Clinical Decision Support for Immunization (CDSi) Project

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American Immunization Registry Association
Post-NIC Workshop
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Agenda

- Objectives for Today
- Project Background
- Available Resources
- Support and Sustainability
- Getting Started
- Future Directions
Objectives for Today

- Understand the different CDSi resources and their respective purpose
- Understand how to engage CDSi support staff
- Develop different ways to dive into CDSi resources
- Others?
CDSI PROJECT BACKGROUND

Problems
Goals
Resource Development
Known Usage
Current Problems - Variance

- The output from existing evaluation and forecasting systems varies widely and does not always match expectations of clinical SMEs
  - Each Immunization Information System (IIS) has developed its own technical approach and interpretations
  - Ambiguity in interpretations of ACIP recommendations leads to invalid doses and extra immunizations
  - A 2009 CDC study showed 53% of IIS surveyed forecasted the next dose due 5 days or more early for at least one test case
Current Problems - Complexity

- Interpretation of ACIP recommendations is challenging, and implementing changes is time-consuming
  - Immunization schedule is complex
  - The schedule changes frequently
  - IIS are decentralized and do not share a common technology or logic framework
  - Implementation is often specific to a given application and implementation setting
Current Problems – Disparity

- There is no common, technology-neutral logic framework for the communication of ACIP recommendations
  - The schedule is published as a narrative and must be converted into logic and algorithms needed for implementation
  - There is lack of consensus on how best to represent CDS guidelines in computer-interpretable formats
  - Many of the representation standards require proprietary tools
### Project Goals

**Improve accuracy and consistency of vaccine forecasting and evaluation**

<table>
<thead>
<tr>
<th>Problem</th>
<th>Goals</th>
</tr>
</thead>
</table>
| **Variance** - The output from existing evaluation and forecasting systems varies widely and does not always match expectations of clinical SMEs | • Foster consistent, accurate evaluation and forecasting across IIS  
• Clarify ACIP recommendations  
• Document the logic for applying the rules  
• Support assessment of IIS accuracy after implementation of panel deliverables |
| **Complexity** - Interpretation of ACIP recommendations is challenging and implementing changes is time-consuming | • Use the logic developed above to communicate ACIP recommendations  
• Identify an approach allowing changes to be quickly incorporated into CDS |
| **Disparity** - There is no common, technology-neutral logic framework for the communication of ACIP recommendations | • Identify a methodology to communicate rules and supporting data |
Translating ACIP Recommendations

- Translation of scientific language to technical logic is complex and time-consuming.
- Uniform interpretation is challenging:
  - Mostly happens independently within each health information system.
  - Significant variance in system outputs.
  - Outputs frequently don’t match expectations of clinical SMEs.
Bridging the Gap

- Increase the accuracy and consistency of immunization evaluation and forecasting
- Improve the process of accommodating new and/or changed ACIP recommendations
- Make it easier to develop and maintain immunization evaluation and forecasting products
- Ensure patients get “the right immunization at the right time”
Expert Panel Facilitation Approach

40 industry experts

Three working groups

- American Immunization Registry Association (AIRA)
- American Academy of Pediatrics (AAP)
- Indian Health Service (IHS)
- Electronic Health Record (EHR) Vendors
- Immunization Information System (IIS) Vendors
- IIS Programs
- Academic Institutions

Facilitated remote and in-person sessions

Consensus-based decisions “I can live with and support that”
### Known Usage By Entity

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Number of Known Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>IIS Grantees</td>
<td>17</td>
</tr>
<tr>
<td>IIS Vendors and IT Consultants</td>
<td>12</td>
</tr>
<tr>
<td>EHR Vendors</td>
<td>7</td>
</tr>
<tr>
<td>Other (Federal Agencies, National Initiatives, Standards Work, etc…)</td>
<td>17</td>
</tr>
</tbody>
</table>
CDSI RESOURCES

Training Curriculum
Test Cases
Logic Specification and Supporting Data
Training Curriculum

- Introduction to CDSi Resources 41 mins
- Supporting Data Tables 42 mins
  - Evaluation Logic Definition 35 mins
  - Forecasting Logic Definition 25 mins
- Test Cases 26 mins
Test Cases

- **GOAL:**
  - Create a representative set of consensus-based systematic test cases that can be used by an immunization evaluation and forecasting engine

- **750 Test Cases across all childhood vaccine groups**

- **Consistent improvements have resulted in 180 test cases being refined/improved.**

- **Published in an Excel spreadsheet for easy usage**

- **Each Test Case:**
  - Focuses on one unique problem (e.g.: minimum age only)
  - Provides the answer (e.g.: expected outcome; usually a forecast)
  - Is classified by vaccine group, evaluation test type, and forecast test type
### Test Case Sample

*Hib – Dose #2 at 10 weeks – 5 days*

#### Test Case Scenario

<table>
<thead>
<tr>
<th></th>
<th>Birth Date</th>
<th>Admin:</th>
<th>Age:</th>
<th>Interval:</th>
<th>Forecast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose #1</td>
<td>01/01/2010</td>
<td>02/08/2010</td>
<td>5 weeks 3 days</td>
<td>3 weeks 6 days</td>
<td></td>
</tr>
<tr>
<td>Dose #2</td>
<td></td>
<td>03/07/2010</td>
<td>9 weeks 2 days</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### CDSi Expected Result

<table>
<thead>
<tr>
<th></th>
<th>Birth Date</th>
<th>Dose #1</th>
<th>Dose #2</th>
<th>Forecast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eval Status:</td>
<td>01/01/2010</td>
<td>Valid</td>
<td>Not Valid: Age too young</td>
<td></td>
</tr>
<tr>
<td>Rec Date:</td>
<td>05/01/10</td>
<td>Latest Date: 6/28/10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
LOGIC SPECIFICATION AND SUPPORTING DATA
The Logic Specification and Supporting Data Are …

- Documentation of current ACIP recommendations (and clarifications of those recommendations) for healthy children from birth through 18-years-old
- A single, complete source for implementer clarification
- Computable and implementation-neutral

They Are Not …

- Modification of existing ACIP recommendations
- Replacement for the role of ACIP
- National evaluation and forecasting application or other product
- Replacement for current software applications
Logic Specification and Supporting Data Components

- **Supporting Data**
  - Varies depending upon antigen
  - e.g., Absolute minimum age for Varicella versus PCV
  - Updated as ACIP recommendations change

- **Logic Definition**
  - How recommendation considerations work together in a consistent way through business rules and decision tables
  - e.g., Age, Interval, Gender, Preferable Vaccine
  - Generally will not change when ACIP recommendations change

- **Processing Model**
  - Technical “glue” that brings everything together
  - Generally will not change when ACIP recommendations change
Managing Changing Rules and State Variance

- Supporting Data (2012 ACIP Rules)
- Supporting Data (2013 ACIP Rules)
- Supporting Data (2013 State Rules)

Logic Definition
Processing Model
Logic Specification and Supporting Data

Provider

Immunization Program Staff

User

EHR-S

IIS

Other Systems (e.g., School, Pharmacy)

Subject Matter Experts

PHCP CDSi Service

PHCP CDSi Manager

CDSi

PHCP CDSi Shared Service

CDSi Logic Specification

CDSi Supporting Data
## Supporting Data Sample

**PCV Dose #2**

<table>
<thead>
<tr>
<th>Series Dose</th>
<th>Dose 2</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Age</th>
<th>Absolute Minimum Age</th>
<th>Minimum Age</th>
<th>Earlier Recommended Age</th>
<th>Latest Recommended Age (less than)</th>
<th>Maximum Age (less than)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10 weeks - 4 days</td>
<td>10 weeks</td>
<td>4 months</td>
<td>5 months + 4 weeks</td>
<td>5 years</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interval</th>
<th>From Immediate Previous Dose Administered? Y/N</th>
<th>From Target Dose # in Series</th>
<th>Absolute Minimum Interval</th>
<th>Minimum Interval</th>
<th>Earliest Recommended Interval</th>
<th>Latest Recommended Interval (less than)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>n/a</td>
<td>4 weeks - 4 days</td>
<td>4 weeks</td>
<td>8 weeks</td>
<td>13 weeks</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Allowable Interval</th>
<th>From Immediate Previous Dose Administered? Y/N</th>
<th>From Target Dose # in Series</th>
<th>Absolute Minimum Interval</th>
<th>Minimum Interval</th>
<th>Earliest Recommended Interval</th>
<th>Latest Recommended Interval (less than)</th>
</tr>
</thead>
<tbody>
<tr>
<td>n/a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Preferable Vaccine</th>
<th>Vaccine Type (CVX)</th>
<th>Vaccine Type Begin Age</th>
<th>Vaccine Type End Age (less than)</th>
<th>Trade Name (CVX)</th>
<th>Volume (mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCV13 (133)</td>
<td></td>
<td>6 weeks</td>
<td>5 years</td>
<td></td>
<td>0.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Allowable Vaccines</th>
<th>Vaccine Type (CVX)</th>
<th>Vaccine Type Begin Age</th>
<th>Vaccine Type End Age (less than)</th>
<th>Trade Name (CVX)</th>
<th>Volume (mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCV7 (100)</td>
<td></td>
<td>6 weeks - 4 days</td>
<td>n/a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pneumococcal, unspecified formulation (109)</td>
<td></td>
<td>6 weeks - 4 days</td>
<td>n/a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCV13 (133)</td>
<td></td>
<td>6 weeks - 4 days</td>
<td>n/a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pneumococcal Conjugate, unspecified formulation (152)</td>
<td></td>
<td>6 weeks - 4 days</td>
<td>n/a</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Skip Dose | Trigger Age | Trigger Interval | Trigger Target Dose | 
|-----------|-------------|-------------------|--------------------|---|
|           | 24 Months - 4 days | n/a | n/a | |

| Recurring Dose | Preventing Dose (Yes/No) | 
|----------------|--------------------------|---|
|                | No                       | |

<table>
<thead>
<tr>
<th>Conditional Need</th>
<th>Condition Set</th>
<th>Start Date</th>
<th>End Date</th>
<th>Dose Count (less than)</th>
<th>CVX List</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n/a</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Seasonal Recommendation | Start Date | End Date | 
|-------------------------|------------|----------|---|
|                         | n/a        |          | |

| Substitute Dose | total count of valid doses | First Dose Begin Age | First Dose End Age (less than) | Number of Target doses to substitute | 
|----------------|---------------------------|----------------------|-------------------------------|----------------------------------|----------|
|                | n/a                       |                      |                               |                                  |          |

| Gender | Required Gender | 
|--------|-----------------|---|
|        | n/a             | |

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Logic Specification Samples

The glossary provides the definitions of terms identified by the domain model.

TABLE 5 - 14 GENERATE FORECAST DATE BUSINESS RULES

<table>
<thead>
<tr>
<th>Business Rule ID</th>
<th>Term</th>
<th>Business Rule</th>
</tr>
</thead>
<tbody>
<tr>
<td>FORECASTDT-1</td>
<td>Earliest Date</td>
<td>Earliest date must be the latest of the following dates:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>a. Minimum age date</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. Latest minimum interval date</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c. Latest conflict end interval date</td>
</tr>
<tr>
<td></td>
<td></td>
<td>d. Seasonal recommendation start date</td>
</tr>
<tr>
<td>FORECASTDT-2</td>
<td>Unadjusted Recommended Date</td>
<td>Unadjusted recommended date must be the earliest recommended age date.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>a. The earliest of all earliest recommended interval dates must be used if</td>
</tr>
<tr>
<td></td>
<td></td>
<td>earliest recommended age date is not present.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. Earliest date must be used if earliest recommended age date and earliest</td>
</tr>
<tr>
<td></td>
<td></td>
<td>recommended interval date are not present.</td>
</tr>
<tr>
<td>FORECASTDT-3</td>
<td>Unadjusted Past Due Date</td>
<td>Unadjusted past due date must be the latest recommended age date – 1 day.</td>
</tr>
</tbody>
</table>

OUTCOMES

| Yes, An allowable vaccine was administered. | No, This supporting data defined allowable vaccine was not administered. | No, This supporting data defined allowable vaccine was administered out of the allowable age range. |
SUPPORT AND SUSTAINABILITY
ACIP Recommendation Support

High-Level Process

CDSi
- Answer based on ACIP or EIPB clarifications found in CDSi publication
- Forward unknown question to EIPB

EIPB
- Clarify known questions
- Forward unknown to ACIP

ACIP
- Discussion by ACIP SME working groups as necessary
**ACIP Recommendation Support**

*Response Variation*

- Considers each case specific to the scenario given for the patient referenced
- May override strict ACIP recommendations in certain situations due to clinical perspective (e.g.: likelihood of patient returning)

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**EIPB**

- Applies same logic to all scenarios based on ACIP published recommendations and EIPB clarifications
- One-time clinical exceptions are not taken into consideration

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**CDSi**
ACIP Recommendation Support

Closing the Gap

- CDSi and EIPB related improvements
  - Relationship and communication between CDSi and EIPB teams continues to strengthen
  - Understanding one-off scenarios vs. ACIP clarifications
  - Working towards common vocabulary to strengthen communication
  - Questions are flowing in both directions
    - CDSi asking EIPB for clarifications
    - EIPB asking CDSi for affirmation of previous clarifications
Technical Support

- One-on-one support through email, conference calls, and/or live meetings to aid in the continuum of usage
  - Extension to training videos
  - Aid in learning curve for CDSi resources
  - Work through detailed weed-level topics

- Review of your CDS resources in comparison CDSi resources
  - Usually results in improvements to both projects (yours and CDSi)
# CDSi Sustainability Process

## Formal Version – ACIP Changes

<table>
<thead>
<tr>
<th>Step</th>
<th>Task Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Prepare for ACIP meeting</td>
</tr>
<tr>
<td>2.0</td>
<td>Provide input into preparing for ACIP meeting and drafting ACIP Recs</td>
</tr>
<tr>
<td>3.0</td>
<td>Provide direction to IISSB CDSi Support Team on new or changed recs</td>
</tr>
<tr>
<td>4.0</td>
<td>Make decisions on ACIP recs</td>
</tr>
<tr>
<td>5.0</td>
<td>Publish provisional recs on ACIP website</td>
</tr>
<tr>
<td>6.0</td>
<td>Publish final recs on ACIP website</td>
</tr>
<tr>
<td>7.0</td>
<td>Draft changes to Logic Specification</td>
</tr>
<tr>
<td>8.0</td>
<td>Modify Logic Specification based on comments from the CDSi Review Panel</td>
</tr>
<tr>
<td>9.0</td>
<td>Provide input to Logic Specification changes</td>
</tr>
<tr>
<td>10.0</td>
<td>Finalize Logic Specification</td>
</tr>
<tr>
<td>11.0</td>
<td>Review final Logic Specification</td>
</tr>
<tr>
<td>12.0</td>
<td>Review final Logic Specification</td>
</tr>
<tr>
<td>13.0</td>
<td>Publish Logic Specification on AIRA and IISSB websites</td>
</tr>
<tr>
<td>14.0</td>
<td>Execute Communication Plan</td>
</tr>
</tbody>
</table>

**Diagram:**

- ACIP
- CDC
- IISSB CDSi Support Team
- CDSi Review Panel

**Key Points:**

- New/Changed ACIP Recommendations (Logic Specification Maintenance) - CDSi Recommended Process
- Draft Recs
- Provisional Recs
- Final Logic Specification
- MMWR/Harmonized Schedule
- Communication Plan
GETTING STARTED

Enter Here
Sign up for CDSi updates

Clinical Decision Support for Immunization (CDSi)

CDSi: Clarity, Consistency, and Computability

Immunization clinical decision support (CDS), more commonly referred to as evaluation and forecasting, is an automated process that determines the recommended immunizations needed for a patient and delivers these recommendations to the healthcare provider. Health Information Systems (HIS) – which can include Health Information Exchanges (HIEs), Immunization Information Systems (IIS)

Get Email Updates: see Registry (IIS)

On this Page
- Logic Specification and Supporting Data
- Testing
- Training
- Support
- Additional Resources
- Project Background
Using CDSi Resources

From minor to major engagement

- Research specific ACIP Recommendation
  - < 1 hour: Individual research or supported by CDSi project team
- Take training courses
  - < 1 hour: per course
- Execute and compare the test cases expected results against CDS engine’s actual results
  - < 1 day: Manually execute a handful of test cases
  - < 1 month: Automate all test cases
- Compare CDSi supporting data against CDS engine’s supporting data
  - < 1 week: Per vaccine group
- Develop/Improve CDS engine logic based on CDSi Logic Specification
  - Really depends on scope of development and improvement
Future Directions

- **Phase II underway**
  - Expanded scope to include
    - Adult recommendations
    - Increased/High risk recommendations
  - Spring/Summer 2015 publication

- **Evaluation of existing resources being developed**
  - Goal is to understand how resources are being used and how to improve them.

- **CDSi Status Check**
  - Similar to the HL7 Status Check project
  - Will use a small sample of CDSi test cases
  - Personalized report will be developed per participant
Questions

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http://www.cdc.gov/vaccines/programs/iis/interop-proj/cds.html
Or simply Google “CDC CDSi”

For more information please contact Centers for Disease Control and Prevention
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E-mail: cdcinfo@cdc.gov  Web: www.cdc.gov