Improving EHR Function and Usability for Immunization

AIRA Annual Meeting

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CNI Advantage, LLC.

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- **Current Status of Immunization-Related Capability in EHRs**
- **EHR Certification Process Pilot Overview**
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Current Status:
US Vaccination Rates 2013-2014

Vaccination Rates by State

Percentage of kindergartners vaccinated by state, 2013-2014 school year

- 96.6%-100%
- 92.7%-96.5%
- 88.8%-92.6%
- 84.9%-88.7%
- 81%-84.8%
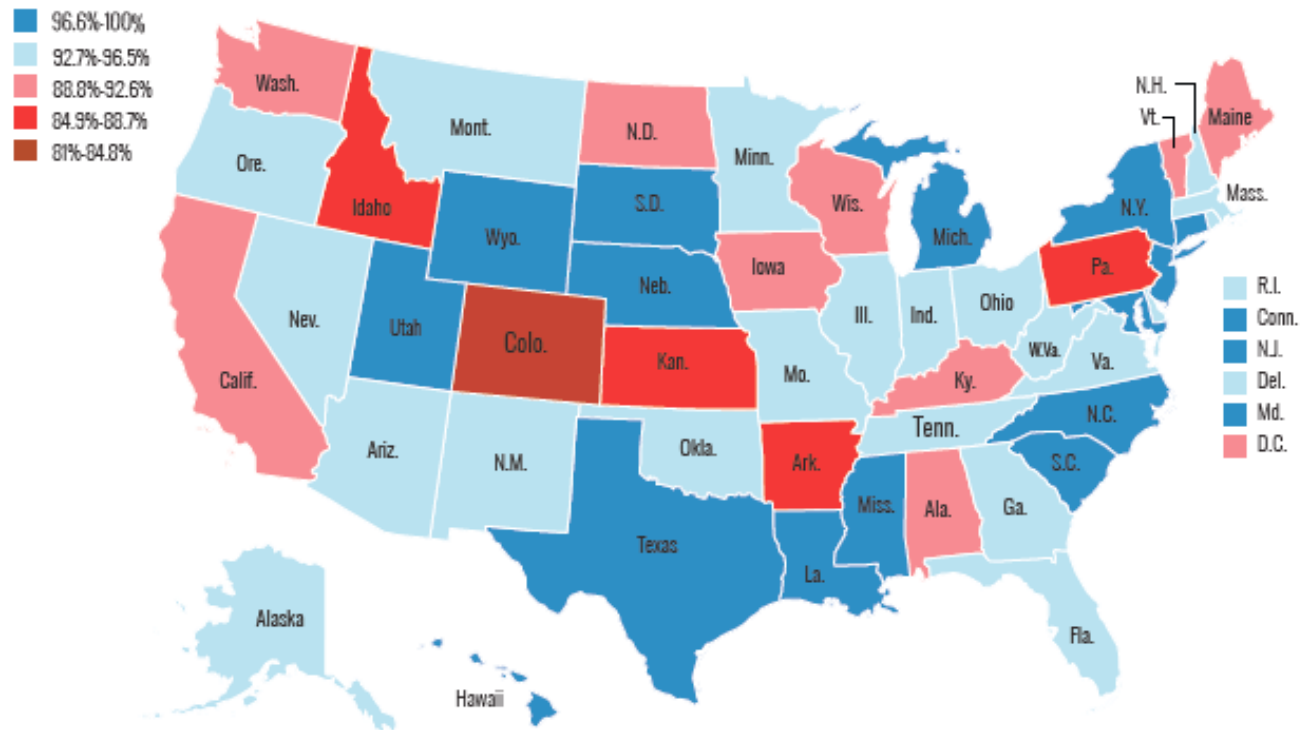
Note: Data for Wyoming is from the 2012-13 school year.
Source: Centers for Disease Control and Prevention

Mother Jones

Vicens AJ, Cannon G. Do you live in a state with low vaccination rates, *Mother Jones*.Available at; http://www.motherjones.com/politics/2015/02/mapping-measles-vaccine-coverage-around-the-country. Accessed 2 April 2015

Current Status: Existing EHR Certification Requirements

1. Meaningful Use Stage 1:

   a. Enable submission of immunization report to an IIS

2. Meaningful Use Stage 2:

   a. Successfully submit electronic immunization data to an IIS for the entire EHR reporting period

   b. Enable a user to electronically record, change and access immunization information

   c. Electronically create immunization information for electronic submission to IIS using

Current Status:
Proposed EHR Certification Requirements

3. Meaningful Use Stage 3 (proposed):

   a. Require bidirectional exchange

      - EHR: Enable a user to request, access, and patient's immunization history and forecast from an immunization registry in accordance with the HL7 Version 2.5.1: Implementation Guide for Immunization Messaging, Release 1.5.

      - Provider: The provider is in active engagement with a public health agency to submit immunization data and receive immunization forecasts and histories from the (IIS).

   b. Reconcile immunization history (considered)

   c. Represent immunizations in NDC and CVX codes

   d. Include immunizations in the "common clinical data set"

   e. Use HL7 2.5.1 Implementation Guide for Immunization Messaging, Release 1.4 and using CVX as updated through July 11, 2012

Current Status:
EHR Immunization-Related Capability Ongoing Challenges

1. EHR Usability
2. Quality of Immunization Data in EHRs
3. EHR use of Forecasting Data
4. Management of Immunization Deferrals
5. Management of VFC Eligibility

EHR CERTIFICATION PROCESS PILOT OVERVIEW

EHR Certification Process Pilot
Phase 1: 2013-2014

- **Immunization-Related Capabilities for Clinical Software**
- **Literature Review**
- **Interviews with Experts and Stakeholders**
- **EHR Certification Incentives and Requirements**
    - Initial incentives
    - Requirements for functionality and usability
    - Certification tier definitions
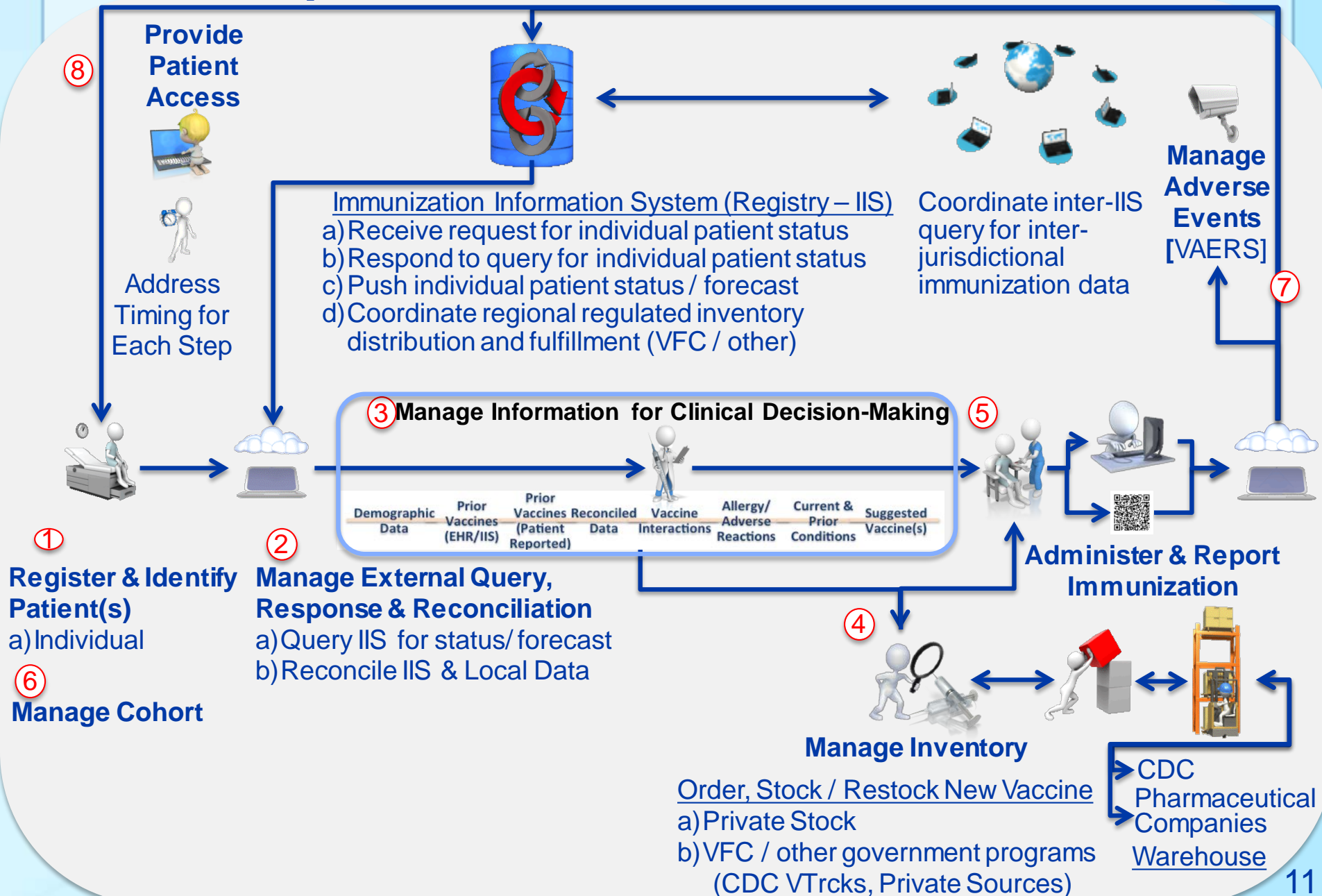   - Certification implementation plan

EHR Certification Process Pilot
Phase 2: 2014-2015

- ❑ **Use Cases and Clinical Scenarios for Broad Vetting**
- ❑ **EHR Clinical Software Assessment**
- ❑ **Stakeholder Vetting of Requirements: www.immunizationsandhealthit.org**
- ❑ **Immunization-Centric Pilot Demonstration and Evaluation**
- ❑ **Immunization-Centric Guidance for EHR and Other Clinical Software Vendors and Purchasers**
- ❑ **Plan and Timeline for Full Implementation of EHR Certification Plan**
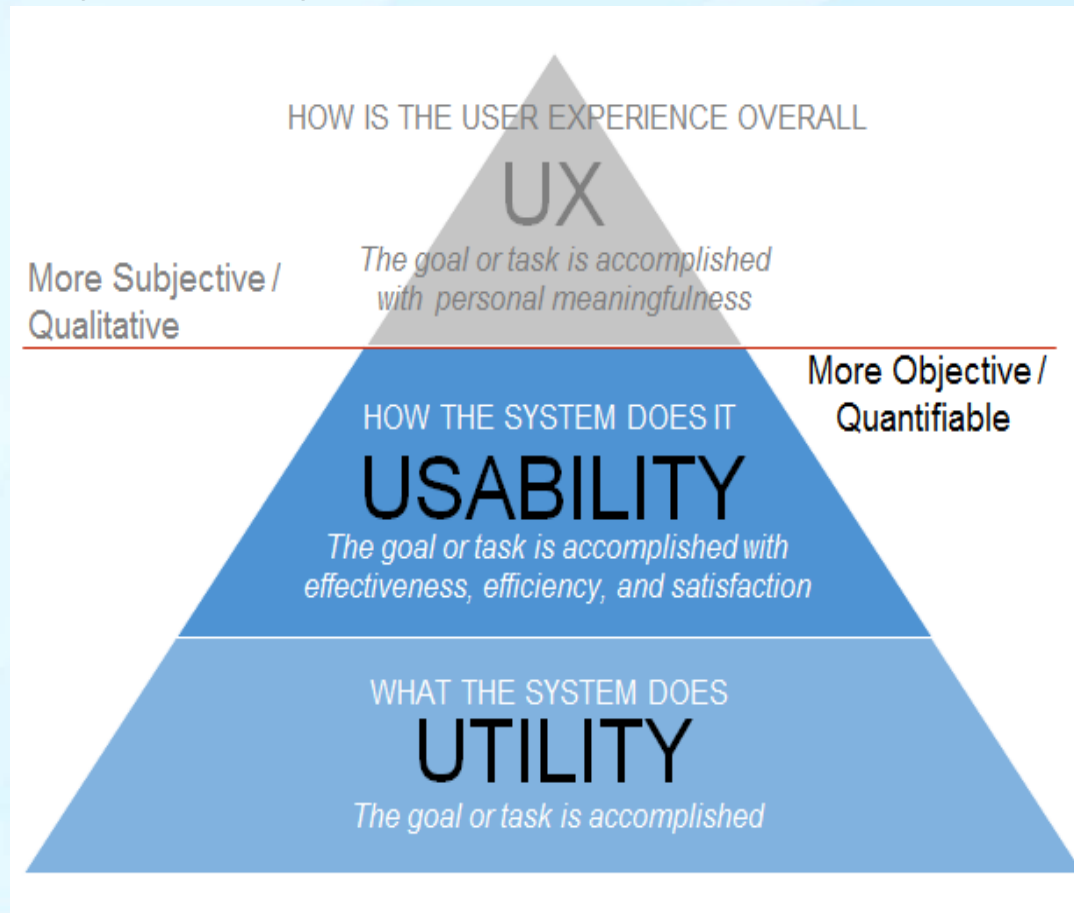
IMMUNIZATION CLINICAL WORKFLOW CONCEPTUAL MODEL

Conceptual Model: General User Workflows

⑧ **Provide Patient Access**

Address Timing for Each Step

Immunization Information System (Registry – IIS)
a) Receive request for individual patient status
b) Respond to query for individual patient status
c) Push individual patient status / forecast
d) Coordinate regional regulated inventory distribution and fulfillment (VFC / other)

Coordinate inter-IIS query for inter-jurisdictional immunization data

Manage Adverse Events [VAERS]

⑦

③ **Manage Information for Clinical Decision-Making** ⑤

Demographic Data	Prior Vaccines (EHR/IIS)	Prior Vaccines (Patient Reported)	Reconciled Data	Vaccine Interactions	Allergy/ Adverse Reactions	Current & Prior Conditions	Suggested Vaccine(s)

Administer & Report Immunization

① **Register & Identify Patient(s)**
a) Individual

② **Manage External Query, Response & Reconciliation**
a) Query IIS for status / forecast
b) Reconcile IIS & Local Data

⑥ **Manage Cohort**

④

Manage Inventory

Order, Stock / Restock New Vaccine
a) Private Stock
b) VFC / other government programs (CDC VTrcks, Private Sources)

CDC Pharmaceutical Companies Warehouse

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EHR Certification Process Pilot
Usability vs. Function (Utility)

❑ **Usability:** *Focused on HOW a system functionality impacts patient safety and physician workflow outcomes*

HOW IS THE USER EXPERIENCE OVERALL

UX

The goal or task is accomplished with personal meaningfulness

More Subjective / Qualitative

More Objective / Quantifiable

HOW THE SYSTEM DOES IT

USABILITY

The goal or task is accomplished with effectiveness, efficiency, and satisfaction

WHAT THE SYSTEM DOES

UTILITY

The goal or task is accomplished

EHR CLINICAL SOFTWARE ASSESSMENT

EHR Clinical Software Assessment: Criteria for Selecting Vendors

❑ **Market Share:**

- Pediatricians, Small practices, Large healthcare enterprises

❑ **EHR Attributes:**

- Bidirectional exchange with IIS', Used in retail clinics, Cloud technology, Client-server technology

Sources:

1. SkaInfo: http://www.skainfo.com/health_care_market_reports/EMR_Electronic_Medical_Records.pdf
2. AHIMA: http://journal.ahima.org/2013/02/06/ehr-market-share-report-shows-top-mu-vendors/
3. ONC: Top 15 EHR vendors used by pediatricians attesting to Meaningful Use in the Medicare EHR program,
4. ONC: Top 15 EHR vendors used by pediatricians participating in the Regional Extension Center (REC) program for Medicaid participants

EHR Clinical Software Assessment: Vendor Participants

	Vendor	Date
1	Connexin (Office Practicum v14)	1-29-2015 √
2	eMDs (Solution Series, v8.0)	1-30-2015 √
3	NextGen (NextGen EHR v5.8.1)	2-2-2015 √
4	McKesson (Practice Choice v4.01)	2-3-2015 √
5	Greenway Health (PrimeSuite v17.10.7.HF2)	2-5-2015 √
6	Practice Fusion (Practice Fusion EHR v3.3)	2-6-2015 √
7	Cerner (Power Chart)	2-9-2015 √
8	Athenahealth (AthenaClinicalEHR v15.1)	2-17-2015 √
9	Allscripts (Touchworks v11.5.0)	2-24-2015 √
10	Epic (Epic Care Ambulatory 2015)	3-10-2015 √
11	PCC (v6.2.7)	3-11-2015 √
12	eClinicalWorks (v10)	3-16-2015 √

EHR Clinical Software Assessment: Evaluation Process

1 Vendor Preliminary Assessment

2 Vendor Demonstration Evaluation

3 Vendor Demonstration Report

1 EHR Immunization Functions & Capabilities for Vendor Validation

3 Table 1. Functionality Observations

Reqt. No.	Description	Preliminary Assessment (as reported by Vendor)	CNIADV Observation
REGISTER AND IDENTIFY A PATIENT			
1	Select multiple patients (e.g., those scheduled for appointments during the upcoming week)	No	Yes, Out of the Box
2	Include mother's maiden name, multiple birth indicator and birth order when registering new patients	No	No
3	Differentiate from a list of similar sounding names to select a single patient	Yes, Out of the Box	Yes, Out of the Box
MANAGE EXTERNAL QUERY, RESPONSE, AND RECONCILIATION			
4	Send an immunization registry a batch request for immunization histories and receive and incorporate the response	Yes, With Configuration	No
5	Send an immunization registry a real-time request on demand for immunization history and receive and incorporate the response	No	No
6	Compare Immunization Information System (IIS) immunization history to EHR Immunization history and update as needed	No	No

2 Immunization Utility Functions Worksheet

Note: "Yes, With Configuration" implies back-end or infrastructure labor to make the functionality work as described. "Yes, With Customization" implies front-end labor to make the function work as described.
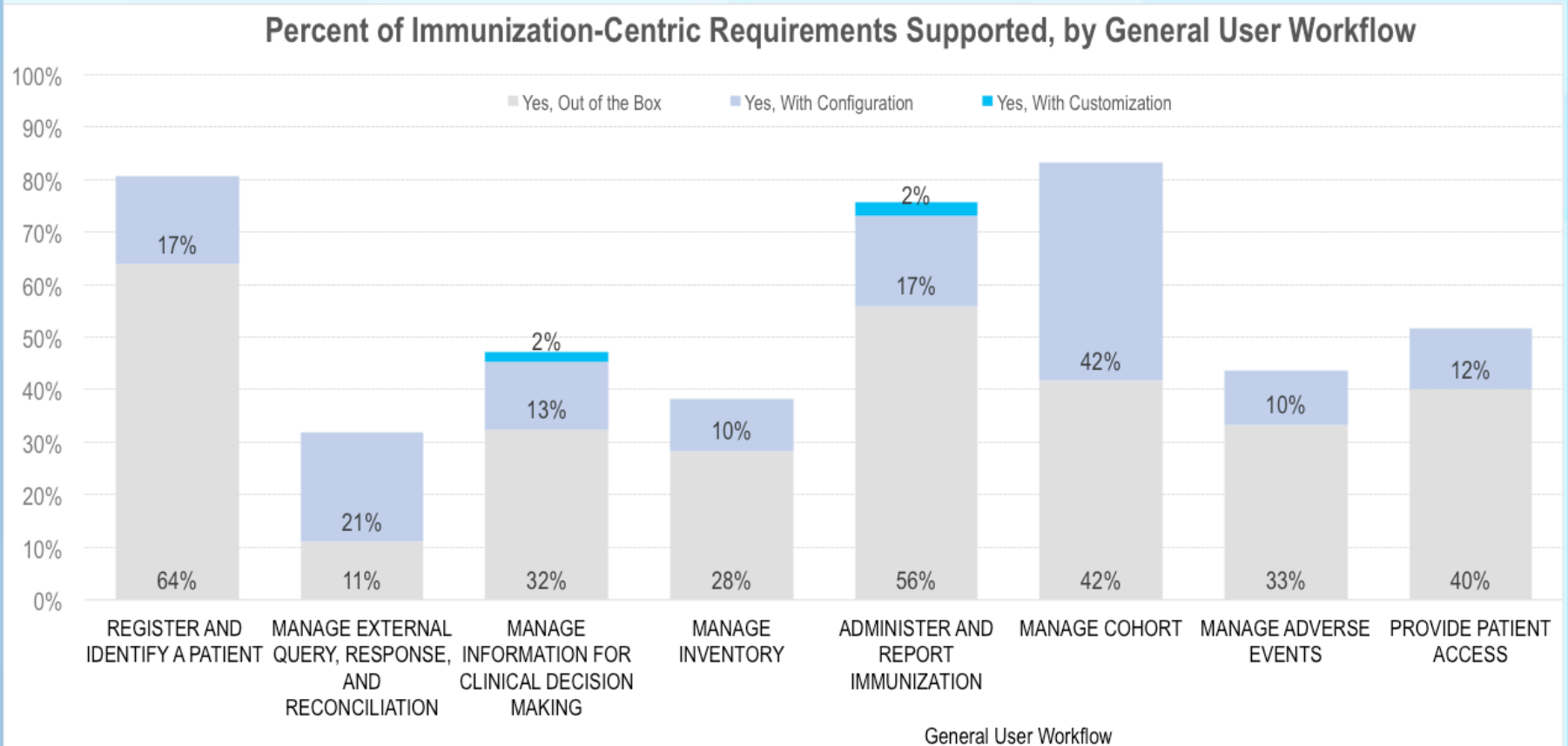
Sample Script Text	#	Use Case #	EHR Immunization Utility Functions	Vendor Comments	Vendor Rating	Evaluation Rating	Comments
REGISTER AND IDENTIFY A PATIENT							
1a	1	REG4 UC3	Select a Multiple Patients		Yes, With Configuration	Yes, With Configuration	
1b	2	REG4 UC1	Register New Patients		Yes, Out of the Box	Yes, Out of the Box	
1c	3	REG4 UC2	Select a Single Patient		Yes, With Configuration	Yes, With Configuration	
MANAGE EXTERNAL QUERY, RESPONSE, AND RECONCILIATION							
2a	4	QR3 UC1	Batch Request / Receive Patient Immunization History(s)		Yes, With Customization	Yes, With Customization	
2a	5	QR3 UC2	Real-Time Request / Receive for Immunization History(s)		Yes, With Configuration	Yes, With Customization	
2b	6	QR8a UC1	Compare IIS Immunization History to EHR Immunization History		Yes, With Configuration	Yes, With Configuration	
2c	7	QR3 UC1	Request / Receive Patient Immunization Data and Identify Source		Yes, Out of the Box	Yes, Out of the Box	

EHR Clinical Software Assessment: Functional Evaluation of 48 Requirements

❑ **Yes, Out of the Box** – a function is readily available within the software product as typically delivered and installed

❑ **Yes, with Configuration** – someone in the practice must set up the software function with or without using documentation (but without intervention by the vendor)

❑ **Yes, with Customization** – the practice must contact the vendor to make changes in the software specific to the practice to make the function work as described

❑ **No** – a function is not available in the software product

❑ **Don't Know** – there is insufficient information to determine whether or not a function is available in the software product
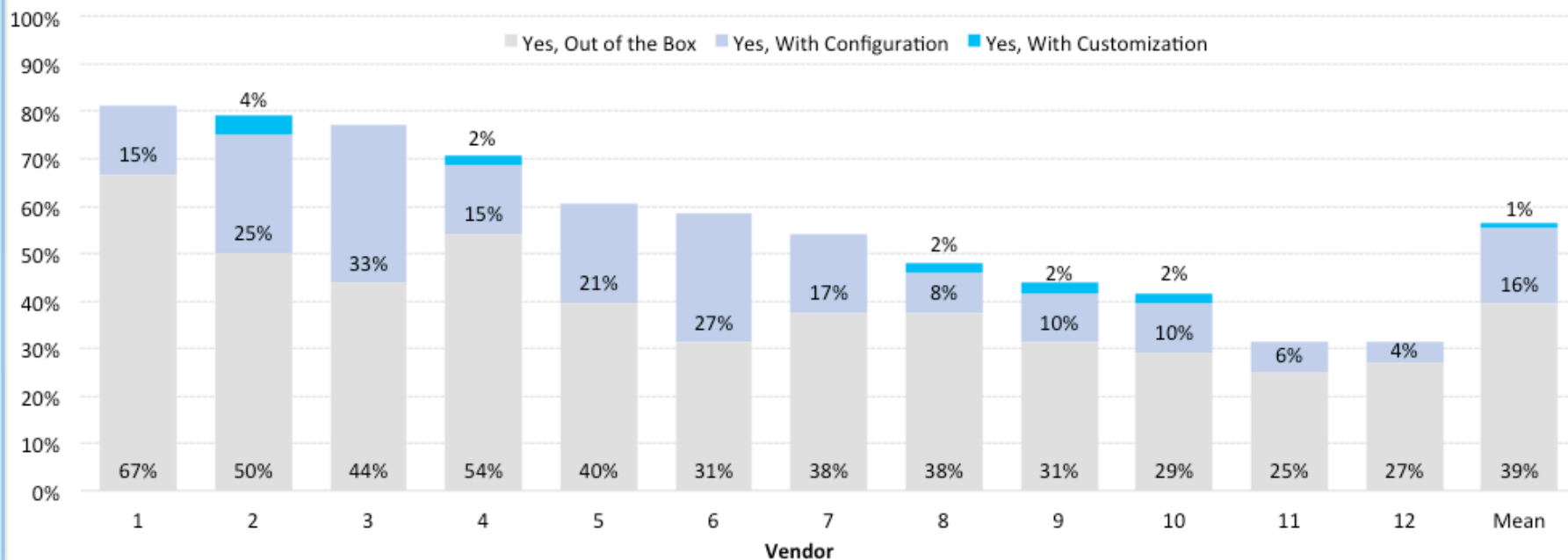
EHR Clinical Software Assessment: Findings

Percent of Immunization-Centric Requirements Supported, by General User Workflow

Legend: Yes, Out of the Box — Yes, With Configuration — Yes, With Customization

Workflow	Yes, Out of the Box	Yes, With Configuration	Yes, With Customization
REGISTER AND IDENTIFY A PATIENT	64%	17%	
MANAGE EXTERNAL QUERY, RESPONSE, AND RECONCILIATION	11%	21%	
MANAGE INFORMATION FOR CLINICAL DECISION MAKING	32%	13%	2%
MANAGE INVENTORY	28%	10%	
ADMINISTER AND REPORT IMMUNIZATION	56%	17%	2%
MANAGE COHORT	42%	42%	
MANAGE ADVERSE EVENTS	33%	10%	
PROVIDE PATIENT ACCESS	40%	12%	

General User Workflow

26 of the 48 requirements (54%) are supported by a majority (6 or more) of the 12 products observed.

EHR Clinical Software Assessment: Proportion of Requirements Supported

Percent of Immunization-Centric Requirements Supported, by Vendor

Legend: Yes, Out of the Box | Yes, With Configuration | Yes, With Customization

Vendor	Yes, Out of the Box	Yes, With Configuration	Yes, With Customization
1	67%	15%	
2	50%	25%	4%
3	44%	33%	
4	54%	15%	2%
5	40%	21%	
6	31%	27%	
7	38%	17%	
8	38%	8%	2%
9	31%	10%	2%
10	29%	10%	2%
11	25%	6%	
12	27%	4%	
Mean	39%	16%	1%

Measure	% Requirements Supported	Yes, Out of the Box	Yes, With Configuration	Yes, With Customization
Mean	56%	39%	16%	1%
Median	56%	38%	15%	0%
Mode	31%	31%	15%	0%
Range	50%	40%	10%	0%

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Observations:
Workflows 1, 2 and 3

❑ **Register and Identify a Patient**
- Mother's maiden name, multiple birth indicator and birth order, if known --- Demographics Vs Individual Vaccine Reports

❑ **Manage External Query, Response and Reconciliation**
- 33% perform bi-directional data exchange directly with IIS'; all require local configuration due to variation among IIS'
- Reconciliation methods vary but include IIS and other sources

❑ **Manage Information for Clinical Decision Support**
- 5 vendors provide their own forecasting (3rd party / Internal)
- Allergy/adverse event checks with medication knowledge bases (e.g., FirstDataBank, Multum, Medispan); some vendors allow configurable alerts
- Premature immunization guidance is variable

Observations: Workflows 4 and 5

❑ **Manage Inventory**

- Concern about coordinating inventory with IIS' for private stock
- Only 40% of vendors have any inventory function
- Inventory function does not consistently address Vaccines for Children or other guarantee programs

❑ **Administer and Record Immunization**

- All allow deferral of immunizations (time-based)
- All allow entry of patient-reported immunizations
- All allow entry of VFC eligibility
- 33% vendors support bar code entry to administer vaccines
- Data Quality varies and can be configured in some products, (e.g., limiting administration site and route based on vaccine product, standardizing refusal reasons)

Observations:
Workflows 6 and 7

❑ **Manage Cohort**

- Re-use Meaningful Use "patient list" function
- Some allow searching by immunizations out of the box (e.g., lot numbers), others require configuration
- All use Meaningful Use patient preferences data for notification

❑ **Manage Adverse Events**

- All allow entry of adverse events (similar to allergies)
- None supports VAERS reporting
- Prior adverse event notification during future ordering/administering of the same antigen requires significant configuration
- Few support sending updated vaccine reports to IIS' because of a perception that registries don't accept the updates

Observations:
Workflow 8

❏ **Provide Patient Access**

  ▪ Most vendors provide access to immunization data for patients on a portal

    • Some portals include immunization sections

    • Most portals mix immunization data with other health maintenance information

    • Few vendors provide future immunization recommendations and none include the vaccine information statement (VIS) form in advance of patient visits

  ▪ Few vendors allow patients to directly enter immunizations on the portal for direct review by providers

  ▪ Most vendors allow patients to enter comments on the portal

EHR Clinical Software Assessment: 11 Challenging Requirements

41 Initiate and submit a VAERS report   0%

 9 Notify IIS of differences between EHR and IIS data   8%

 4 Send IIS a batch request, receive and incorporate response   17%

 8 Receive IIS forecast and store it   17%

10 View the IIS forecast   25%

15 Compare a patient's immunization schedule to planned visits   25%

37 Produce updated forecast at the end of a patient visit   25%

43 Update IIS with adverse event added to immunization report   25%

45 Provide portal access to history, forecast and VIS forms   25%

47 Allow patients/parents to update immunizations on a portal   25%

EHR Clinical Software Assessment: Specific Usability Findings

❑ **General User Interface Design – Consistency Issues:**
- Navigation across system modules and within individual system modules (e.g., billing, patient chart, patient schedule)
- Navigation between features using tabs and buttons (screen placement is not consistent, icons vary)

❑ **Cognitive Task Support Issues – Examples:**
- Immunization status on a forecast – different methods to indicate status (past due, due soon, etc)
- Immunization forecasting logic – differences in interpretation and frequency of updates
- Clinical rules and logic – methods to configure and present rules logic
- User interface – missing icon / color legends, presentation of "due" or "overdue," busy/complex screen layout

EHR Clinical Software Assessment: Specific Functional and Usability Recommendations

❑ **Managing Patient Matching**

- Evaluate best practice for user interface design and function for patient matching.

- Focus on individuals with multiple births.

- Establish collaboration among IIS', EHR vendors, providers and HIEs.

- Develop consistent mechanisms for patient matching for all interoperability concerns (not limited to immunizations).

EHR Clinical Software Assessment: Specific Functional and Usability Recommendations

❑ **Managing Immunization Reconciliation**

- ▪ Evaluate best practice for user interface design and function for reconciliation (to view and act on the data)

- ▪ Evaluate similarities among reconciliation efforts (immunizations, medications, problems, allergies)

- ▪ Encourage collaboration among vendors, providers and IIS'

  - Determine areas of inconsistent data

  - Evaluate mechanisms to resolve inconsistent data.

EHR Clinical Software Assessment: Specific Functional and Usability Recommendations

❑ **Managing Immunization Forecasts**

- Evaluate best practice for user interface design and decision support function to manage immunization forecasts.

- Determine methods to coordinate immunization forecasting information and clinical decision support regarding interactions with diagnoses and allergies.

- Encourage collaboration among vendors, providers and IIS'.

  - Determine most effective methods to coordinate EHR and IIS forecasting data.

  - Evaluate mechanisms to resolve inconsistent data.

EHR Clinical Software Assessment: Specific Functional and Usability Recommendations

❑ **Recording Immunizations Administered**

- ▪ Encourage consistency for documenting immunizations given elsewhere.

- ▪ Determine best practices for documenting multiple immunizations for the same patient.

- ▪ Assess methodologies for improving data quality associated with recording immunizations.

- ▪ Collaborate with IIS' to address high priority areas for data quality.

EHR Clinical Software Assessment: Specific Functional and Usability Recommendations

❑ **Additional areas for collaboration:**

- Determine eligibility for guarantee programs (e.g., VFC).

- Manage inventory.

- Evaluate and report adverse immunization events.

- Share immunization forecast information with patients.

EHR Certification Process Pilot
Next Steps

❑ **Evaluate responses from vetting requirements**

❑ **Pilot test a subset of requirements – EHR conformance testing and Usability evaluation**

❑ **Develop general guidance for EHR vendors and purchasers**

Improving EHR Function and Usability for Immunization

Thank you!

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Reference:
General Usability Guidance

Topic	Description
NIST Pediatric EHR (NISTIR 7865)	The "Human Factors Guide to Enhance EHR Usability of Critical User Interactions when Supporting Pediatric Patient Care" (NISTIR 7865) is available at www.nist.gov/manuscript-publication-search.cfm?pub_id=911520 and offers technical guidance to help the designers of pediatric electronic health records create software products that can be used as intended, efficiently and effectively. This guidance also focuses on critical user interactions that can potentially lead to errors, workarounds, or adverse events that can harm patients. For example, the guide recommends a unique patient identification number and pictures of pediatric patients and pictures of newborns with their caregiver.
NIST Integrating Electronic Health Records into Clinical Workflow	The "Integrating Electronic Health Records into Clinical Workflow: An Application of Human Factors Modeling Methods to Ambulatory Care" (NISTIR 7988) is available at http://nvlpubs.nist.gov/nistpubs/ir/2014/NIST.IR.7988.pdf and offers technical guidance to help the teams apply human factors methods to improve workflow integration with the HER.
ONC Health IT SAFER Guides	The ONC created the "SAFER Guides" (http://www.healthit.gov/safer/safer-guides) to help developers, patient safety organizations, and others who are concerned with optimizing the safe use of health IT in the following areas: High Priority Practices, Organizational Responsibilities, Contingency Planning, System Configuration, System Interfaces, Patient Identification, Computerized Provider Order Entry with Decision Support, Test Results Reporting and Follow-Up, Clinician Communication.

Reference:
General Usability Guidance

Topic	Description
Form Design	A useful resource for form design is Luke Wroblewski's "Web Form Design: Filling in the Blanks" (2008, Rosenfeld Media).
Table Design	Table design guidance is provided as part of a series of Safety Enhanced Design Briefs (https://sbmi.uth.edu/nccd/SED/Briefs/) created as part of the ONC's SHARPC project. The link to these guidelines is: https://sbmi.uth.edu/dotAsset/3fc9f186-7608-4b57-9ade-64a90e5916e0.pdf.
Clinical Information Reconciliation	Clinical information reconciliation is an important and complex task for which careful user interface design has the potential to help reduce errors and improve quality of care. Design guidance for medication reconciliation is provided as part of a series of Safety Enhanced Design Briefs crated as part of the ONC's SHARPC project. The link to these guidelines is: https://sbmi.uth.edu/nccd/SED/Briefs/sedb-mu06.htm.
Warnings	Best practices for warnings, in general, are 1) capture the user's attention, 2) let the user know what the issue is using the language of the user, 3) let the user know how to resolve the issue using the language of the user, 4) let the user know the consequences of not resolving the issue/the consequences of proceeding, and 5) if the clinical decision support is suggesting an action, provide the action on the warning screen or a link directly to where the action can be taken. A useful reference is: M. Wogalter. Purposes and scope of warnings. In M. Wogalter, editor, Handbook of warnings, Human Factors and Ergonomics. Lawrence Erlbaum Associates, 2006.

Reference:
General Usability Guidance

Topic	Description
Style Guide	A style guide may help to maintain consistency of design and layout for labels, fields, checkboxes, radio buttons, tabs, buttons, tables, etc.
Text Size	Assure text height is readable for users with 20/40 vision. As a rule of thumb apply the "007 Rule" to text, then verify text height in task-based usability testing. The "007 Rule" formula is: Text height = (0.007) x (distance between eyes and screen). If we assume 24 inches between the eyes and the computer screen, then text height should be 0.168 in = .007 * 24 inches. During the design phase, a designer can convert inches to the appropriate font size based on the targeted screen resolution for the application. During review the reviewer can take a ruler and measure. Guidance can be found in Smith, S.L. (1979). Letter Size and Legibility. Human Factors, December, -21(6), pages 661-670.
Use of Color Red	In general, guidelines would suggest the color red (*e.g.*, for fonts, button or table cell fills) be reserved for urgent or critical warning information.
Abbreviations	In general, abbreviations should be avoided, unless widely understood on their own (*e.g.*, DOB).
Capitalization	In general, words in all capital letters should be avoided to aid readability and scanning