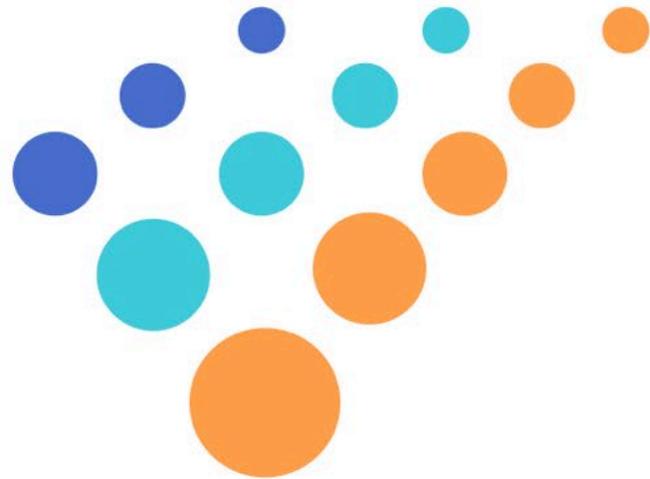




AGENCY FOR HEALTHCARE RESEARCH AND QUALITY



# December 2019 CDS Connect Work Group Call



# CDS Connect

# Agenda

Schedule	Topic
3:00 – 3:05	Roll Call, Lisa Ide (MITRE)
3:05 – 3:10	Review of the Agenda, Maria Michaels (CDC)
3:10 – 3:20	Key Takeaways from Conferences, Lisa Ide and Chris Moesel (MITRE) <ul style="list-style-type: none"><li>• Patient-Centered Clinical Decision Support-Learning Network</li><li>• American Medical Informatics Association Annual Symposium</li></ul>
3:20 – 3:30	Update on CDS Connect Priorities for September 2019-2020, Lisa Ide (MITRE)
3:30 - 3:40	Sharing Lessons Learned with CDS Connect, proposed future series (Lacy Fabian, MITRE)
3:40 – 4:25	Exemplar Lessons Learned Session: Translation of <i>C. difficile</i> Infection Treatment Clinical Pathway into Machine-readable shareable CDS, Jeremy Michel (ECRI Institute - Penn Medicine Evidence-based Practice Center)
4:25 – 4:30	Open Discussion and Close Out, Maria Michaels (CDC) <ul style="list-style-type: none"><li>• Open discussion and announcements</li><li>• Concluding comments, review next steps and adjourn</li></ul>

# Objectives

- Share key takeaways for CDS Connect based on recently attended conferences
- Update the Work Group on outcome of theme and trust attribute discussion
- Introduce a topical series to hear from members on their lessons learned using CDS Connect
- Discuss topics of interest to members relating to opportunities for CDS Connect

# KEY TAKEAWAYS FROM CONFERENCES

Patient-Centered Clinical Decision Support Learning Network (PCCDS-LN) Annual Conference

American Medical Informatics Association (AMIA) Annual Symposium

# PCCDS-LN Annual Conference (October 21, 2019)



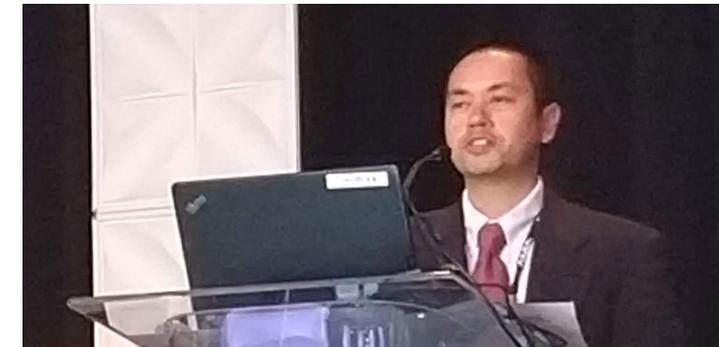
- Notable Themes / Topics
  - ▶ Leveraging CDS to enable informed decision making by clinicians and patients
    - Examples of patient facing CDS in use
    - Engaging patients in design of solutions that benefit them
    - Importance of user interface / design CDS to meets user needs
  - ▶ Differences between clinician and patient needs & uses for CDS (usability)
  - ▶ Issues of trust remain important
  - ▶ Unresolved questions of policy / liability as impediment to progress
  - ▶ Need for a guiding influence to set standards, establish best practices, maintain an index of artifacts
- Codeathon
  - ▶ Limited demonstrations of apps in Epic App Orchard
- Awareness of CDS Connect
  - ▶ Continued use of Authoring Tool

Link to materials: <https://pccds-ln.org/2019conference>

# AMIA Annual Symposium (November 16-20)



- System Demonstrations – CDS Systems
  - ▶ [Authoring and Integrating Interoperable Clinical Decision Support: CDS Connect Open Source Tools](#)
  - ▶ [Interoperable Consumer Decision Support: CDS Connect and b.well](#)
- Other sessions w/ CDS Connect AHRQ Leaders
  - ▶ [Panel - Results from a Multi-stakeholder Action Plan to Better Leverage Patient-centered Clinical Decision Support in Addressing the Opioid Misuse Crisis](#)
  - ▶ [Panel - Quantifying Efficiencies Gained Through Shareable Clinical Decision Support Resources](#)



# **UPDATE ON CDS CONNECT PRIORITIES FOR SEPTEMBER 2019-2020**

# General Themes (1 of 2)

- Topics and sentiments raised by Work Group and other stakeholders during discussion
  - ▶ Artifacts
    - Necessity to update
    - What is the value of artifacts
  - ▶ Standards
    - Evolving
    - CDS Connect as a champion for the use of standards
    - Impact of compliance on artifact ease of use / demonstrated value
  - ▶ Trust
    - Trust is a "monster"
    - Currency increases trust
  - ▶ General / Value
    - Expand the safe use and value of CDS artifacts
    - Extending the range of topics will bring in more users
    - There must be intentional effort to demonstrate the value of CDS Connect
    - CDS Connect needs to evolve too if we will stay cutting edge long term

# General Themes (2 of 2)

- "Must Have" General Themes:
  - ▶ Ensure Artifact Currency
    - Update / validate artifacts to ensure they reflect the most recent clinical guidelines
  - ▶ Enforce Standards Compliance (Artifacts)
    - Update artifacts already in the Repository to ensure compliance with applicable standards
- "Should Have" General Themes:
  - ▶ Increase Trust
    - Implementing recommendations from the Trust Framework Work Group
  - ▶ Expand the Use of Existing Artifacts
    - Improve usability and update the Repository to support expanded use of existing artifacts

# Trust Attribute Weights (1 of 2)

- Topics and sentiments raised by Work Group and other stakeholders during discussion
  - ▶ Standards
    - Copyright and IP considerations
  - ▶ Bias
    - Biased evidence behind artifacts is significant to trust
  - ▶ Currency
    - Visibility into artifact update status
    - Ongoing maintenance of artifacts (obligations)
    - Impact of currency on use of artifacts
  - ▶ Data / Feedback
    - Need for mechanisms to provide feedback on patient and clinician experiences with CDS Connect
    - Patient outcomes as a potential measure of artifact value
    - Role of feedback to facilitate co-ownership in CDS Connect
  - ▶ General
    - Ability to assess artifact trustworthiness of artifacts in the Repository
    - Information / disclosures about an artifact
    - Findability of artifacts

# Trust Attribute Weights (2 of 2)

- Trust attribute with (relatively) greatest influence on trust:
  - ▶ Evidence-based
    - The evidence instantiated within an artifact must apply to the clinical condition it is meant to support
- Trust attributes with (relatively) greater influence on trust:
  - ▶ Discovery & Accessibility
    - The evidence behind an executable knowledge artifact is documented (discoverable) from metadata associated with the artifact.
  - ▶ Transparency
    - A knowledge artifact should be applied and used ethically to clearly convey all potential conflicts of interest and disclosures of interest related to its development or recommendation to detect bias or discrimination in its use
- Trust attributes with (relatively) lesser influence on trust:
  - ▶ Feedback and Updating
  - ▶ Compliance
  - ▶ Competency
- Trust attributes with (relatively) least influence on trust:
  - ▶ Organizational Capacity
  - ▶ Patient-centeredness
  - ▶ Consistency

# **SHARING LESSONS LEARNED WITH CDS CONNECT: PROPOSED TOPICAL SERIES**

# Proposed Topical Series (1 of 7)



- Objective
  - ▶ Share lessons learned from using aspects of CDS Connect
    - CDS Artifacts, Authoring Tool, and/or Open Source Tools
- Format
  - ▶ Each remaining scheduled Work Group meeting (January – August 2020)
  - ▶ Member/s will
    - Work with MITRE team to populate template slides, including brief interview, if preferred
    - Share lessons learned 15-25 minutes, with additional 20 minutes for discussion

# Proposed Topical Series (2 of 7)



- Proposed Content for Series
  - ▶ Tell us what you have learned
    - Key Takeaways
  - ▶ Tell us about your organization(s)
    - What is the clinical environment?
    - How is CDS relevant?

# Proposed Topical Series (3 of 7)



- Proposed Content for Series
  - ▶ Tell us about your use case with, as relevant
    - CDS Artifacts
    - Authoring Tool
    - Open Source Tools
  - ▶ What is the goal of use?
    - Author and upload
    - Select CDS for use
    - Implement CDS
  - ▶ When did use begin?

# Proposed Topical Series (4 of 7)



- Proposed Content for Series
  - ▶ Tell us about your lessons learned, as appropriate
    - Data Availability
    - Data Quality and Representation
    - Integration
    - Availability of Evidence
    - Content Development
    - Barriers
    - Best Practices
    - Impacts

# Proposed Topical Series (5 of 7)



- Proposed Content for Series
  - ▶ Tell us about your next steps

# Proposed Topical Series (6 of 7)



- Proposed Content for Series

- ▶ Discussion

- What are others' experiences with using this aspect of CDS?
    - What trends or observations from the field of CDS could have an impact on this type of CDS use?

# Proposed Topical Series (7 of 7)

- What about this topic and format does/does not resonate with the work group?
  - ▶ Are there other topics to consider?
    - Consider CDS use cases with multiple perspectives presented?
      - Author and upload, Select CDS for use, Implement CDS
    - Consider perspectives on each use case?
      - Clinicians, vendors, authors, patients, quality improvement analysts, etc.
- What information would you like to highlight as part of lessons learned?
- What information is less important as part of lessons learned?

# SHARING LESSONS LEARNED WITH CDS CONNECT:

TRANSLATION OF *C. DIFFICILE* INFECTION TREATMENT CLINICAL  
PATHWAY INTO MACHINE-READABLE SHAREABLE CDS

**JEREMY MICHEL, MD, MHS**

ECRI INSTITUTE & THE UNIVERSITY OF PENNSYLVANIA

# Background/Objectives



- Background/Objective
  - ▶ An L2 representation (clinical pathway, not machine readable) of a CDS module for *C. difficile* infection (CDI) published in 2018
  - ▶ This module was subsequently consumed by an external organization as an L2 artifact (pathway published outside of the EHR)
  - ▶ As part of an Evidence Practice Center project, we looked to update this
    - L3 CDS for dissemination
    - L4 CDS for local implementation
  - ▶ To support future iterations, we sought to develop and utilize a transparent process to perform this CDS maturity level transition

# Organizational Background



- Evidence Translation Background

- ▶ An evidence report focused on CDI treatment was initially developed by the Minnesota Evidence-based Practice Center in 2016
- ▶ The ECRI – Penn collaborative develop an initial L2 version of the CDI treatment algorithm that was published via the PennPathways program.
  - ECRI contributed to the evidence aggregation and analysis
  - Penn developed the algorithm and published it through CDS Connect
- ▶ The method to translate an EPC report into L2 CDS was published as a AHRQ methods report in 2018 (Flores E, Jue J, et. al.).

<https://effectivehealthcare.ahrq.gov/sites/default/files/pdf/clinical-pathway-methods-report.pdf>

# CDI Treatment Pathway Implementation



- The CDI Treatment pathway was rolled out through the University of Pennsylvania Health System (UPHS)
- The pathway was accessible through the hospital intranet
  - ▶ Used Dorsata as a platform for hosting the pathway
  - ▶ Included links to the pathway within the EHR
  - ▶ Publicized pathway on screen savers
- CDS module was uploaded to CDS Connect for dissemination
  - ▶ Uploads included PDF versions of the original pathway and abstracted evidence statements from the source materials
  - ▶ No direct method available for importing this into an EHR

# Initial Roll Out and Dissemination

- Success! A pathway was developed.
- Variable uptake of the pathway by clinicians
- No clear method or mechanism for evaluating outcome measures related to pathway use
- Nothing to prevent clinicians from inappropriate deviation from pathway recommendations
- Nothing to support clinicians in recognizing patients that met criteria for pathway inclusions

# Building on Initial 'Success'

What should we do next with our L2 module?

- Embed it into the EHR
  - ▶ Use a systematic transparent process to develop this clinical pathway into evidence-based decision support for EHR integration
  - ▶ Select and design a CDS interface optimized for local implementation in the University of Pennsylvania Health System (UPHS) EHR
- Share our work
  - ▶ Publish a shareable version of the EHR-ready artifact on CDS Connect
  - ▶ See if organizations can/will implement and assess implementation effort

# Planning the Next Phase

- Assembled a team with expertise across key domains:
  - ▶ Physician clinical informaticist
  - ▶ Clinical practice guideline methodologist
  - ▶ UPHS clinical pathways program manager
  - ▶ Practicing ID physician
  - ▶ Practicing hospitalist
- Environmental scan (for evidence changes)
  - ▶ Conducted an updated literature searched which revealed no new evidence directly impacting the CDI treatment pathway

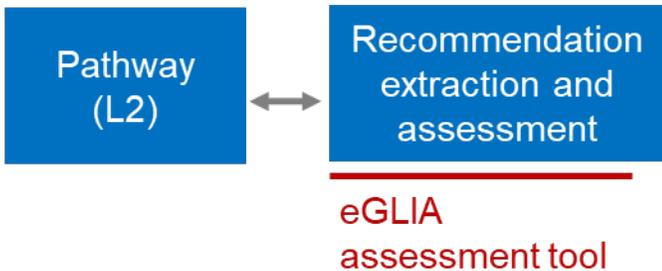
# Establishing a Transparent Process

Phase	Tasks	Description
Analysis	T1	Extract L2 recommendation statements from clinical pathway, classify, and assess for L3 CDS artifact inclusion eligibility
Analysis	T2	Assess feasibility and barriers for conversion to L3 CDS artifact
Analysis	T3	Assign clinical phase and target interventions to each statement
Design	T4	Select a CDS channel and develop wireframe prototypes for L4 CDS planning
Development	T5	Parse recommendations and restructure content for encoding
Development	T6	Meta-tagging and creation of standardized value sets
Development	T7	Encode recommendations using CQL



# Methods: Analysis and Preparation

Phase 1:  
Analysis and  
Preparation



*Pathway content iterative updated*

## Recommendation Extraction:

Example: Order 2 “When starting the CDI pathway, if possible STOP laxatives.”

## Assessment (Challenges to Implementation):

Example: Clinical Pathway did not identify treatment alternatives for patients with vancomycin allergy.

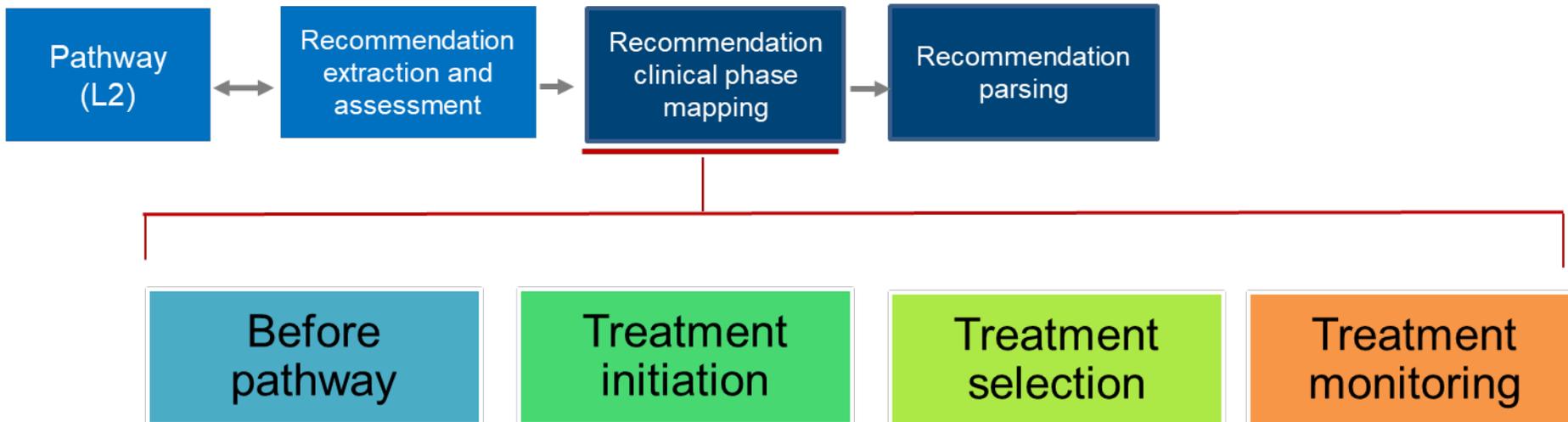


Updated clinical pathway to address this and other identified issues

# Recommendations Mapped by Clinical Workflow Phase

Phase 1:  
Analysis and  
Preparation

Phase 2:  
Development



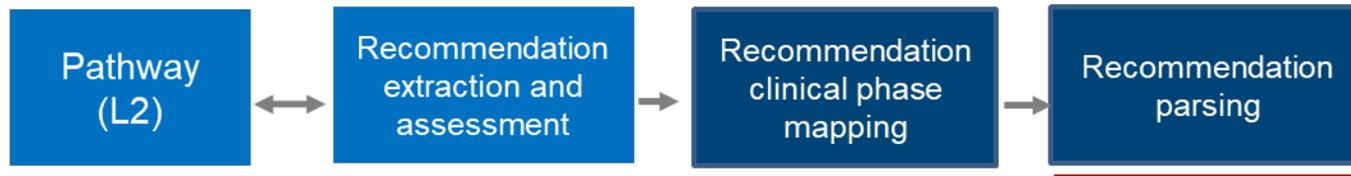
# Potential CDS Intervention Targets Evaluated

- Before Pathway
  - ▶ Identifying patients who met criteria for CDI was determined to be out of scope for this project
- Initiation of Treatment
  - ▶ Multiple recommendations addressed this phase
  - ▶ Most involved stopping medications or avoiding ordering medications
  - ▶ Could be handled through alerts/reminders or passively incorporated into an order set
- Selection of Treatment
  - ▶ For most patients this was felt to occur at a single time
  - ▶ An order set was suggested to support appropriate treatment selection
- After Starting Treatment
  - ▶ A single action involved re-evaluating 5 days after starting treatment
  - ▶ An alert had potential, but this was not suitable for the target organization

# Recommendations Parsed to Structure Logic and Variables

Phase 1:  
Analysis and  
Preparation

Phase 2:  
Development



Guideline  
Elements  
Model (GEM)

Converting narrative recommendation statement into variables and structured logic

Example: “When starting CDI pathway if possible STOP precipitating antibiotic(s). Discontinue therapy with inciting antibiotic agents as soon as possible, as this may influence the risk of CDI recurrence”

**Decision Variable:** CDI

**Value:** true

**Action:** stop antibiotics (except those for CDI) IF possible.

**Value:** antibiotics

**Type:** prevent

**Benefit:** this may influence the risk of CDI recurrence

**Actor:** clinician

**Verb:** discontinue if possible

**Complement:** if possible

**Deontic:** should

**Risk/Harm:** antibiotics may be needed for another illness

**Logic:**

# Creating Value Sets

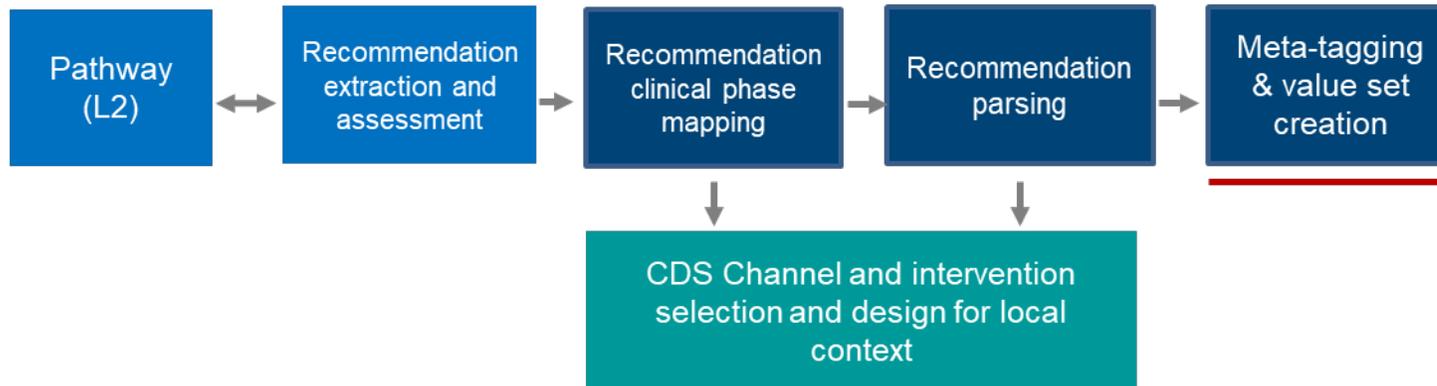


Creating groups of codes (i.e. “value sets”) that define what any variable means for a computer

Code	Descriptor	Code System
008.45	Intestinal infection due to Clostridium difficile	ICD9CM
10895-1	Clostridioides difficile toxin B [Presence] in Stool	LOINC
13957-6	Clostridioides difficile toxin A [Presence] in Stool by Immunoassay	LOINC
186431008	Clostridioides difficile infection (disorder)	SNOMEDCT

Phase 1:  
Analysis  
and  
Preparation

Phase 2:  
Development

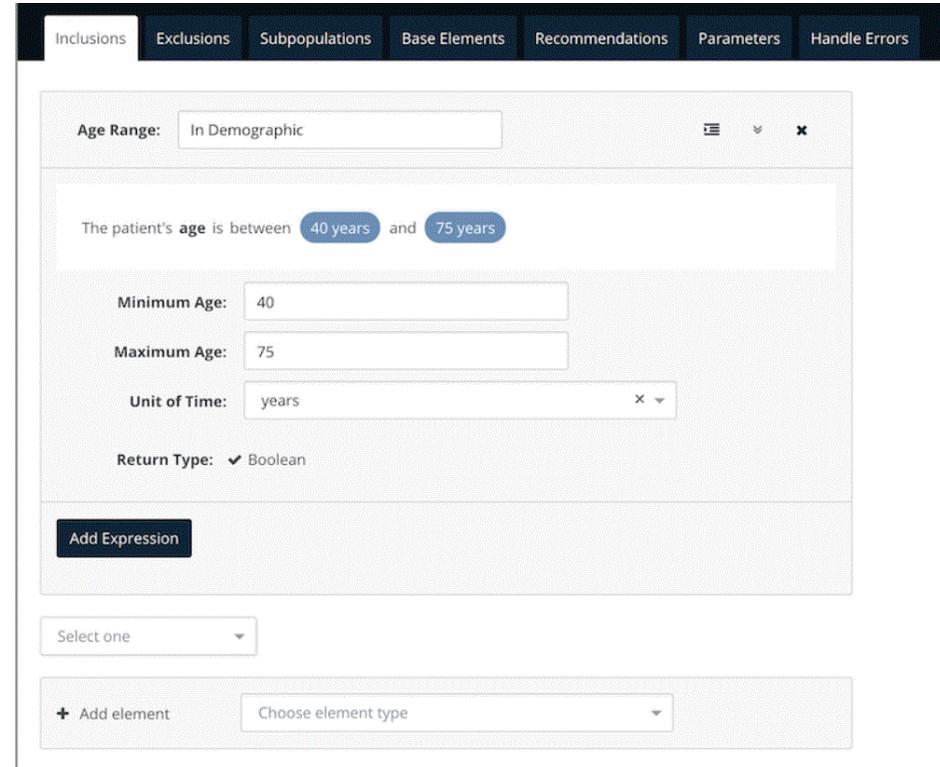


Value sets uploaded to the Value Set Authority Center (VSAC), a public repository of value sets

<https://vsac.nlm.nih.gov/>

# CDS Authoring Tool

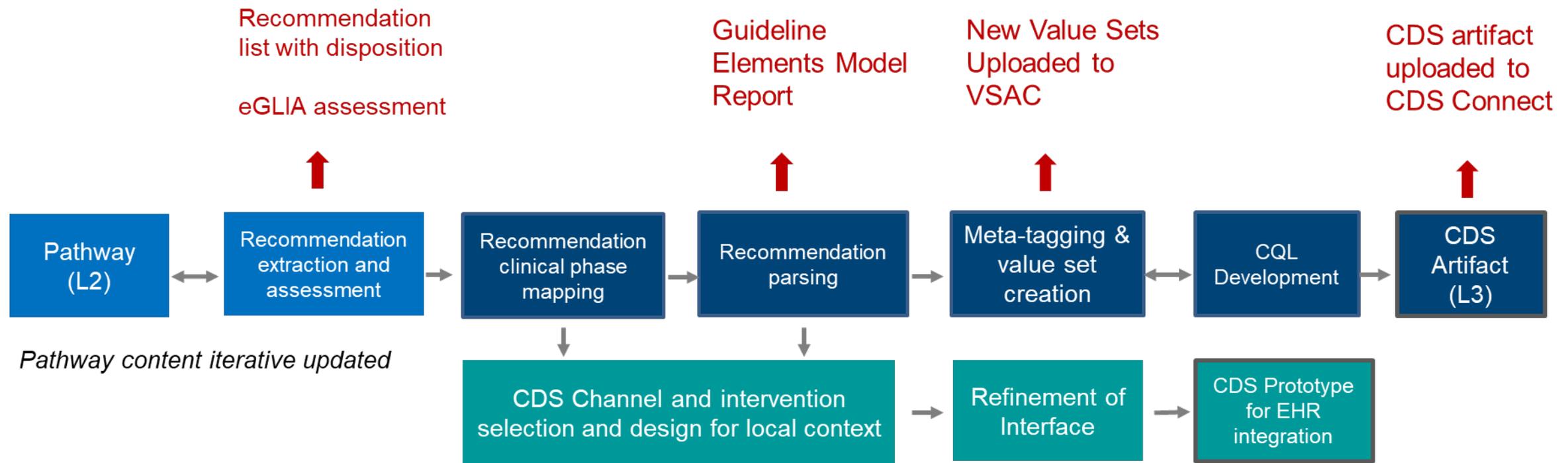
- We sought to use the CDS Authoring tool to represent the updated pathway through CQL
- Not all concepts could be encoded due to limitations with the authoring tool
  - ▶ Certain concepts did not have codes (Vancomycin Enema & Taper)
  - ▶ Issues with temporal relationships
  - ▶ Issues with completed durations
  - ▶ Requirements for combinations of statement modifiers (occurrence count within a lookback time) not yet supported
  - ▶ Groupings of sub populations



The screenshot displays the 'Inclusions' tab of the CDS Authoring Tool. The 'Age Range' section is active, showing a configuration for 'In Demographic'. The visual representation of the rule is: 'The patient's age is between 40 years and 75 years'. Below this, the configuration fields are: 'Minimum Age: 40', 'Maximum Age: 75', 'Unit of Time: years', and 'Return Type: Boolean'. There is an 'Add Expression' button and a 'Select one' dropdown menu. At the bottom, there is an 'Add element' button and a 'Choose element type' dropdown menu.

<https://cds.ahrq.gov/cdsconnect/authoring>

# The Systematic and Transparent Process



# CDS Intervention Selection and Design

- Selected CDS Intervention:
  - ▶ Order set
- Design Features:
  - ▶ Orders grouped into panels by CDI episode (i.e. initial episode, fulminant episode, first recurrence, etc.)
  - ▶ Panel details initially collapsed to minimize visual complexity
  - ▶ Groups of orders can be selected by checking one box
  - ▶ Orders for most clinical scenarios can be selected in 2 clicks or less

Checking this box automatically selects a group of orders

See the [PennPathways: C. difficile Treatment](#) for the UPHS treatment algorithm

[Link to clinical pathway](#)



## STOP Orders

- STOP ANY other systemic antibiotic agent(s) as soon as possible, as this may influence the risk of CDI recurrence.
- STOP all laxatives immediately to reduce risk of prolonged diarrheal illness
- STOP and AVOID anti-peristaltic agents (eg loperamide, Lomotil) throughout treatment course
- STOP and AVOID unnecessary proton pump inhibitors (PPI)

<Print group: administered laxatives, anti-peristaltic agents, PPIs, systemic ABX>

## ▼ Uncomplicated/Non-Fulminant infection – Initial/First episode

### ▼ Oral Vancomycin (preferred treatment)

- Vancomycin PO 125 mg Q6H x 10 days (Preferred Treatment)
- Add C. Diff to the Problem List
- Nursing order* Document stool volume, frequency, and consistency (Bristol Stool Scale)
- Nursing order* Isolation precautions

### ▼ Oral Vancomycin ALLERGY/INTOLERANCE?

- ▼ Vancomycin ALLERGY/INTOLERANCE?
  - Metronidazole PO 500 mg, 3x/day, 10 days, OR
  - Fidaxomicin PO 200mg, 2x day, 10 days, OR
- Add C. Diff to the Problem List
- Nursing order* Document stool volume, frequency, and consistency (Bristol Stool Scale)
- Nursing order* Isolation precautions (*not HUP, Princeton*)
- Infectious Disease Consult (required for fidaxomicin orders)

## ▼ Uncomplicated/Non-Fulminant infection – FIRST recurrence (symptoms within 8 weeks of previous successful treatment)

### ▼ Vancomycin (preferred treatment)

#### ▼ Previously treated with metronidazole?

- Vancomycin PO 125 mg Q6H x 10 days
- Add C. *Difficile* infection to the Problem List
- Nursing order* Document stool volume, frequency, and consistency (Bristol Stool Scale)
- Nursing order* Isolation precautions (*not HUP, Princeton*)

#### ▼ NOT previously treated with metronidazole or unknown?

- Vancomycin taper order panel **Conditional orders**
- Add C. *Difficile* infection to the Problem List
- Document stool volume, frequency, and consistency (Bristol Stool Scale)
- Isolation precautions (*not HUP, Princeton*)

### ▼ Oral Vancomycin ALLERGY/INTOLERANCE?

- Fidaxomicin PO 200mg, 2x day, 10 days - *requires ID consult, can order single dose stat*
- Infectious Disease Consult (required for fidaxomicin orders)
- Add C. *Difficile* infection to the Problem List
- Nursing order* Document stool volume, frequency, and consistency (Bristol Stool Scale)
- Nursing order* Isolation precautions (*not HUP, Princeton*)

# Revising the Pathway

- Numerous barriers to implementation of pathway recommendations
- The pathway team evaluated these barriers and revised the pathway
- Changes included
  - ▶ Removal of redundancy (e.g. no difference in management for non-severe vs. severe)
  - ▶ Clarification of definitions within the pathway (e.g. clinical sepsis)
  - ▶ Inclusion of alternatives (e.g. Fidaxomicin for vancomycin allergic patients)
  - ▶ Removal of ambiguity and vagueness (e.g. adding the type and position for abdominal imaging)
  - ▶ Reorganization of nodes to decrease cognitive burden
  - ▶ Removal of extraneous information (e.g. tests for establishing CDI)

# Revising the CDS Artifact

- Use of CDS Connect Version control
  - ▶ Helped to clarify which changes were made, when, and by which author
- How best to handle the new artifact classifications
  - ▶ L2, Active – Original
  - ▶ L3, Experimental or L3, Draft – Current (but the L2 still exists and is Active)
  - ▶ L4, Draft – Eventually Penn will complete the implementation...
- Publishing the CQL
  - ▶ CQL does not yet move directly from CDS Authoring Tool to CDS Connect
  - ▶ Testing and validation of the CQL artifact is ongoing
  - ▶ Manual revisions to the CQL (outside the Authoring Tool) were needed to handle the complicated logic of the pathway.

# Next Steps

- Finalizing the CQL
  - ▶ We have recognized issues with the CQL that are fixable manually, but not yet through the CDS Authoring Tool
- Validation and Testing of the CQL
  - ▶ Once complete, we will be looking to evaluate the logic with test patients in simulated environments
- EHR Implementation
  - ▶ We are waiting in the queue for resources at Penn to take on the implementation phase of this project
- Process Revision and Repetition
  - ▶ Learn from issues identified to improve the translation and implementation process
  - ▶ Determine if the process used for this project can be applied to other L2 artifacts

# Conclusions and Lessons Learned

- Publicly available software can be used to translate an evidence based clinical pathway into electronic CDS
- Early and continuous collaboration between subject matter experts and clinical informaticists improved clinical accuracy and usability of the final CDS end products
- Utilizing an iterative development process improved the quality of the source CDI treatment pathway and interim CDS products
- Developing an L3 CDS artifact from a trustworthy evidence-based clinical pathway offered efficiency gains
- Creating CDS from EPC report-informed clinical pathways can promote widespread dissemination of evidence into clinical practice

# Acknowledgements



## **Penn Medicine**

Lauren Dutcher, MD

Emilia Flores, PhD, RN

Nikhil Mull, MD

## **ECRI Institute**

Amy Tsou, MD, MSc

Amber Moran

Kariann Hudson

## **AHRQ**

Kim Wittenberg, MA

# **ANNOUNCEMENTS, OPEN DISCUSSION AND CLOSE-OUT**