Neonatal Bilirubin SMART on FHIR Clinical Decision Support System

HL7 FHIR Applications Roundtable
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Kensaku Kawamoto, MD, PhD, MHS, FACMI
Associate Chief Medical Information Officer
Assistant Professor, Biomedical Informatics
University of Utah

Co-Chair, HL7 Clinical Decision Support Work Group

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Disclosures

• In the past year, I have been a consultant or sponsored researcher on clinical decision support for:
  – Office of the National Coordinator for Health IT*
  – McKesson InterQual
  – Hitachi

*via ESAC, SRS, A+ Government Solutions, and Hausam Consulting
Part of University of Utah Interoperable Apps and Services (IAPPS) Initiative

- Goal to improve patient care the provider experience through innovative, interoperable extension of native EHR functionality
- Scope includes both SMART on FHIR applications and CDS Web services using the FHIR Clinical Reasoning module and CDS Hooks

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Multi-Institutional Collaboration

Kensaku Kawamoto, MD, PhD, MHS
Associate CMIO
Steering Member, IAPPS

Carole Stipelman, MD, MPH
Medical Director, University Pediatric Clinic

Scott Narus, PhD, MS
Chief Clinical Systems Architect

Ricky Bloomfield, MD
Director of Mobile Technology Strategy

Robert Lenfestey, MD
Neonatologist and Clinical Faculty

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Multiple EHR Platforms

- Epic
  - Univ. of Utah
  - Duke
- Cerner
  - Intermountain
- CareWeb
  - Healthcare Services Platform Consortium (HSPC)
- Others TBD
Baseline Bilirubin App, Integrated with Epic (developed by Intermountain)

![Bilirubin App](image)

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Result (mg/dL)</th>
<th>Age (hrs)</th>
<th>Value: Test</th>
<th>Risk Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/01/2016 02:00</td>
<td>2</td>
<td>9</td>
<td>Bilirubin [Mass/Volume] in Skin</td>
<td>Low Risk Zone (&lt;5%)</td>
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<td>31</td>
<td>Bilirubin [Mass/Volume] in Skin</td>
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<td>01/02/2016 06:00</td>
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<td>55</td>
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<td>59</td>
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<td>Low Risk Zone (&lt;4%)</td>
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<td>Low Risk Zone (&lt;4%)</td>
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<td>01/03/2016 12:00</td>
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<td>67</td>
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<tr>
<td>01/03/2016 20:00</td>
<td>7.5</td>
<td>75</td>
<td>Bilirubin [Mass/Volume] in Skin</td>
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<tr>
<td>01/04/2016 00:00</td>
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<td>79</td>
<td>Bilirubin [Mass/Volume] in Skin</td>
<td>Low Risk Zone (&lt;4%)</td>
</tr>
</tbody>
</table>
American Academy of Pediatrics Guidelines for Exchange Transfusion

Current Bilirubin Application, in Production Use within Epic

Gest. Age (auto-calculated)
- 30 wks+
- 35-37 wks
- < 35 wks

Direct Coombs (risk factor, auto-calculated)
- Pos. (09/28/16)
- Neg.
- Unknown

Other risk factors (not auto-calculated)
- Isoimmune hemolytic disease, G6PD deficiency, asphyxia, sig. lethargy, temp. instability, sepsis, acidosis
- Present
- Not Present

Albumin < 3.0 g/L (risk factor for phototherapy only, auto-calculated)
- Yes (2.9, 09/28/16)
- No
- None on record

**Consider Exchange Transfusion.**
Rationale: Patient’s latest bilirubin level of 17.1 mg/dL at 46.57 hrs is above treatment threshold for exchange transfusion (16.98) given gestational age >= 35 wks and < 38 wks with risk factors for exchange transfusion.

**Bilirubin Measurements**

<table>
<thead>
<tr>
<th>Age (Hrs)</th>
<th>Result</th>
<th>Date/Time</th>
<th>Test Type</th>
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<tbody>
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<td>12.25</td>
<td>8.1</td>
<td>09/26/16 16:24</td>
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<td>23.38</td>
<td>10.5</td>
<td>09/27/16 03:32</td>
<td>Transcutaneous</td>
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<td>30.68</td>
<td>12.2</td>
<td>09/27/16 10:50</td>
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<td>35.9</td>
<td>14.8</td>
<td>09/27/16 17:03</td>
<td>Total</td>
</tr>
<tr>
<td>48.57</td>
<td>17.1</td>
<td>09/28/16 02:43</td>
<td>Total</td>
</tr>
</tbody>
</table>

**Albumin Measurements**

<table>
<thead>
<tr>
<th>Age (Hrs)</th>
<th>Result</th>
<th>Date/Time</th>
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</thead>
<tbody>
<tr>
<td>43.85</td>
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<td>09/28/16 00:00</td>
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</table>
Encapsulation of Decision Support Logic within OpenCDS (www.opencds.org)

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Support of HL7 Decision Support Standards

• Quality Improvement Core (QICore) FHIR Profiles (http://hl7.org/fhir/current/qicore/)


• FHIR Clinical Reasoning Module (http://hl7-fhir.github.io/clinicalreasoning-module.html)
  – Being unified with CDS Hooks specification (http://cds-hooks.org/)
Status

• 1.0 Release complete
• Full integration with Epic & CareWeb EHRs
• In production clinical use at University of Utah
• Positive provider feedback
• Enhancement requests being incorporated for v2.0
• Aiming for wide dissemination of 2.0 Release
• Awarded HHS Provider User Experience App Challenge Awards

https://www.challenge.gov/challenge/provider-user-experience-challenge/
Demo within HSPC CareWeb EHR Platform

http://docker.bmi.utah.edu:8081/cwfdemo-webapp/
Lessons Learned

• Initial learning curve fairly high
  – Hopefully will become easier as Interoperable Apps and Services become more “mainstream”
• Security is a critical consideration
• Standards (e.g., FHIR) are still evolving and require greater specificity for true plug-and-play interoperability
• Cross-institutional (and cross-platform) collaboration can significantly accelerate development
Future Directions

• Scale up initiative
• Evaluate impact of Apps and Services
• Influence underlying technical standards
• Prioritize projects with greatest impact potential
  – E.g., via data-driven opportunity identification
• Explore potential for expanded collaborations


Thank You!

Kensaku Kawamoto, MD, PhD, MHS

Associate Chief Medical Information Officer
Director, Knowledge Management and Mobilization
Assistant Professor, Biomedical Informatics

kensaku.kawamoto@utah.edu