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Immunization Calculation Engine (ICE)
an Open Source Immunization Decision Support System for Integration with Immunization Information Systems

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Maintaining Clinical Decision Support (CDS) for immunizations is hard…

- New vaccines coming to market
- Large and growing rule set
- Rules are increasingly complex
- Evolving recommendations from ACIP
...complicated by a challenging national environment for IIS

- Aging technologies
- Continual growth of IIS responsibilities
- Lack of funds for major upgrades
- Less IIS autonomy due to IT centralization
How can an IIS overcome these challenges?
Multiple organizations pooling resources to **jointly develop** a CDS solution that meets a common IIS need

**ICE Collaborators**
- New York City Citywide Immunization Registry
- HLN Consulting, LLC
- Alabama Department of Public Health
- OpenCDS Team, led by the University of Utah
Goal of the ICE Project

“Create a freely available immunization decision support system that promotes clinical best practices, adapts to changing requirements, and easily integrates with other health information systems.”
Design Principles

- Collaborative process
- Rigorous approach
- Standards-based
- Rich configuration tools
- Scalable
- Open source software, no vendor lock-in
- Flexible deployment options
Components of ICE Software System

- **ICE Web Service**
  - Provides immunization forecasting to IIS and other clinical information systems
  - Implemented in OpenCDS, a tool set for developing CDS web services

- **Clinical Decision Support Administration Tool (CAT)**
  - Enables non-technical subject matter experts (SMEs) to manage ICE
  - Web-based application with graphical user interface
Pre-Configured with Immunization Schedules

- Childhood, adolescent, and adult schedules for 14 vaccine groups
- Pre-configured by SME Workgroup
- Follows ACIP guidelines
- Informed by CDC’s CDSi project
Pre-Configured Vaccine Groups

1. HepB
2. Rotavirus
3. DTP (in progress)
4. Hib
5. PCV Pneumococcal Conjugate
6. Polio (in progress)
7. MMR
8. Varicella
9. HepA
10. Meningococcal (in progress)
11. PPSV Pneumococcal Polysaccharide
12. HPV
13. Influenza (in progress)
14. H1N1 (in progress)
Publicly Accessible Documentation of Pre-Configured Rules

**Immunization Series: Hep B Newborn Series**

The Hep B Newborn series is complete after 3 doses.

### Vaccine Dose Parameters - Minimum and Routine Ages

<table>
<thead>
<tr>
<th>Dose</th>
<th>Series Name</th>
<th>Absolute Minimum Age</th>
<th>Minimum Age</th>
<th>Routine Age</th>
<th>Valid CVX Code(s) per Dose for this Series</th>
<th>Invalid CVX Code(s) per Dose for this Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hep B Newborn</td>
<td>0 days</td>
<td>0 days</td>
<td>0 days</td>
<td>08, 42, 45, 43, 44, 51, 110, 104</td>
<td>N/A</td>
</tr>
<tr>
<td>2</td>
<td>Hep B Newborn</td>
<td>24 days</td>
<td>28 days</td>
<td>2 months¹</td>
<td>08, 42, 45, 43, 44, 51, 110, 104</td>
<td>N/A</td>
</tr>
<tr>
<td>3</td>
<td>Hep B Newborn</td>
<td>164 days</td>
<td>168 days</td>
<td>6 months</td>
<td>08, 42, 45, 43, 44, 51, 110, 104</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### Vaccine Dose Parameters - Minimum and Recommended Intervals

<table>
<thead>
<tr>
<th>Doses</th>
<th>Series Name</th>
<th>Absolute Minimum Interval</th>
<th>Minimum Interval</th>
<th>Recommended Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose 1 to 2</td>
<td>Hep B Newborn</td>
<td>24 days</td>
<td>28 days</td>
<td>N/A ²</td>
</tr>
<tr>
<td>Dose 2 to 3</td>
<td>Hep B Newborn</td>
<td>52 days</td>
<td>56 days</td>
<td>56 days</td>
</tr>
</tbody>
</table>

### Series Special Rules

There are no special rules for this series.

### Notes

- The routine age for dose 2 in the table above (2 months)¹ differs from the CDC CDSi routine age of 1 month. The ICE Workgroup recommends 2 months as the routine recommended age for the following reasons:
  - Two months is a routine age for preventive care visits and the recommended age for several other vaccine groups.
  - If combination Hep B vaccines are used, these are not licensed before 6 weeks of age.
  - For a routine recommendation for a healthy child, it is not necessary to squeeze dose 2 in before 2 months of age.
Clinical Decision Support Administration Tool (CAT)

- Graphical user interface
- Non-Technical SMEs may configure ICE
- Create, edit, delete...
  - Vocabulary and code sets
  - Schedule parameters
  - Rules
  - Test cases
Ex: Creating the Varicella Rule for Patients Born before 01/01/1980

Rule Editor

When

1. The Patient information Must be known to complete writing this rule
   a. - The Patient's birthdate is < 01/01/1980
2. There is a Series That needs Forecasting
   a. - The Series belongs to the Vaccine Group Varicella (600)
   b. - the Series Completion Status is Not Complete

Then

1. Create a Recommendation as with Status Conditional (CONDITIONAL) for the Series TargetSeries1
2. Set the Conditional Recommendation Reason for to High Risk (HIGH_RISK)
3. Include the Recommendation for Consideration in the final Forecast of the Series TargetSeries1
## Standards Based

<table>
<thead>
<tr>
<th>Attribute of ICE</th>
<th>Conforms to Relevant Technical Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Messaging framework</td>
<td>Simple Object Access Protocol (SOAP)</td>
</tr>
<tr>
<td>Web Service interface</td>
<td>Decision Support Service (DSS) - an HL7 &amp; OMG standard</td>
</tr>
<tr>
<td>Data model</td>
<td>Virtual Medical Record (vMR) - an HL7 standard</td>
</tr>
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</table>
Technical Documentation for ICE’s Standards-Based Interface

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<tr>
<td>3.1</td>
<td>Invoking ICE as a Decision Support Service</td>
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<td>3.2</td>
<td>Virtual Medical Record Format (VMR)</td>
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<tr>
<td>3.3</td>
<td>ICE Input Message</td>
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<tr>
<td>3.3.1</td>
<td>Input Message Format</td>
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<td>3.3.2</td>
<td>Sample Input Message</td>
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<td>3.3.3</td>
<td>Input Node Elements and Attributes</td>
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<td>3.4</td>
<td>ICE Output Message</td>
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<td>3.4.1</td>
<td>Output Message Format</td>
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<tr>
<td>3.4.2</td>
<td>Sample Output Message</td>
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<tr>
<td>3.4.3</td>
<td>Output Node Elements and Attributes</td>
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<td>4</td>
<td>Code Tables</td>
<td>47</td>
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<td>Vaccines</td>
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<td>CVX - Code System 2.16.840.1.113883.12.292</td>
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<td>4.1.2</td>
<td>Vaccines by Vaccine Group</td>
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<td>HL7 Administrative Gender - Code System 2.16.840.1.113883.5.1</td>
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<td>SNOMED - Code System 2.16.840.1.113883.6.5</td>
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<td>Disease Immunity Value - Code System 2.16.840.1.113883.3.795.12.100.8</td>
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<td>Disease Immunity Focus - Code System 2.16.840.1.113883.6.103</td>
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<td>53</td>
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</tbody>
</table>
Flexible Deployment Options

- Runs on a wide variety of hardware and operating system platforms
- Can be deployed in a variety of ways
  - On the same server as the IIS
  - On the same network, but on a different server
  - On a different network
- Can be hosted and/or managed by the IIS jurisdiction or by a 3rd party
Scalable

- Supports simultaneous processing of multiple patients
- Supports multiple complete schedules
- Fully automated testing process
Open Source

- Releasing under a standard open source license
- Lesser General Public License version 3 (LGPL v3)
  - Any IIS (or other system) may utilize/modify/integrate with ICE at no cost
  - Any modifications to ICE software must be shared
- No dependencies on any commercial software or commercial services
Production Use of ICE by an EHR System

- eClinicalWorks (eCW) v10 uses ICE to deliver evaluations and recommendations
- Integrated by eCW developers, with minimal support from ICE team
- No modifications to the default configuration
- ICE is hosted by eCW at central location
- Beta customers began use in spring 2013
- Nationwide availability 2nd half of October
Learn More About ICE Through…

- Website (www.hln.com/ice)
  - Rule documentation
  - Interface documentation
- Demonstrations
- Executable distribution of software
- Access HLN-hosted test instance of ICE
- Talk with the ICE Collaborators
Summary

- ICE is immunization forecasting software
- ICE can integrate with any IIS
- ICE is freely available
- ICE is transparent
- ICE can be maintained by non-developers
- Collaborating enables better solutions
- Let’s collaborate to make ICE even better!
Questions? Suggestions?

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