following are true:</p> <ul style="list-style-type: none"> <li>The IIS has a Degree of Alignment score at or above DEV%, but less than MEETS%.</li> <li>Each individual vaccine family shall be at or above VAC_FAM%.</li> </ul>
<b>Does Not Meet</b>	<p>The IIS will Not Meet this measure if either of the following are true:</p> <ul style="list-style-type: none"> <li>The IIS has a Degree of Alignment score below DEV%</li> </ul>

- |  |   |
|--|---|
|  | <ul style="list-style-type: none"><li>• Any individual vaccine family is below VAC_FAM%</li></ul> |
|--|---|

## Appendix A: Glossary

**Returns:** The concept being tested must explicitly return the concept through the query/response interface in a standards-based way. For consistency across all interfaces, the assessment process will not imply or infer the results of a query/response interface.

**Routine Age-Based:** ACIP recommendations which are based solely on age of the patient.

**Matches:** The IIS must produce the exact same answer as the CDSi expected value.

**Pediatric:** Birth through the entire sixth year of life

**Adolescent:** 7 years through the entire eighteenth year of life

**Adult:** 19 years and above

## Appendix B: Past Due Date and Series Status

Past Due Date and Series Status were originally proposed by MACAW to be part of CDS Assessment but have been deferred at this time due to comments received by the community.

Past Due Date - The date at which the patient is considered overdue for the next dose – was deferred due to lack of published standards or guidance documents that past due date must be part of an HL7 response message.

Series Status - The status of the patient towards protection against the vaccine preventable disease (e.g., complete, immune, contraindicated, not complete, too old, etc.) – was deferred due to lack of clarity within published standards or guidance documents on how series status is to be messaged consistently as part of an HL7 response message.

MACAW will continue to monitor standards development and guidance documents to determine an appropriate time to include either Past Due Date or Series Status.