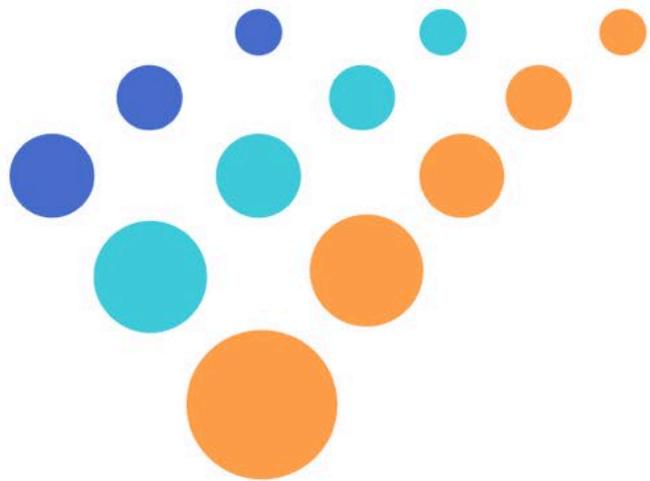




AGENCY FOR HEALTHCARE RESEARCH AND QUALITY



# January 2020 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	• What's New with CDS Connect (David Winters and Chris Moesel, MITRE)
• 3:20 - 4:00	• FHIR Clinical Guidelines (CPG-on-FHIR) and CDS Connect: Intersections and Opportunities (David Winters, MITRE)
• 4:00 – 4:25	• Sharing Lessons Learned with CDS Connect: Using the CDS Authoring Tool in a Graduate Course (Dr. Mustafa Ozkaynak, University of Colorado College of Nursing)
• 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 new features and resources available for CDS Connect
- Discuss opportunities and challenges for CDS Connect and CPG-on-FHIR
- Share lessons learned for use of the CDS Connect Authoring Tool in Academia
- Discuss topics of interest to members relating to opportunities for CDS Connect

# WHAT'S NEW WITH CDS CONNECT

David Winters and Chris Moesel, MITRE

# Updates and New Features



- Prototype Tools

- ▶ [CQL Testing Framework](#)

- Version 1.1.0: Adds support for writing test cases using *any* FHIR DSTU2/STU3 resource
- Version 1.2.0 (coming soon): Adds FHIR R4 support

- ▶ [CQL Services](#)

- Version 1.4.5: Ensured alignment with CDS Hooks v1.0

- Artifacts

- ▶ [Statin Therapy for the Prevention and Treatment of Cardiovascular Disease Electronic Clinical Quality Measure](#)

- Updated Implementation Guide, evidence, metadata, and value sets

Link to CDS Connect: <https://cds.ahrq.gov/cdsconnect>

# **FHIR CLINICAL GUIDELINES AND CDS CONNECT: INTERSECTIONS AND OPPORTUNITIES**

David Winters, MITRE

# Introduction (1 of 2)

- Fast Healthcare Interoperability Resources (FHIR) is an international standard for exchanging healthcare information electronically [\[1\]](#)
  - ▶ FHIR is very general and is meant to be customized [\[2\]](#)
- FHIR Clinical Guidelines is what is known as an implementation guide (IG)
  - ▶ FHIR IGs are used to describe how FHIR is to be used in a particular context or for a particular application [\[3\]](#)
- It is also known as “Clinical Practice Guidelines (CPG) on FHIR”
  - ▶ Was born out of the CDC-sponsored Adapting Clinical Guidelines for the Digital Age initiative [\[4\]](#)
  - ▶ Is meant to be a “framework” IG that can be applied across different types of clinical guidelines
- The CPG on FHIR IG is currently being balloted with Health Level 7 International (HL7)
  - ▶ It is a standard for trial use (STU) [\[5\]](#)
  - ▶ Is based on FHIR R4

# Introduction (2 of 2)

- CPG on FHIR is meant to reduce implementation burden by facilitating the following [6]:
  - ▶ Computable representation of clinical guideline recommendations
  - ▶ Iterative co-development of clinical guidelines and their computable representation
- These are accomplished by:
  - ▶ Elaborating on how existing standards (e.g., FHIR) can be used to express these so-called “computable guidelines”
  - ▶ Providing guidance and checklists to help with iterative co-development
- Computable guidelines are related to clinical decision support (CDS)
  - ▶ Which is the focus of the CDS Connect project
- The purpose of this briefing is two-fold:
  - 1) Review CPG on FHIR as it pertains to CDS
  - 2) Consider ways CDS Connect project can better align with CPG on FHIR

# Key FHIR Concepts

- Resource [\[7\]](#)
  - ▶ Structure for describing various types of clinical or healthcare-related data or other information
- Extension [\[2\]](#)
  - ▶ FHIR is not one-size-fits-all and is meant to be an 80% solution
  - ▶ Extensions are the mechanism by which resources can be augmented
- Profile [\[8\]](#)
  - ▶ A set of constraints on a resource
  - ▶ May include one or more extensions
- Implementation Guide [\[8\]](#)
  - ▶ “A coherent and bounded set of adaptations that are published as a single unit”
  - ▶ Basically a self-contained specification that can contain one or more profiles
  - ▶ Focus / scope can be broad (e.g., CPG on FHIR) or narrow (e.g., [\[9\]](#))

# Related Standards

- Clinical Quality Language (CQL) [\[10\]](#)
  - ▶ A high-level, domain-specific programming language focused on expressing logic for healthcare quality metrics and CDS
  - ▶ Can be used in conjunction with FHIR
- Clinical Reasoning Module [\[11\]](#)
  - ▶ Part of FHIR specification
  - ▶ Provides resources for defining how clinical knowledge artifacts (like CDS) can be expressed and shared in a standard way:
    - **ActivityDefinition**: A consumable description of some activity to be performed
    - **PlanDefinition**: A pre-defined group of actions to be taken under certain circumstances; can be used to describe knowledge artifacts.
    - **Library**: A container for knowledge artifacts
  - ▶ These resources provide a wide variety of metadata fields that can be used to describe CDS... but almost all these fields are optional

# CPG on FHIR: Profiles

- The Clinical Reasoning Module provides a means for describing knowledge artifacts like CDS
  - ▶ But is very unopinionated about what metadata needs to be specified
- CPG on FHIR provides profiles for many different FHIR resources [\[12\]](#)
  - ▶ Including several from the Clinical Reasoning Module
- These profiles are very opinionated about what metadata should be provided when describing knowledge artifacts
  - ▶ Example: Library resource
    - Core resource has 2 required fields (*status* and *type*) [\[13\]](#)
    - CPG on FHIR profile has 11 required fields [\[14\]](#)
  - ▶ Example: PlanDefinition resource
    - Core resource has 1 required field (*status*) [\[15\]](#)
    - CPG on FHIR profile has 11 required fields [\[16\]](#)

CPG on FHIR is very opinionated about how knowledge artifacts should be described.

# CDS Connect: Repository

- The CDS Connect Repository allows CDS authors to specify the metadata for describing the CDS they contribute
  - ▶ Much like the FHIR Clinical Reasoning Module, the Repository is currently very unopinionated about which metadata are required
    - Advantage: Should encourage more contributions
    - Disadvantage: Potential lack of conformity across contributed CDS
- The Repository allows CDS of any knowledge level (see Backup) to be contributed
  - ▶ However the Repository metadata is all at Level 2 (L2)
  - ▶ Higher knowledge levels can be included via attachments
- This is in contrast to the Clinical Reasoning Module and CPG on FHIR, which are at Level 3 (L3)
  - ▶ In other words, they are more structured and machine-friendly compared to the Repository metadata

# CDS Connect: Authoring Tool

- The CDS Connect Authoring Tool allows CDS authors to specify CDS logic written in CQL
  - ▶ Allows generation of CQL without requiring knowledge of CQL specifics and syntax
- Logic written in CQL is considered L3 CDS
  - ▶ Can be embedded within a FHIR Library resource
- The modus operandi of CDS Connect is for CDS authors to:
  - 1) Design their CDS
  - 2) Enter the L2 metadata into the Repository
  - 3) Author their L3 logic in the Authoring Tool
  - 4) Download their L3 logic and attach it to their entry in the Repository
- The above is a manual process
  - ▶ But could be automated

# High Level Comparison: CDS Connect and FHIR



- FHIR allows L3 CDS to be described in standard way
  - ▶ Clinical Reasoning Module levies minimal requirements on what metadata is required
  - ▶ CPG on FHIR raises the bar in terms of minimum requirements for metadata
- The CDS Connect Repository allows all levels (L1, L2, L3, L4) of CDS to be defined
  - ▶ But metadata for each CDS is only L2
  - ▶ L3/L4 can be attached to the L2
- Repository has minimum metadata requirements
  - ▶ Similar to Clinical Reasoning Module
- The CDS Connect Authoring Tool allows L3 CDS logic to be more easily defined and exported as CQL
  - ▶ CQL can then be attached to an entry in the Repository

# Metadata Comparison: Key Takeaways



- A lot of qualitative similarities between CDS Connect and FHIR metadata
  - ▶ Intent of both sets of metadata already fairly-well aligned
- CDS Connect and FHIR are both verbose, but in different ways
  - ▶ CDS Connect has multiple file attachment types vs. generic library in FHIR
  - ▶ FHIR has contact, author, editor, reviewer vs. single contributor field in CDS Connect
- FHIR is more hierarchical
  - ▶ PlanDefinition could reference multiple ActivityDefinition and Library resources
  - ▶ The bundle of all these resources would define a CDS artifact
- There are certain fields in CDS Connect which don't appear in any FHIR resources
  - ▶ Namely: Pilot experience, test patients
  - ▶ These could be documented in a FHIR IG developed for a CDS artifact

# Potential Alignments: Repository

- Further align metadata with FHIR Clinical Reasoning Module
  - ▶ Revise field names and meanings
  - ▶ Change how artifacts are stored and rendered
- Further align metadata with CPG on FHIR
  - ▶ Make more metadata fields required for all contributions
  - ▶ Has implications with respect to governance
- Allow Repository API to consume CPG on FHIR resources
  - ▶ Convert the L3 CDS to internal L2 representations
  - ▶ Can't produce FHIR resources since Repository metadata is L2

# Potential Alignments: Authoring Tool

- Expand Authoring Tool to allow creation of L3 metadata
  - ▶ Artifact L2 metadata *could* be automatically imported from Repository
  - ▶ Authoring Tool could be used to edit and format L3 metadata
- Completed artifacts would then be exported as CPG on FHIR resources
  - ▶ And potentially uploaded back to the Repository as attachments on the L2 CDS
- Making these alignments would allow CDS authors to completely define their L3 CDS within the Authoring Tool
  - ▶ Currently users can only define CDS logic (exportable as CQL)
- Propose implementation of CPG on FHIR support incrementally
  - ▶ CPGLibrary → CPGPlanDefinition → CPGActivityDefinition

**DISCUSSION:  
FHIR CLINICAL GUIDELINES AND CDS  
CONNECT:  
INTERSECTIONS AND OPPORTUNITIES**

# USING THE CDS AUTHORIZING TOOL IN A GRADUATE COURSE

Mustafa Ozkaynak, PhD

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College of Nursing

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# Background



- MS in Nursing – Health Care Informatics
  - ▶ 34 credit hours, accredited Online program
  - ▶ Nurses who want to enter informatics field and nurses who want formal training in informatics
- Decision Support Systems and Data Management (NURS 6794)
  - ▶ Students with diverse background
  - ▶ Topics
    - Information and Decision Science
    - Data Management in the Context of Quality and Patient Safety
    - Decision Support Tools
    - Visualization

# Decision Support Tools



- **Module-3 Decision Support Tools**
  - ▶ To explore computerization of decision support
  - ▶ **Module Assignment: Decision Tool Description or Development**
    - Students have two options: (1) Describe a CDS in their clinical settings; (2) Use CDS Authoring Tool

# Assignment Description (1 of 2)



Develop a decision support tool as described in the required watching

[The Clinical Decision Support Authoring Tool: A National Web Conference \(Links to an external site\)](#)

You are expected to follow the steps that are described in the video and develop a clinical decision support system that are specified below.

- Inclusion criteria: Ages 1 and 18
- If Diagnosis is Pneumonia (ICD-9 code is 486) then order Bicillin. If the patient is already using Bicillin, then a message should say, the patient is already on Bicillin. If the patient is allergic to Bicillin, then recommend Ciprofloxacin.

Please save and download the logical expression (in zip file) and then upload the zip file as your submission. You will also need to send me screenshots of your test with the five patients.

Rubric for Option 2:

- Develop logic, including inclusion and exclusion statements, and define the recommended intervention as described in the video (40 points).
- Use synthetic test data to verify that authored CDS logic works as expected as described in the video. (40 points).
- The language of recommendation is clear, appropriate, helpful and not confusing (20 points)

# Assignment Description (2 of 2)

## Test patients:

- Patient-A.json: Patient A: Age: 20; Pneumonia: Yes; Already prescribed Bicillin: No; Allergic to Bicillin: No
- Patient-B.json: Patient B: Age: 15; Pneumonia: Yes; Already prescribed Bicillin: No; Allergic to Bicillin: No
- Patient-C.json: Patient C: Age: 2; Pneumonia: No; Already prescribed Bicillin: No; Allergic to Bicillin: No
- Patient-D.json: Patient D: Age: 17; Pneumonia: Yes; Already prescribed Bicillin: Yes; Allergic to Bicillin: No
- Patient-E.json: Patient E: Age: 10; Pneumonia: Yes; Already prescribed Bicillin: No; Allergic to Bicillin: Yes

# Results

- Out of 48 students 8 students chose the assignment
- They all successfully completed the assignment
- They did not need any significant support or received support immediately

# Student Comments & Questions About the Assignment



- **Motivation**

- ▶ “I’m not sure if it will be way over my head, but it interests me so I want to give it a try.”
- ▶ “I think the knowledge gained in practicing using the tool to produce the CQL will benefit me professionally in my career.”

- **Issues**

- ▶ Use of value sets and vocabularies
- ▶ Conceptual issues (What is null?)
- ▶ Authentication error
- ▶ Browser error

# Student Comments

- “I'm having fun with it”
- “I enjoyed doing this project. I am very happy you put this option in to this assignment. As much as I understand the reason we write papers, it’s much more interesting for me to do hands on practical assignments. So thank you for allowing us to step out of our comfort zone a little more and use the information we are learning in a more hands on approach.”

# Future Plans

- Great learning opportunity for students
- Add more cases which
  - ▶ Are more clinically relevant
  - ▶ Include more complex logic
- Provide more resources for students
- Better evaluate the efficacy of the assignment

# **DISCUSSION: USING THE CDS AUTHORIZING TOOL IN A GRADUATE COURSE**

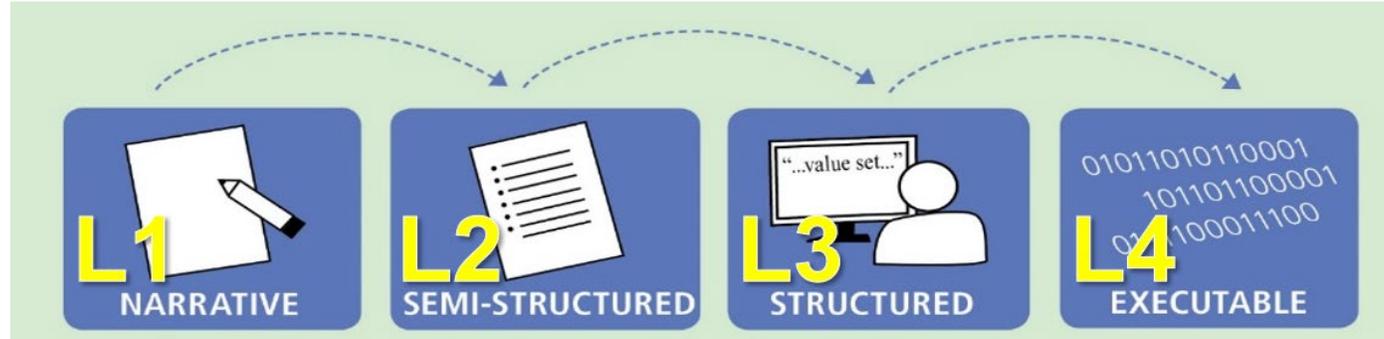
# ANNOUNCEMENTS, OPEN DISCUSSION AND CLOSE-OUT

Maria Michaels

Office of Public Health Scientific Services  
Centers for Disease Control and Prevention

# BACKUP

# Clinical Decision Support: Knowledge Translation



Knowledge Levels:  
Boxwala, et al [\[17\]](#)

Table:  
Michaels, et al [\[18\]](#)

Image:  
Michaels, et al [\[19\]](#)

Knowledge Level	Description	Example
Level 1 (L1)	Narrative	Guideline for a specific disease that is written in the format of a peer-reviewed journal article
Level 2 (L2)	Semi-structured	Flow diagram, decision tree, or other similar format that describes recommendations for implementation
Level 3 (L3)	Structured	Standards-compliant specification encoding logic with data model(s), terminology/code sets, value sets that is ready to be implemented
Level 4 (L4)	Executable	CDS implemented in a local execution environment (e.g., CDS that is live in an electronic health record (EHR)) or available via web services

# References

- [1] <https://www.hl7.org/fhir/overview.html>
- [2] <https://www.hl7.org/fhir/extensibility.html>
- [3] [https://wiki.hl7.org/index.php?title=FHIR\\_Implementation\\_Guides](https://wiki.hl7.org/index.php?title=FHIR_Implementation_Guides)
- [4] <https://www.cdc.gov/ddphss/clinical-guidelines/index.html>
- [5] <https://confluence.hl7.org/display/HL7/HL7+Balloting>
- [6] <http://hl7.org/fhir/uv/cpg/2019Sep/index.html>
- [7] <https://www.hl7.org/fhir/resourcelist.html>
- [8] <https://www.hl7.org/fhir/profiling.html>
- [9] <http://build.fhir.org/ig/cqframework/opioid-cds/index.html>
- [10] <https://cql.hl7.org/>

# References, continued

- [11] <http://www.hl7.org/fhir/clinicalreasoning-module.html>
- [12] <http://hl7.org/fhir/uv/cpg/2019Sep/profiles.html>
- [13] <http://hl7.org/fhir/R4/library.html>
- [14] <http://hl7.org/fhir/uv/cpg/2019Sep/StructureDefinition-cpg-library.html>
- [15] <http://hl7.org/fhir/R4/plandefinition.html>
- [16] <http://hl7.org/fhir/uv/cpg/2019Sep/StructureDefinition-cpg-plandefinition.html>
- [17] [Boxwala et al. JAMIA vol. 18 Suppl 1 \(2011\)](#)
- [18] [Michaels et al. AMIA Annual Symposium 2018, 11/7/2018, Session 111, “From Evidence to Action: Enabling Opioid Pain Management Guidelines through Patient-Centered Clinical Decision Support \(CDS\)”](#)
- [19] [Michaels and Pacchiana, HIMSS 2019, 2/17/19, Session 176, “Adapting Guidelines for Emergencies in the Digital Age”](#)