
# BUILDING AN APPS AND SERVICES PROGRAM: THE UNIVERSITY OF UTAH EXPERIENCE

*TRAVIS GREGORY*

*DIRECTOR OF CLINICAL INFORMATION SYSTEMS*

# UNIVERSITY OF UTAH HEALTH

- Clinical context
  - 4 hospitals, 10 community clinic centers
  - 1,100 physicians, 1.7 million annual visits
  - 34,000 annual discharges
- Technical context
  - Epic system-wide since 2014
  - On Epic 2017

# OPPORTUNITY FOR INNOVATION

- Demand to explore creative ways of consuming EHR information
- Personalization of the EHR is a key factor to successful adoption - KLAS Arches Collaborative
- Epic, Cerner and other vendors are encouraging a paradigm where a large community of contributors can add functionality
- Beyond local and central Epic resources, we could harness the innovation of other local stakeholders, other institutions, and vendors

# EHR DEVELOPMENT HISTORY

- Echart Repository
- Cerner PowerChart mPages
  - Critical Care Summary – Nate Crandall and Nick Lonardo, Pharmacist
- PowerChart/EpicCare Bridge

# UNIVERSITY OF UTAH IAPPS INITIATIVE

- Acronym for Interoperable Apps and Services
- Goal: improve patient care and the provider experience through innovative, interoperable extensions of native Epic functionality
- Multi-stakeholder initiative started by University of Utah in 2016

# GOVERNANCE AND RESOURCING

- Steering committee co-chaired by CIO & CMIO
  - Charged with overseeing strategy, prioritization, and resourcing
- Multi-disciplinary project team
  - IT and Informatics
  - GApp Lab (therapeutic gaming)
  - Clinical collaborators
  - External collaborators and consultants

# INITIAL STRATEGY

- Gain experience with initial implementations
- Complete a few projects end-to-end prior to widely soliciting for potential projects
- Establish processes and resources for efficient development, deployment, support, and eventual retirement of apps and services
- Educate and empower various stakeholders to effectively provide value
- Ensure security as an essential priority

# CONSIDERATIONS FOR PRIORITIZATION

- Does Epic already do this well?
- Will Epic tackle this problem soon?
- Are there existing operational practices that will be changed?  Do they want to change?
- What is the likely clinical impact?
- What is the likely financial impact?
- Is there a committed clinical champion?
- Are there additional resources available?
- How hard will it be to implement?

# IMPLEMENTATION CONSIDERATIONS

## Software

- Open.epic.com
- Utilized existing hyperspace development environment as a sandbox (liberal access)
- Standard change control processes once beyond the proof of concept phase

## People

- Identified an IT team liaison to facilitate requests across multiple Epic Teams
- Utilize key resources for short time periods to explore ideas or answer questions
- Consider long term support options

# SECURITY / INFRASTRUCTURE

- Independent code review
- Third party code audit
- Currently focused on implementations inside the firewall
- Environments strategy that supports volume testing

# EXPERIENCE / THOUGHTS / WORRIES

- Embedding tools in the right context
- Small vendors' adoption of FHIR; prefer HL7 and Vendor Specific Extracts
- No shortage of ideas / picking the right projects for limited resources

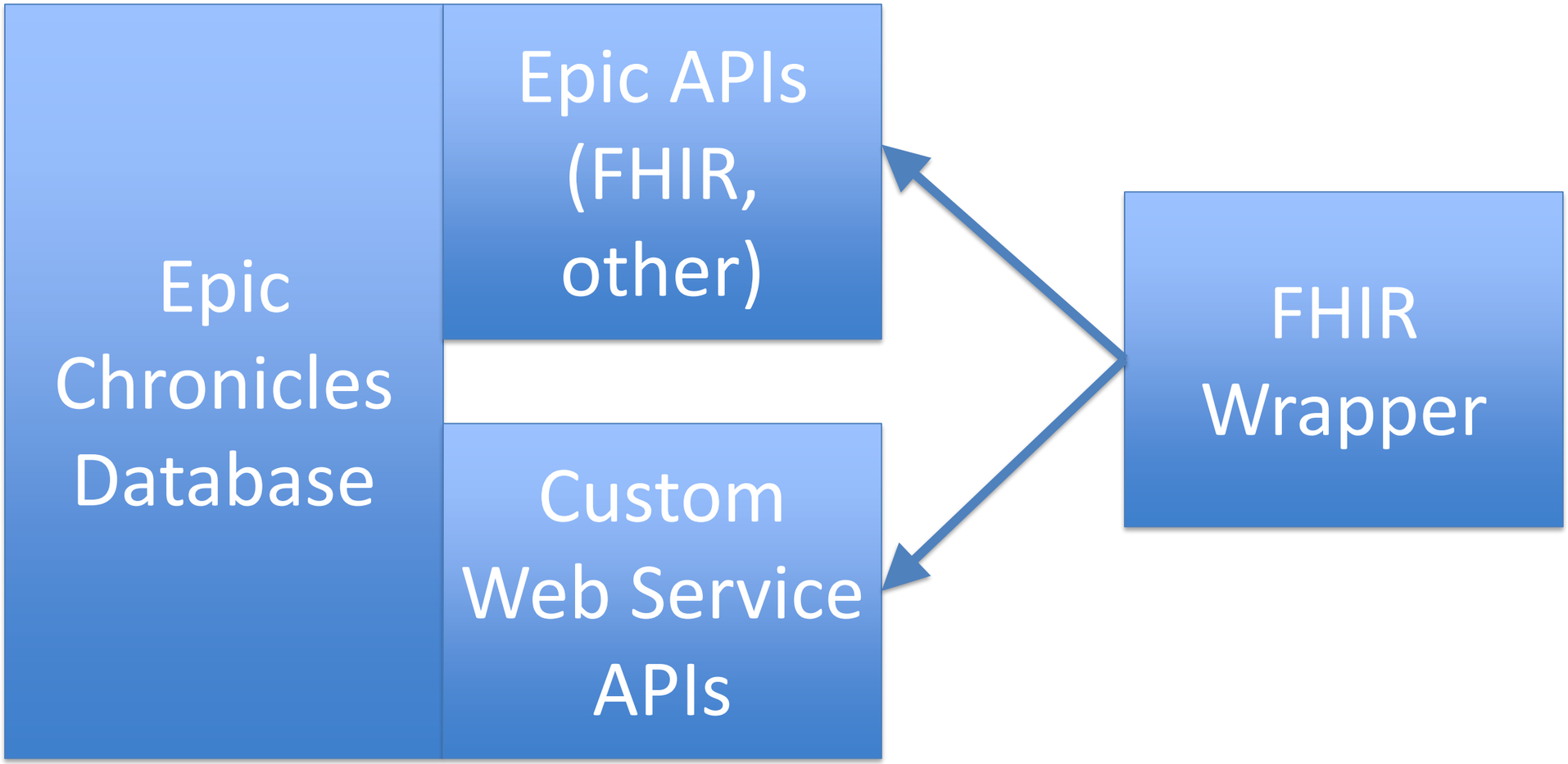

# BUILDING AN APPS AND SERVICES PROGRAM: TECHNICAL DETAILS AND CASE STUDIES

*KENSAKU KAWAMOTO, MD, PHD, MHS*
*ASSOCIATE CHIEF MEDICAL INFORMATION OFFICER*
*ASSISTANT PROFESSOR, BIOMEDICAL INFORMATICS*

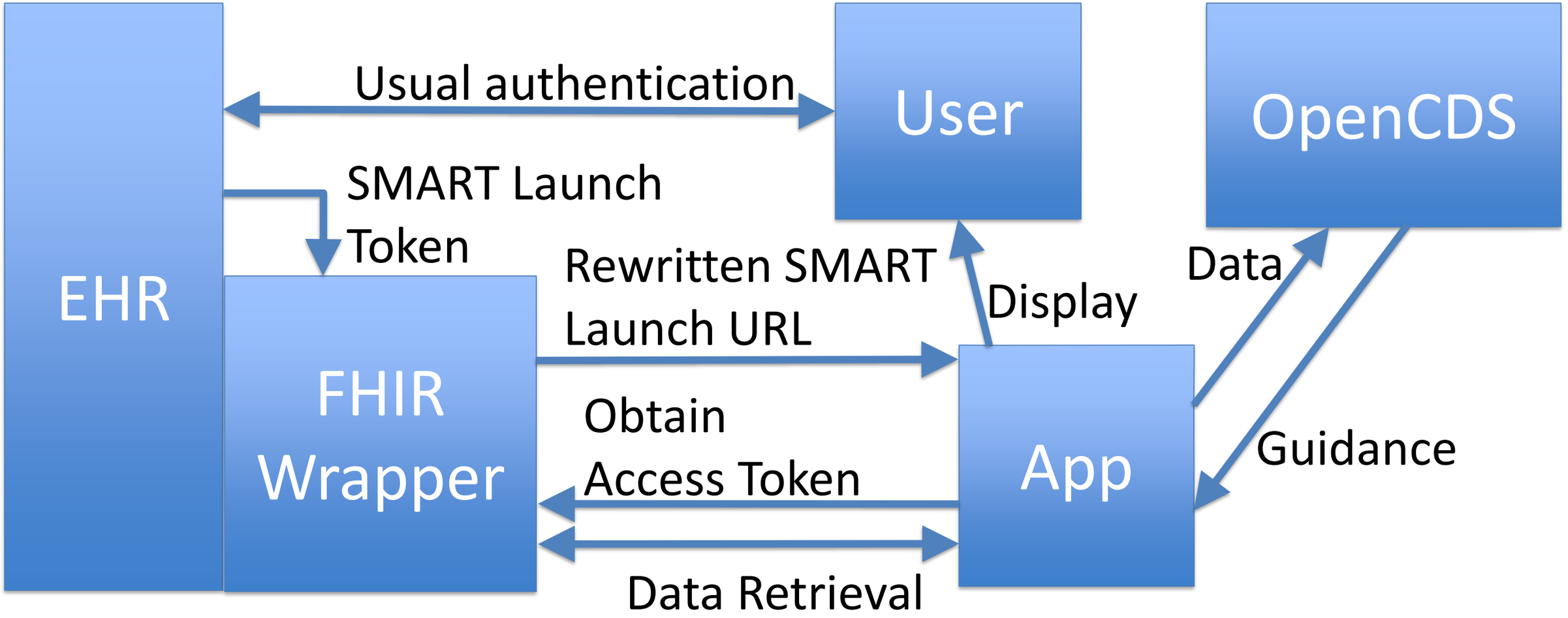
# DISCLOSURES

- In the past year, KK has been a consultant or sponsored researcher on clinical decision support for ONC, Hitachi, and McKesson InterQual
- While there are no concrete plans, one or more of the apps and services described may be commercialized in the future to enable wider impact

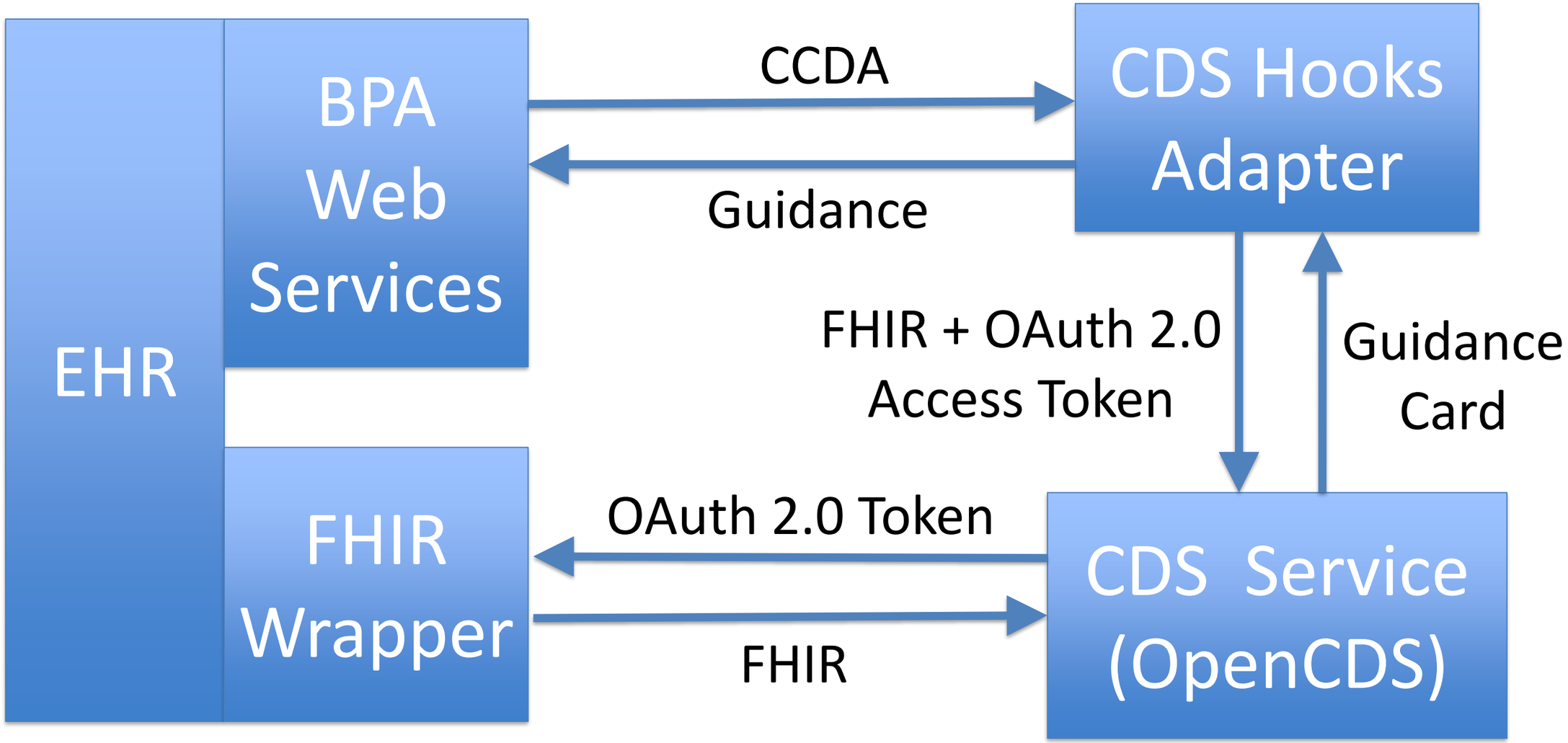
# APPROACH TO DATA: NATIVE + CUSTOM FHIR



# APP FRAMEWORK: SMART



# CDS SERVICE FRAMEWORK: CDS HOOKS



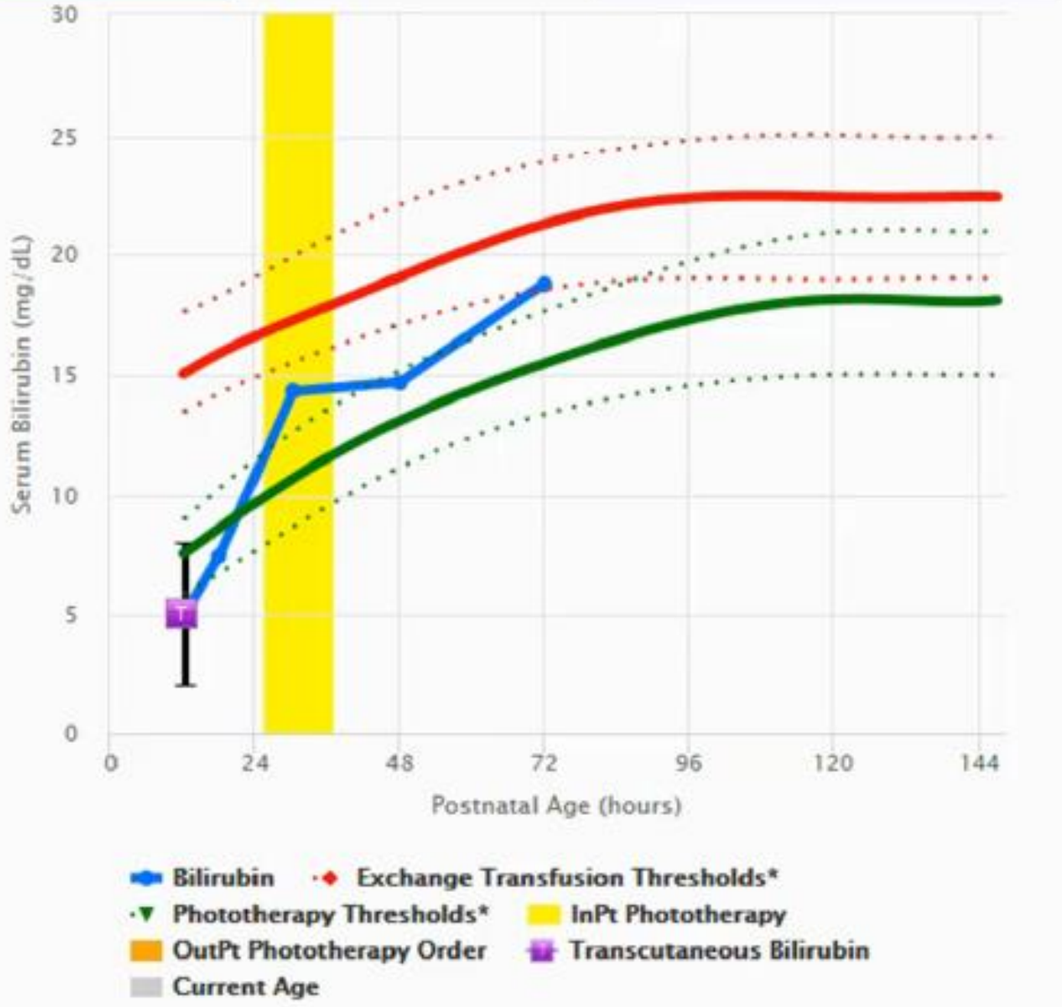
# NEONATAL BILIRUBIN APP

- Goal: improve neonatal bilirubin management and prevent neurotoxicity
- Physician champions:
  - Carole Stipelman, MD, MPH
  - Julie Shakib, DO, MPH
- Iteratively enhanced based on user requests
- Estimated to save >300 hrs of MD time/yr
- Awarded HHS Provider User Experience App Challenge Awards (link)

# Bilirubin App

Neurotoxicity Risk | Hyperbilirubinemia Risk

Print




*Bold = patient-specific threshold.

Source: AAP Hyperbilirubinemia Management Guidelines. Pediatrics. 2004;114:297-316.

**Gest. Age**

○ < 35 wks ○ 35-37 wks ◉ 38 wks+

**Direct Coombs** (risk factor)

◉ Pos. *(01/01/16)* ○ Neg. ○ Unknown

| | Blood Type | Indirect Coombs |
|---|---|---|
| Baby | B Pos (01/01/16) | Positive (01/01/16) |
| Mother | O Neg (04/09/15) | Positive (04/09/15) |

**Other neurotoxicity risk factors?**

- Acidosis
- Asyphyxia
- G6PD deficiency
- Isoimmune hemolytic disease
- Sepsis
- Sig. lethargy
- Temp. instability

○ Present ○ Not Present

**Albumin < 3.0 g/dL** (risk factor for phototherapy only)

○ Yes ◉ No ○ None on record

**Phototherapy** recommended.

Rationale: Patient's latest total serum bilirubin level of 18.8 mg/dL at 72 hrs is above treatment threshold for phototherapy (15.48) given gestational age >= 38 wks with risk factors for phototherapy.

**Clinical Prediction Rule for Rebound Hyperbilirubinemia**

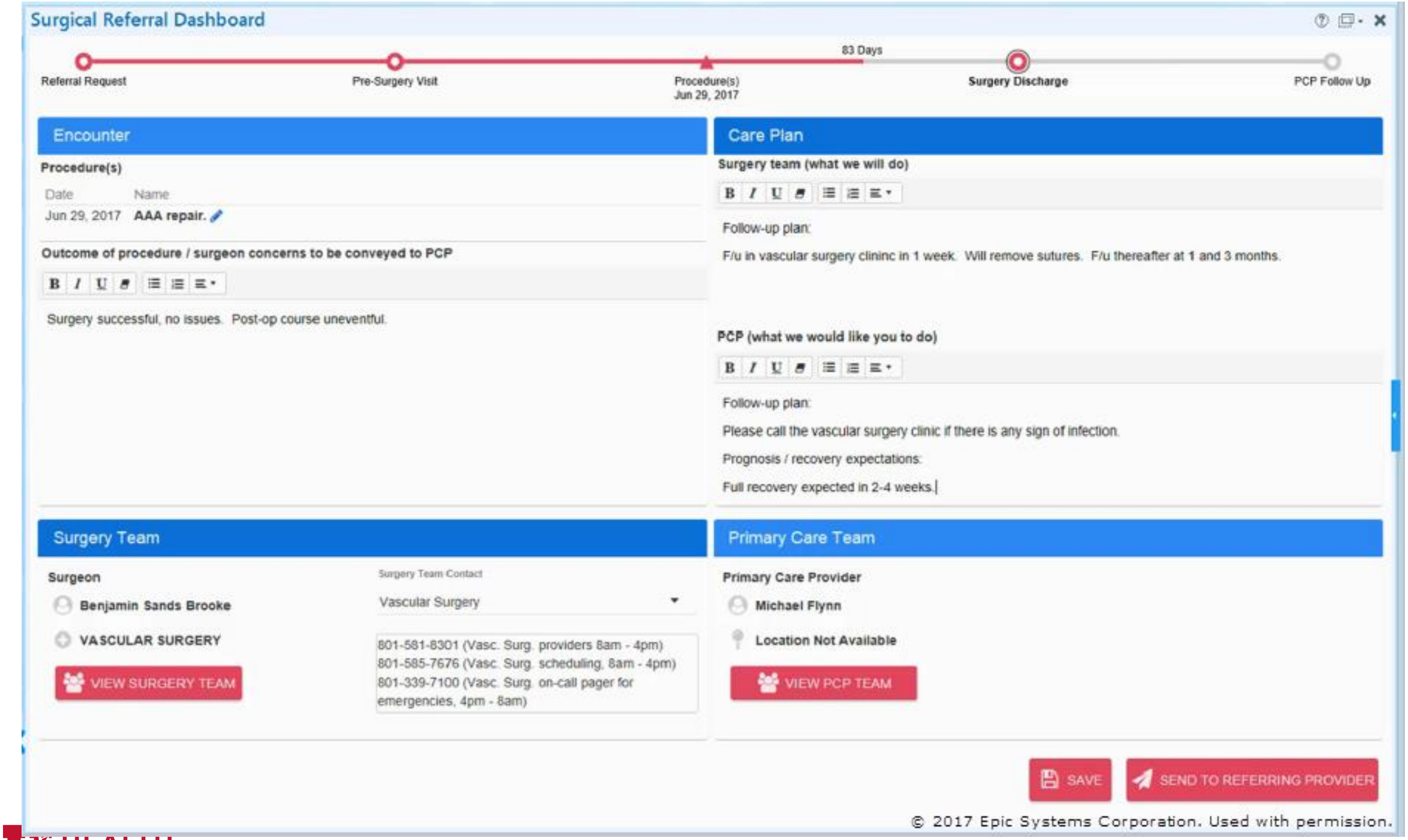
- **Risk Score: 55.84 (above threshold of 20)**
- Predicted risk of rebound hyperbilirubinemia after phototherapy: **ELEVATED (> 4%)**
- Based on paper on probability of return of total serum bilirubin (TSB) to phototherapy threshold within 72 hours of phototherapy termination (Chang et al. A Clinical Prediction Rule for Rebound Hyperbilirubinemia Following Inpatient Phototherapy.

# PROCEDURE SCHEDULE MANAGEMENT APP

- Goal: enable efficient procedure scheduling based on available capacity
- Physician champion: Howard Weeks, MD
- Initial focus: electroconvulsive therapy (ECT)
- Support for custom capacity rules and manual over-rides

# SURGICAL REFERRAL DASHBOARD

- Goal: enhance communication between surgeons and referring providers
- Physician champion: Ben Brooke, MD, PhD
- Builds on prior research on information needs and issues with traditional approach
- ONC High Impact Pilot (PIs: Brooke, Del Fiol)
- Covers PCP → surgeon and surgeon → PCP communication

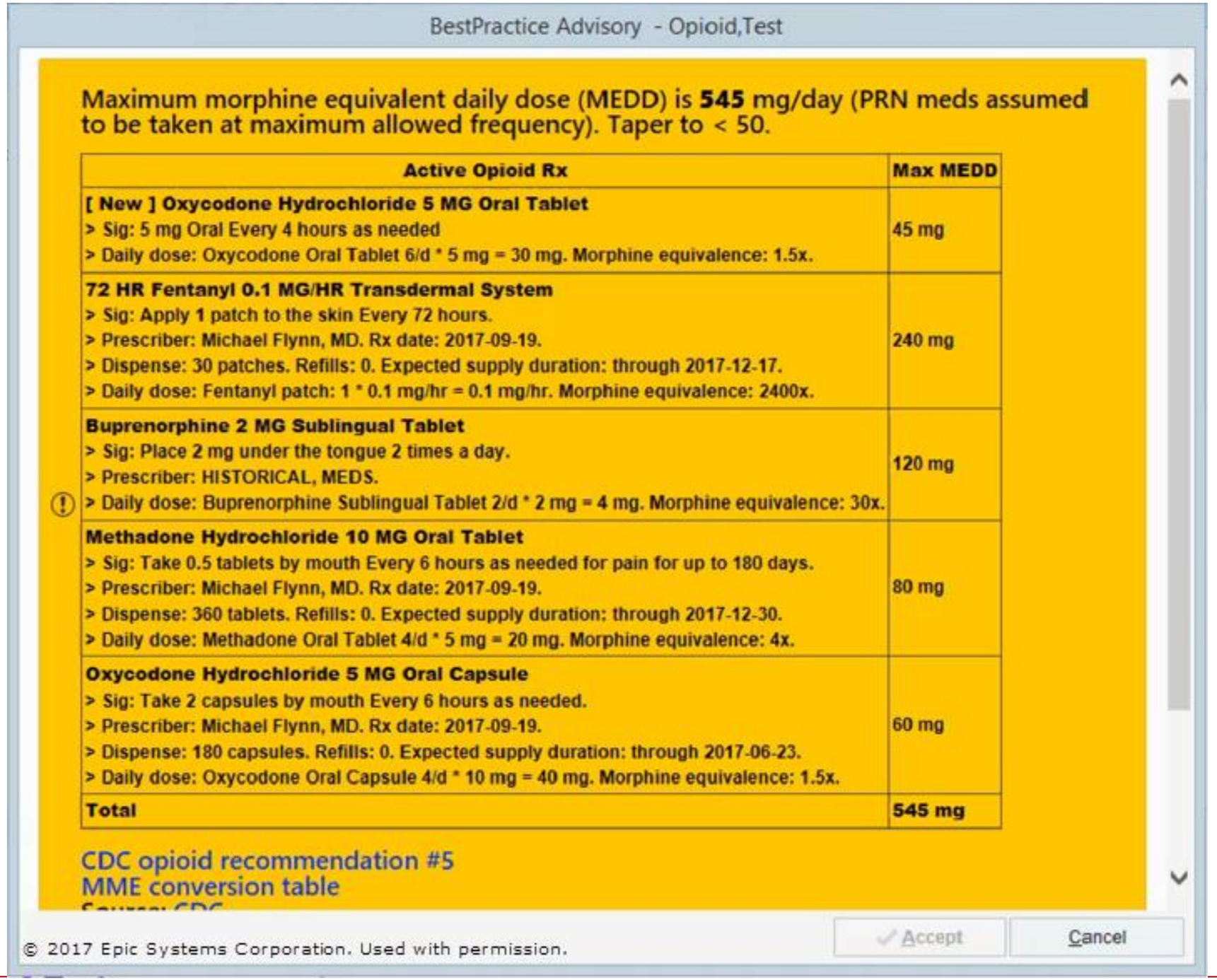


# MEDIGARDEN

- Goal: improve medication compliance through gamification
- Smartphone app developed by Therapeutic Games and Apps (GApp) Lab
- PI: Roger Altizer

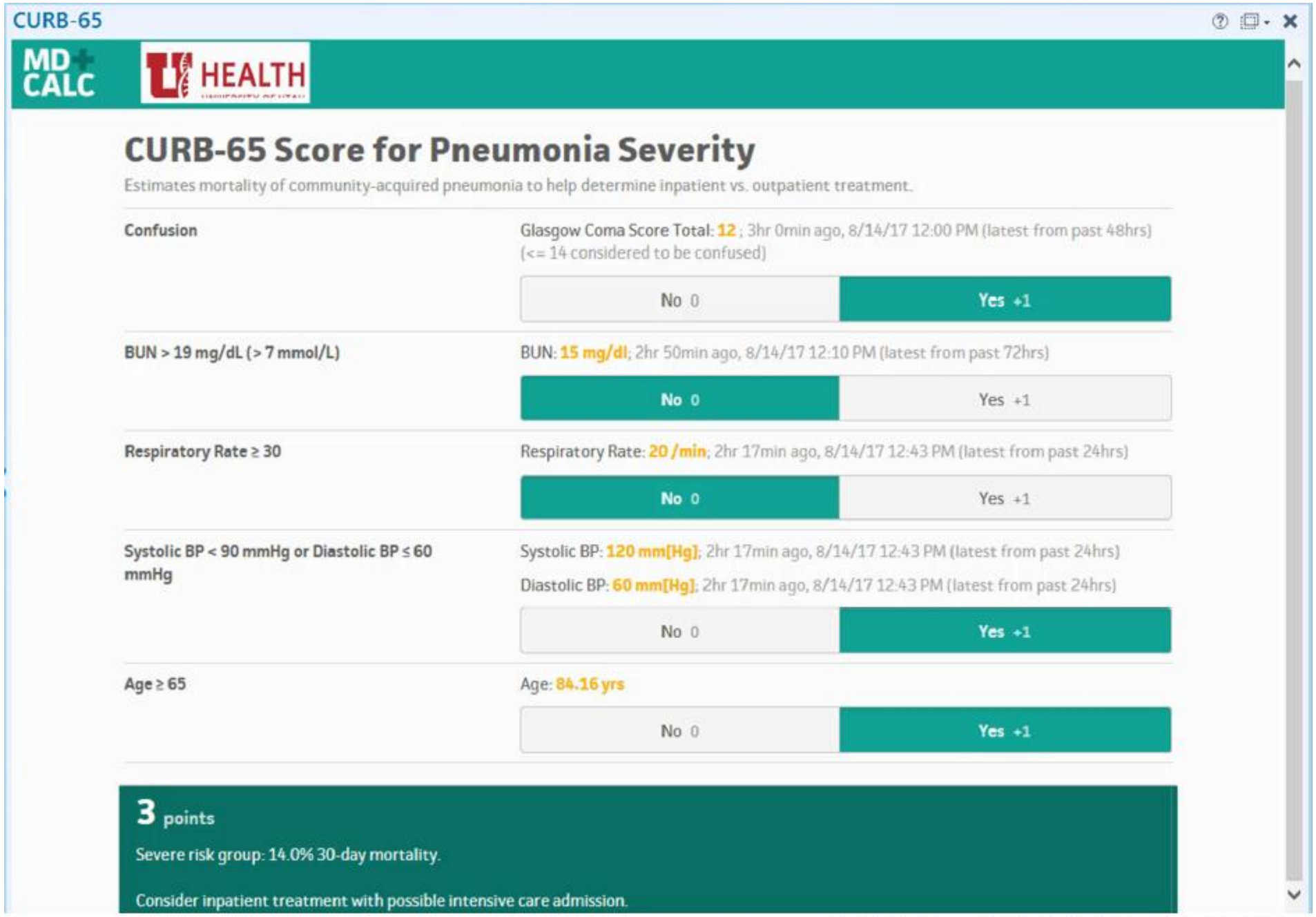
# OPIOID DECISION SUPPORT

- Goal: provide point-of-care decision support for opioid use and pain management
- Physician champions:
  - Jill Sindt, MD
  - David Anisman, MD
  - Scott Junkins, MD
- CDC support
- External partners: Yale, Houston Methodist, ONC



# MDCALC EHR INTEGRATION

- Goal: enable seamless integration of medical calculations within clinical workflows
- Physician champions: Mike Strong, MD + many others
- MDCalc: leading medical calculation tool
  - > 1 million monthly users from 196 countries
  - 35+ specialties, 200+ conditions



# EVALUATION

- Critical for understanding impact and demonstrating ROI
  - Use
  - Satisfaction
  - Clinical and financial impact
- Challenging to prioritize
- High synergy with research

# LESSONS LEARNED AND KEY QUESTION

- Lessons learned
  - Interoperability of FHIR interfaces across EHR vendors still in early stages
  - Custom FHIR interfaces needed in many cases; need to figure out how to best share across institutions and EHR vendor platforms
- Key question
  - How can we best collaborate across organizations on interoperable apps and services to improve patient care and the provider experience?

# ACKNOWLEDGMENTS (PARTIAL LIST)


- Amy Ballard, MBA
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- Charlene Weir, PhD, RN
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- Salvador Rodriguez, PhD
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- Scott Narus, PhD
- Shinji Tarumi
- Travis Cummings
- Travis Gregory
- Wataru Takeuchi
- Wesley Sargent, EdD
- Yi Lu

# The New Frontier of Interoperable Apps and Services at Intermountain Healthcare

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Intermountain Healthcare

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# Intermountain Healthcare

- Integrated Health Delivery Organization
  - HQ in Salt Lake City, UT
  - Spans all of Utah and Southern Idaho
- 22 Hospitals, 185+ clinics
- Strong Hx of Informatics Innovation (Homegrown solutions)

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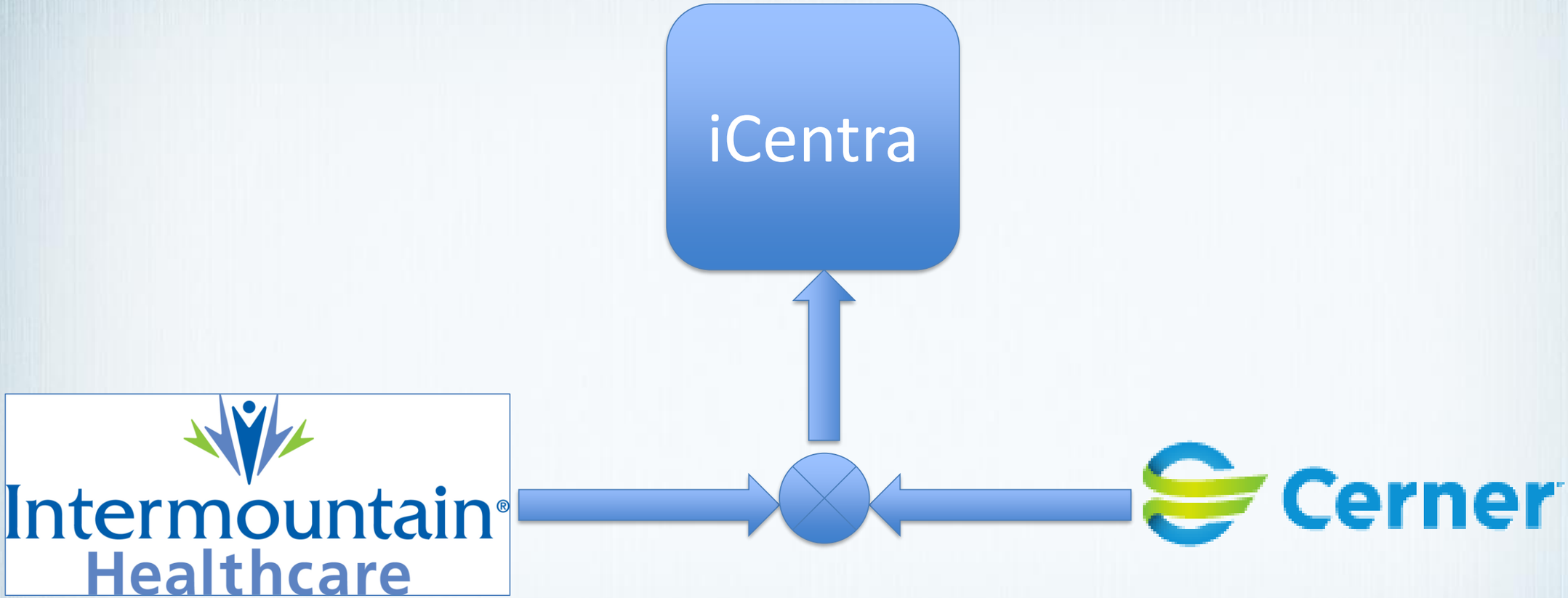
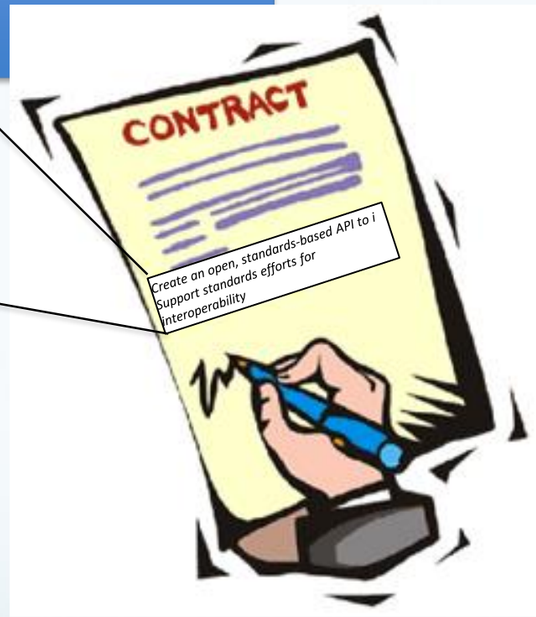
# In the beginning (or about Nov. 2013)…



# In the beginning (or about Nov. 2013)…

- *Create an open, standards-based API to iCentra*
- *Support standards efforts for interoperability*

iCentra




- 5-year mission
- A Fistful of Dollars

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# Coincidentally…


- DSTU 1 published by HL7 in Feb 2014
- Intermountain & Cerner agree on FHIR as API standard


- Intermountain & Cerner agree on SMART as app interop standard
- Joint support for SMART on FHIR
- Participation (w/ other vendors) at HIMSS 2014, demonstrating interoperable SMART on FHIR apps

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# How are (were) we working together?

- Joint oversight committee
- Weekly & Monthly meetings
- Project approval process
- Cerner develops FHIR services
- Intermountain develops requirements, FHIR profiles, apps
  - Cerner helps with FHIR resource (data) mapping
- Participation with Argonauts
- HIMSS coordination
- “Think Days”

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# Accomplishments

- FHIR DSTU 2 development and production servers
- OAuth support
- SMART app integration in iCentra
- Production release of 2 FHIR-based apps
- Use of FHIR resources for HIE support
- Implementation of Pub/Sub services*

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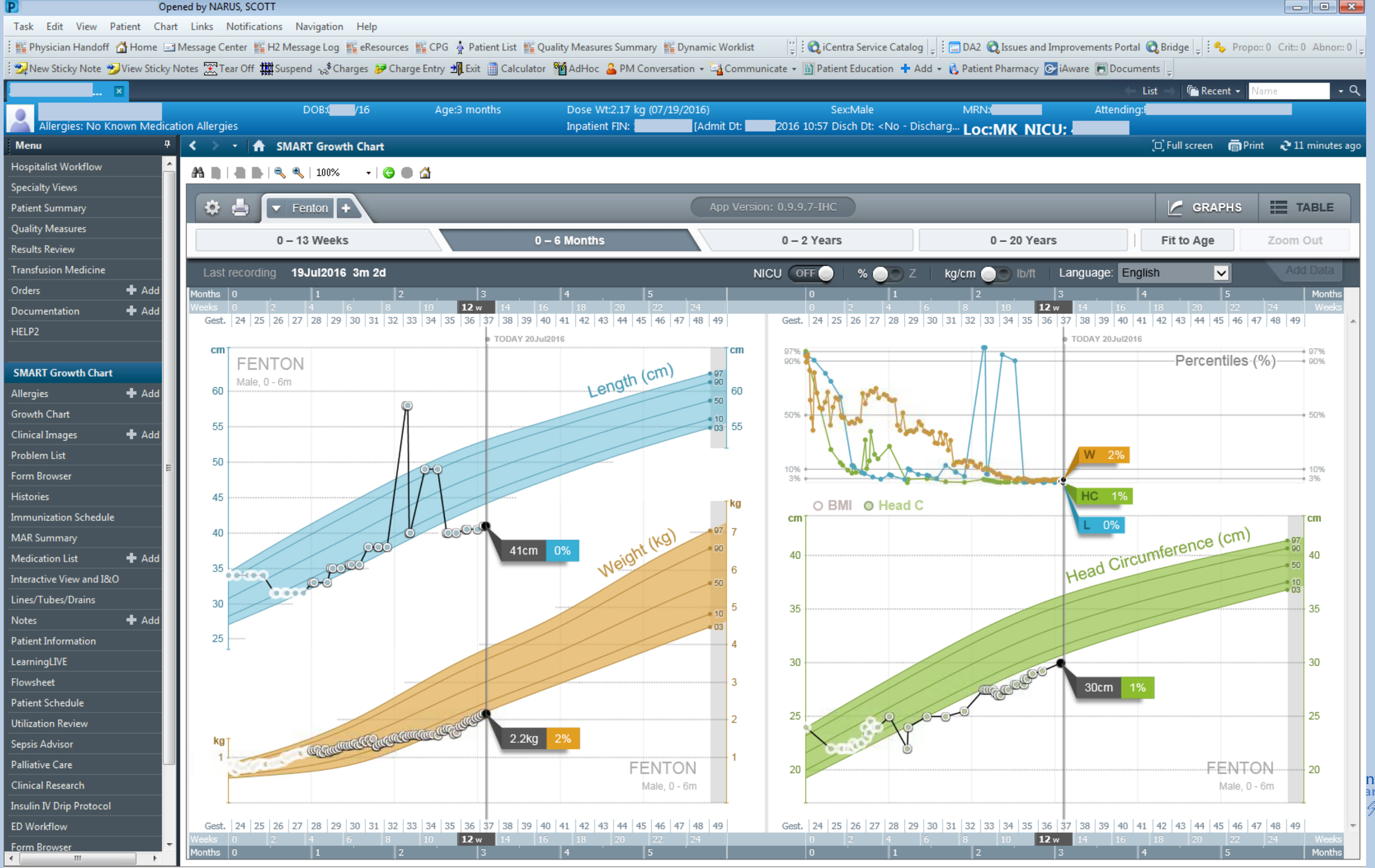
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Physician Handoff Home Message Center H2 Message Log eResources CPG Patient List Quality Measures Summary Dynamic Worklist
iCentra Service Catalog DA2 Issues and Improvements Portal Bridge
New Sticky Note View Sticky Notes Tear Off Suspend Charges Charge Entry Exit Calculator AdHoc PM Conversation Communicate Patient Education Add Patient Pharmacy iAware Documents
Allergies: No Known Medication Allergies
Inpatient FIN:
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Menu
Hospitalist Workflow
Specialty Views
Patient Summary
Quality Measures
Results Review
Transfusion Medicine
Orders Add
Documentation Add
HELP2
SMART Growth Chart
Allergies Add
Growth Chart
Clinical Images Add
Problem List
Form Browser
Histories
Immunization Schedule
MAR Summary
Medication List Add
Interactive View and I&O
Lines/Tubes/Drains
Notes Add
Patient Information
LearningLIVE
Flowsheet
Patient Schedule
Utilization Review
Sepsis Advisor
Palliative Care
Clinical Research
Insulin IV Drip Protocol
ED Workflow
Form Browser
SMART Growth Chart
Full screen
Print
11 minutes ago
Fenton
App Version: 0.9.9.7-IHC
GRAPHS
TABLE
0 – 13 Weeks
0 – 6 Months
0 – 2 Years
0 – 20 Years
Fit to Age
Zoom Out
Last recording 19Jul2016 3m 2d
NICU OFF
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kg/cm lb/ft
Language: English
Add Data
TODAY 20Jul2016
FENTON
Male, 0 - 6m
Length (cm)
Weight (kg)
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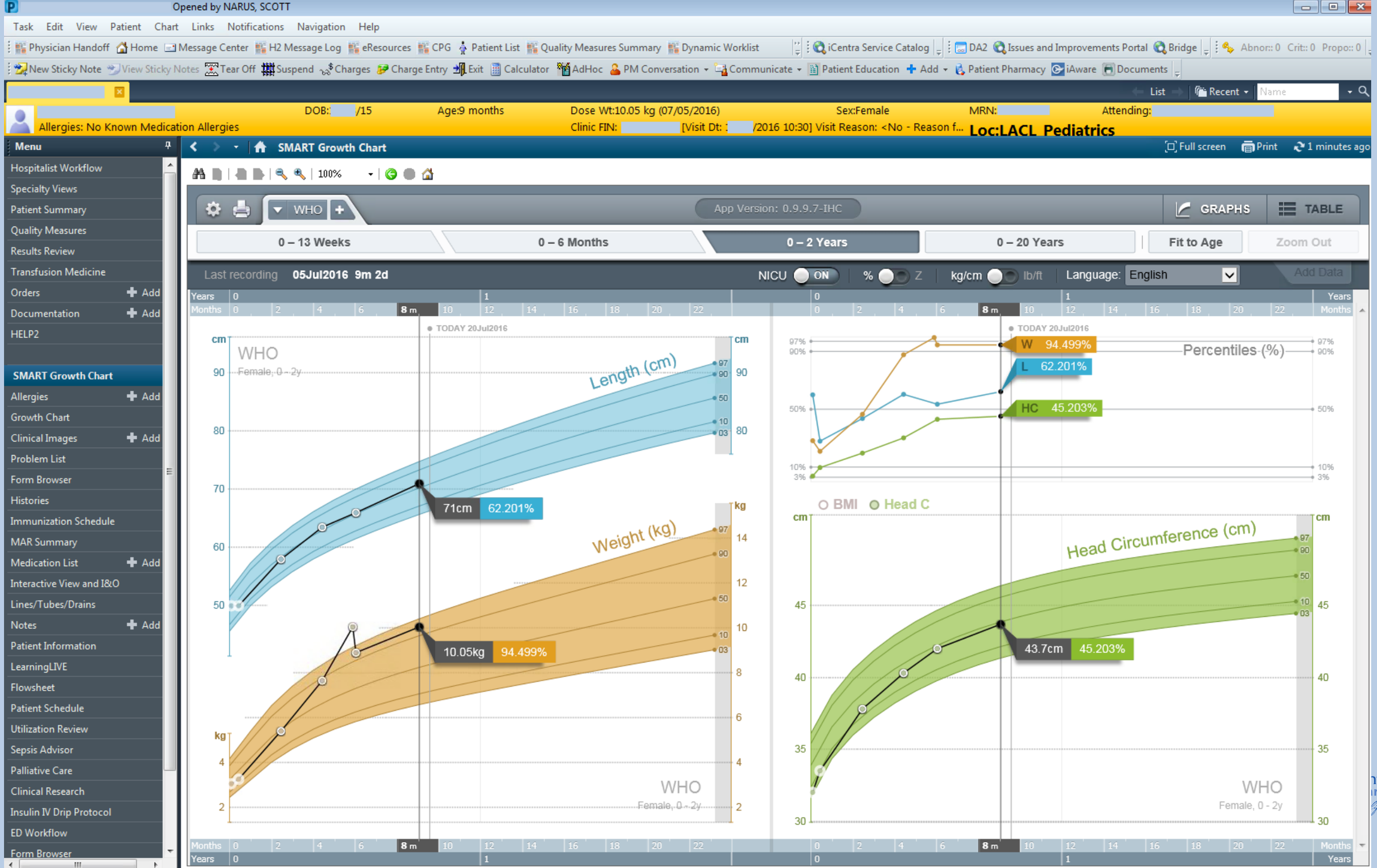
2.2kg 2%
Percentiles (%)
W 2%
HC 1%
L 0%
BMI Head C
Head Circumference (cm)
30cm 1%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List Recent Name
DOB: /15 Age:9 months Dose Wt:10.05 kg (07/05/2016) Sex:Female MRN: Attending:
Allergies: No Known Medication Allergies
Clinic FIN: [Visit Dt: /2016 10:30] Visit Reason: <No - Reason f...
Loc:LACL Pediatrics
Menu
Hospitalist Workflow
Specialty Views
Patient Summary
Quality Measures
Results Review
Transfusion Medicine
Orders Add
Documentation Add
HELP2
SMART Growth Chart
Allergies Add
Growth Chart
Clinical Images Add
Problem List
Form Browser
Histories
Immunization Schedule
MAR Summary
Medication List Add
Interactive View and I&O
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Patient Information
LearningLIVE
Flowsheet
Patient Schedule
Utilization Review
Sepsis Advisor
Palliative Care
Clinical Research
Insulin IV Drip Protocol
ED Workflow
Form Browser
SMART Growth Chart
Full screen Print 1 minutes ago
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App Version: 0.9.9.7-IHC
GRAPHS TABLE
0 – 13 Weeks 0 – 6 Months 0 – 2 Years 0 – 20 Years Fit to Age Zoom Out
Last recording 05Jul2016 9m 2d
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Female, 0 - 2y
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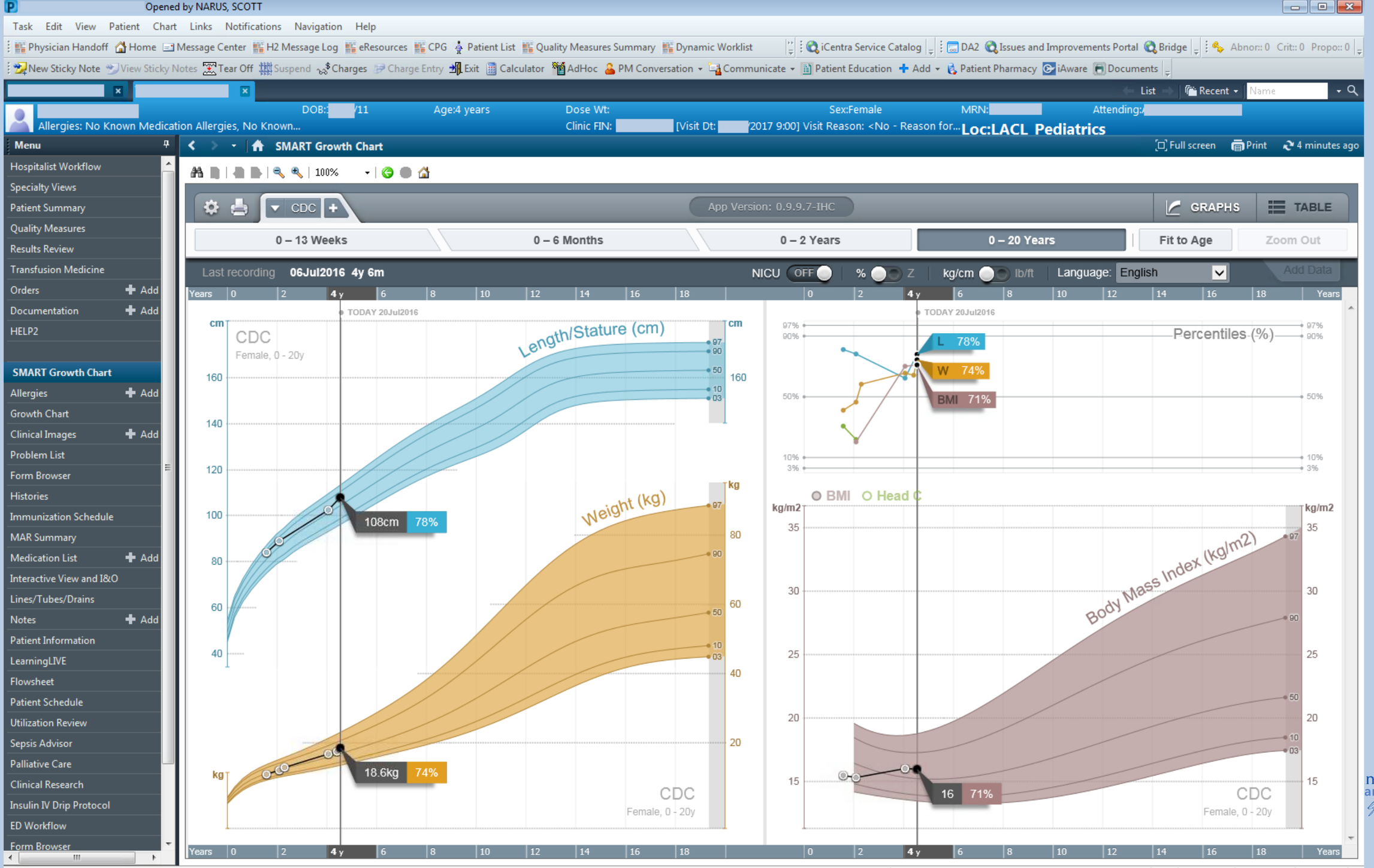
WHO
Female, 0 - 2y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Last recording 06Jul2016 4y 6m
NICU OFF % Z kg/cm lb/ft Language: English
Add Data
Years 0 2 4 y 6 8 10 12 14 16 18
TODAY 20Jul2016
cm
CDC
Female, 0 - 20y
Length/Stature (cm)
97 90 50 10 03
160 140 120 100 80 60 40
108cm 78%
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80 60 40 20
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CDC
Female, 0 - 20y
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16 71%
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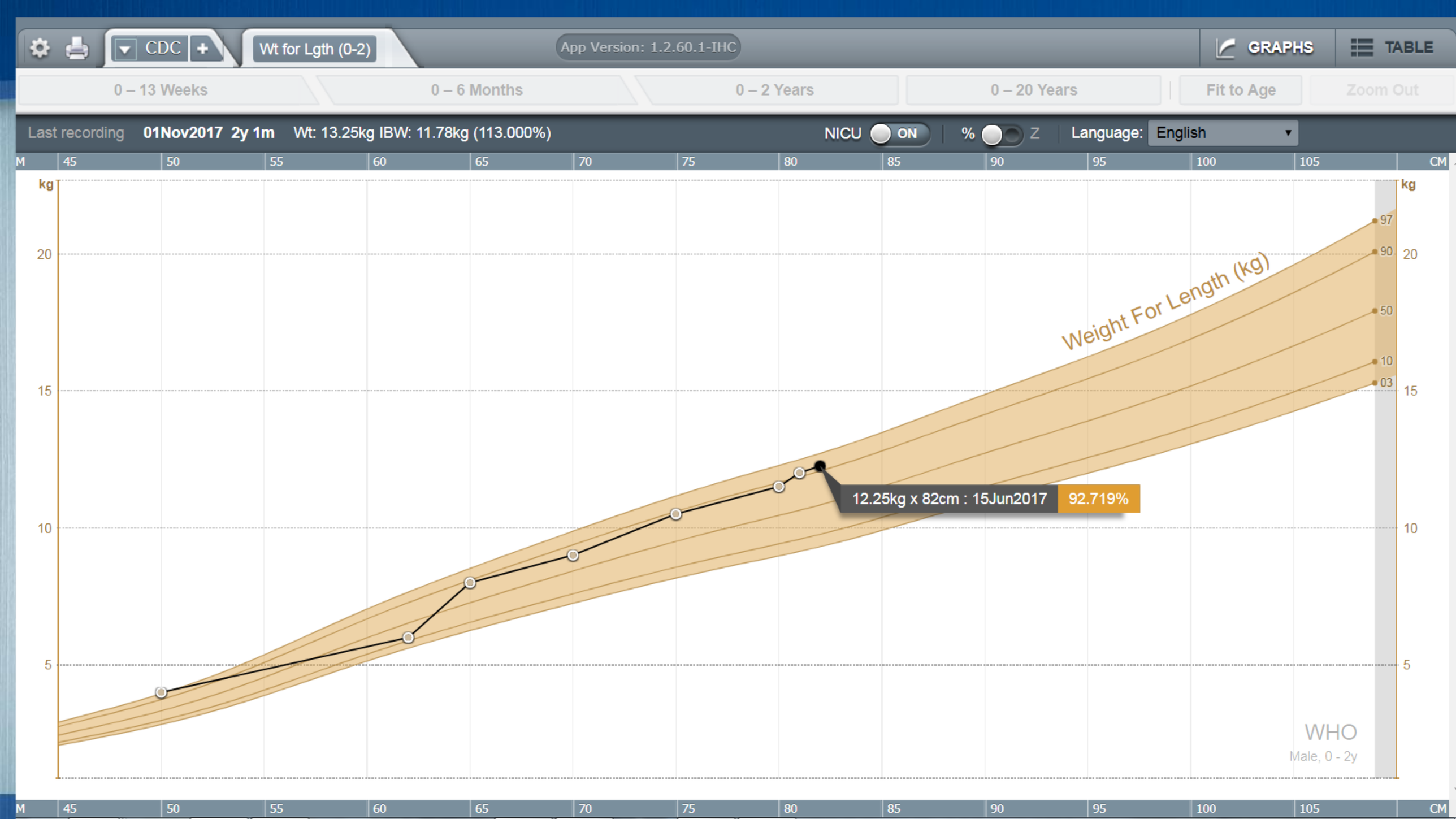
Female, 0 - 20y


CDC
Wt for Lgth (0-2)
App Version: 1.2.60.1-IHC
GRAPHS
TABLE
0 – 13 Weeks
0 – 6 Months
0 – 2 Years
0 – 20 Years
Fit to Age
Zoom Out
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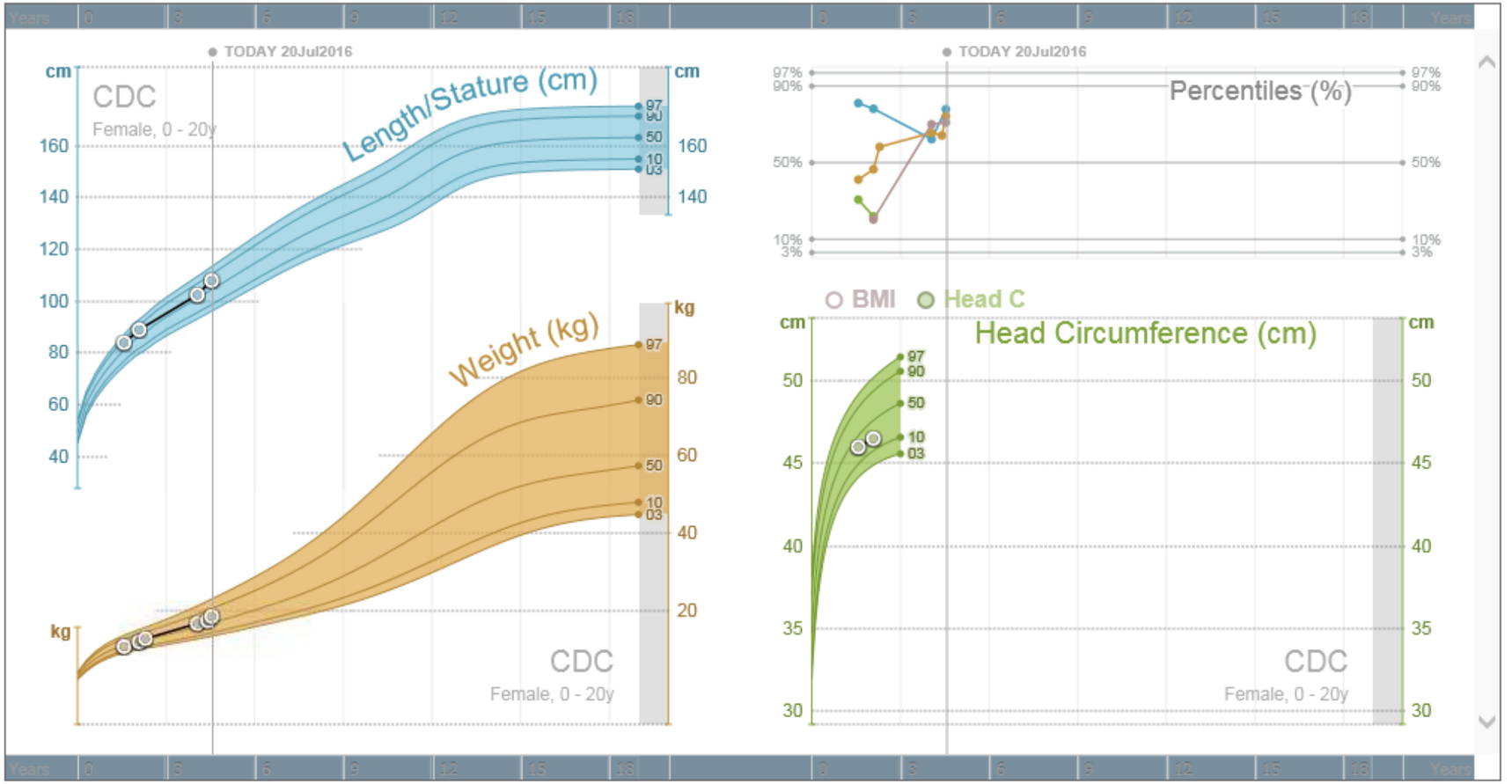
WHO
Male, 0 - 2y

https://webedge.co.ihc.com/ - [redacted] - Charts 20Jul2016 14-07PM - Internet Explorer

Print Now

sex **female** dob [redacted]2011 age **4y 6m** corrected age **4y 6m**

20Jul2016 14:07 PM




| Date | Age | Length | | | | Weight | | | | Head C | | | | BMI | Bone Age |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Value | Percentile | Z Score | Velocity | Value | Percentile | Z Score | Velocity | Value | Percentile | Z Score | Velocity | | |
| 06Jul2016 | 4y 6m | 108cm | 78 | 0.8 | 11.4cm/yr | 18.6kg | 74 | 0.7 | 8.2kg/yr | | | | | 16 | |
| 18May2016 | 4y 4m | | | | | 17.5kg | 64 | 0.4 | 2kg/yr | | | | | | |
| 13Jan2016 | 4y 2w | 102.5cm | 62 | 0.3 | 6.9cm/yr | 16.8kg | 66 | 0.4 | 2.2kg/yr | | | | | 16 | |
| 09Apr2014 | 2y 3m | | | | | 12.9kg | 58 | 0.2 | 3.8kg/yr | | | | | | |
| 24Jan2014 | 2y 1m | 89cm | 78 | 0.8 | 9.7cm/yr | 12.1kg | 46 | -0.1 | 2.3kg/yr | 46.5cm | 22 | -0.8 | 1cm/yr | 15.3 | |
| 19Jul2013 | 1y 6m | 84cm | 81 | 0.9 | | 10.9kg | 41 | -0.2 | | 46cm | 31 | -0.5 | | 15.5 | |

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100%

# The Good, The Bad, and The Ugly…

- Successful release of production apps
- Cerner provides a fairly robust set of FHIR resources
- Have demonstrated interoperability of apps
- Vendors are cautious & conservative at this point
- Open source apps are NOT free
- Data are not always where you think they are, and they don't always come back as expected
  - Need *true* semantic interoperability
- Printing & IE plugin

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# THANK YOU!

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University of Utah

Scott P. Narus, Ph.D.
Medical Informatics Director
Intermountain Healthcare

# DISCUSSION QUESTIONS

- What have you done?
- What apps/services would you find most useful?
- What barriers do you see at your institution?
- How responsive have your vendors been to this approach?
- Any tips/tricks you'd like to share?
- What pitfalls do you see to this vision?
- Where do you think we are in the hype curve?