

May 16, 2019 CDS Connect Work Group Call



AGENDA

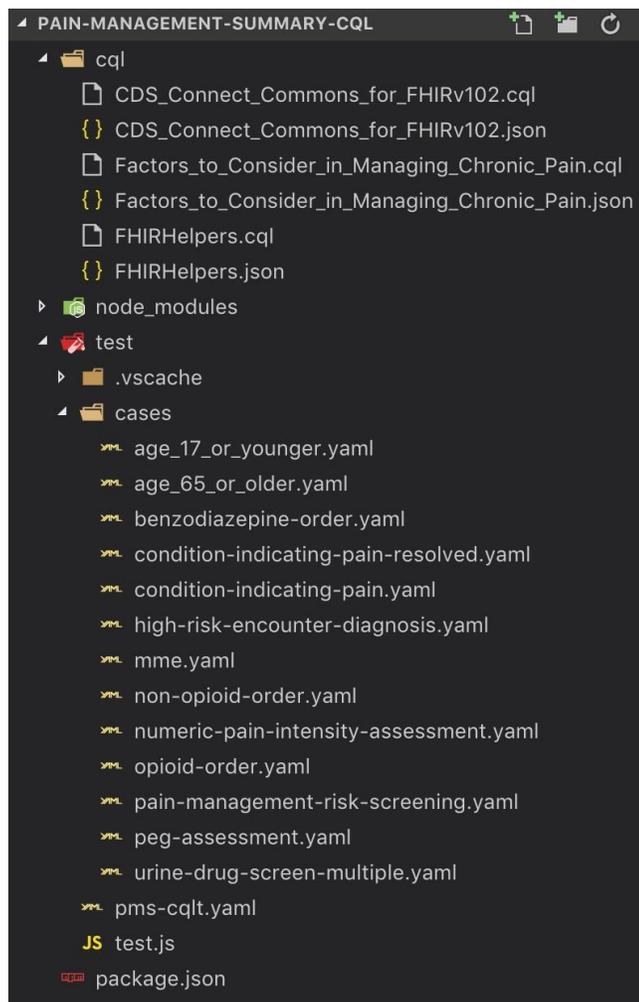
3:00 – 3:05	Roll Call, Ginny Meadows (MITRE)
3:05 – 3:10	Review of the Agenda, Ginny Meadows (MITRE)
3:10 – 3:40	AHRQ Evidence-Based Care Transformation Support Initiative (ACTS), Jerry Osheroff (ACTS Project SME) <ul style="list-style-type: none"> • Share information on the ACTS initiative and synergies with CDS Connect • Question and answer period
3:40– 3:55	CDS Prototype Tool Update: Testing and CQL Services, Chris Moesel (MITRE) <ul style="list-style-type: none"> • Share an update on the Prototype tool and provide a demonstration • Question and answer period
3:55 – 4:05	Demonstrate New Parameter Type Features in the AT, Dylan Mahalingam (MITRE) <ul style="list-style-type: none"> • Question and answer period
4:05 – 4:20	OY2 Pilot Update: Technical Approach and Status, Dave Winters (MITRE) <ul style="list-style-type: none"> • Share information on OY2 pilot partner technical approach • Question and answer period
4:20 – 4:25	CDS Connect Outreach and Demonstrations, MITRE <ul style="list-style-type: none"> • Update on the AMIA 2019 Clinical Informatics Conference, Ginny Meadows
4:25 – 4:30	Open Discussion and Close Out, Ginny Meadows (MITRE) <ul style="list-style-type: none"> • Open discussion and announcements • Concluding comments, review next steps and adjourn

- *AHRQ = Agency for Healthcare Research and Quality*
- *CDS = Clinical Decision Support*
- *OY2 = Option Year 2*
- *AT = Authoring Tool*
- *AMIA = American Medical Informatics Association*

AHRQ Evidence-Based Care Transformation Support Initiative (ACTS)

Prototype Tool Update: Testing and CQL Service

CQL Testing Framework Review: Configuration



Configuration for project structure on the left:

```
YAML pms-cqlt.yaml x
1  ---
2  library:
3  |   name: Factors_to_Consider_in_Managing_Chronic_Pain
4  |   paths: ../cql
5  tests:
6  |   path: cases
7  options:
8  |   date: "2018-12-10T00:00:00.0Z"
9
```

CQL Testing Framework Review: Test Cases (Data)

```
peg-assessment.yaml x
1 ---
2 name: Has PEG Assessment
3
4 data:
5 -
6   resourceType: Patient
7   name: Joe Smith
8   gender: male
9   birthDate: 1954-02-16
10 -
11  resourceType: Condition
12  code: SNOMED#203082005 Fibromyalgia (disorder)
13  onsetDateTime: 2012-04-05
14 -
15  resourceType: Observation
16  code: http://cds.ahrq.gov/cdsconnect/pms#PEGASSESSMENT Pain Enjoyment General Activity (PEG) Assessment
17  category: OBS-CAT#survey
18  valueQuantity: 5
19  issued: 2018-12-05
20  component:
21  -
22    code: http://cds.ahrq.gov/cdsconnect/pms#PEGPAIN Pain
23    valueQuantity: 7
24  -
25    code: http://cds.ahrq.gov/cdsconnect/pms#PEGENJOYMENT Enjoyment of life
26    valueQuantity: 5
27  -
28    code: http://cds.ahrq.gov/cdsconnect/pms#PEGGENERALACTIVITY General activity
29    valueQuantity: 4
30
```

Defined in YAML

Previously supported only
FHIR DSTU2:

- Condition
- Encounter
- MedicationOrder
- MedicationStatement
- Observation
- Procedure

CQL Testing Framework Review: Test Cases (Expected Results)

- Deep compares each expression result
- Ignores unlisted top-level expressions
- Supports strings, integers, decimals, booleans, datetimes, lists, intervals...

More to come...

```
peg-assessment.yaml x
31 results:
32   Summary:
33     Patient:
34       Name: Joe Smith
35       Gender: male
36       Age: 64
37       MeetsInclusionCriteria: true
38     PertinentMedicalHistory:
39       ConditionsAssociatedWithChronicPain:
40         -
41           Name: Fibromyalgia (disorder)
42           Status: active
43           Onset: '2012-04-05T00:00:00.000+00:00'
44           DateRecorded: null
45       RiskFactorsForOpioidRelatedHarms: []
46     PainAssessments:
47       NumericPainIntensityAssessments: []
48       PainEnjoymentGeneralActivityAssessments:
49         -
50           Name: 'Pain Enjoyment General Activity (PEG) Assessment [Range: 0-10]'
51           Score: '5'
52           Interpretation: null
53           Questions:
54             -
55               Name: Pain
56               Score: '7'
57             -
58               Name: Enjoyment of life
59               Score: '5'
60             -
61               Name: General activity
62               Score: '4'
63           Date: '2018-12-05T00:00:00.000+00:00'
64       STarTBackAssessments: []
65     HistoricalTreatments:
66       OpioidMedications: []
67       NonOpioidMedications: []
68       NonPharmacologicTreatments: []
69       StoolSoftenersAndLaxatives: []
70     RiskConsiderations:
71       RiskScreeningsRelevantToPainManagement: []
72       BenzodiazepineMedications: []
73       NaloxoneMedications: []
74       UrineDrugScreens: []
75       MostRecentMME: null
```

CQL Testing Framework Review: Results (Pass)

```
2. bash
pain-management-summary-cql $ npm test

> pain-management-summary-cql@1.0.0 test /Users/cmoesel/dev/cds-connect/pain-management-summary-cql
> mocha --reporter spec --recursive

CQLT Config: /Users/cmoesel/dev/cds-connect/pain-management-summary-cql/test/pms-cqlt.yaml

Factors_to_Consider_in_Managing_Chronic_Pain_v1.0.0
  ✓ Aged 17 years or younger
  ✓ Aged 65 years or older
  ✓ Has Benzodiazepine Order (Diazepam)
  ✓ Has a Resolved Condition Likely to Indicate Chronic Pain (Fibromyalgis)
  ✓ Has Condition Likely to Indicate Chronic Pain (Fibromyalgis)
  ✓ Has High Risk Encounter Diagnoses for Opioid Therapy (Suicide attempt)
  ✓ Has Recent MME Calculation
  ✓ Has Non-Opioid Order (Aspirin)
  ✓ Has Numeric Pain Intensity Assessment (FACES)
  ✓ Has Opioid Order (Oxycodone)
  ✓ Has Pain Management Risk Screening (PHQ-9)
  ✓ Has PEG Assessment
  ✓ Has Multiple Urine Drug Screens (Opiates [Presence])

13 passing (132ms)

pain-management-summary-cql $
```

CQL Testing Framework Review: Results (Fail)

```
2. bash
12 passing (138ms)
1 failing

1) Factors_to_Consider_in_Managing_Chronic_Pain_v1.0.0
   Has PEG Assessment:

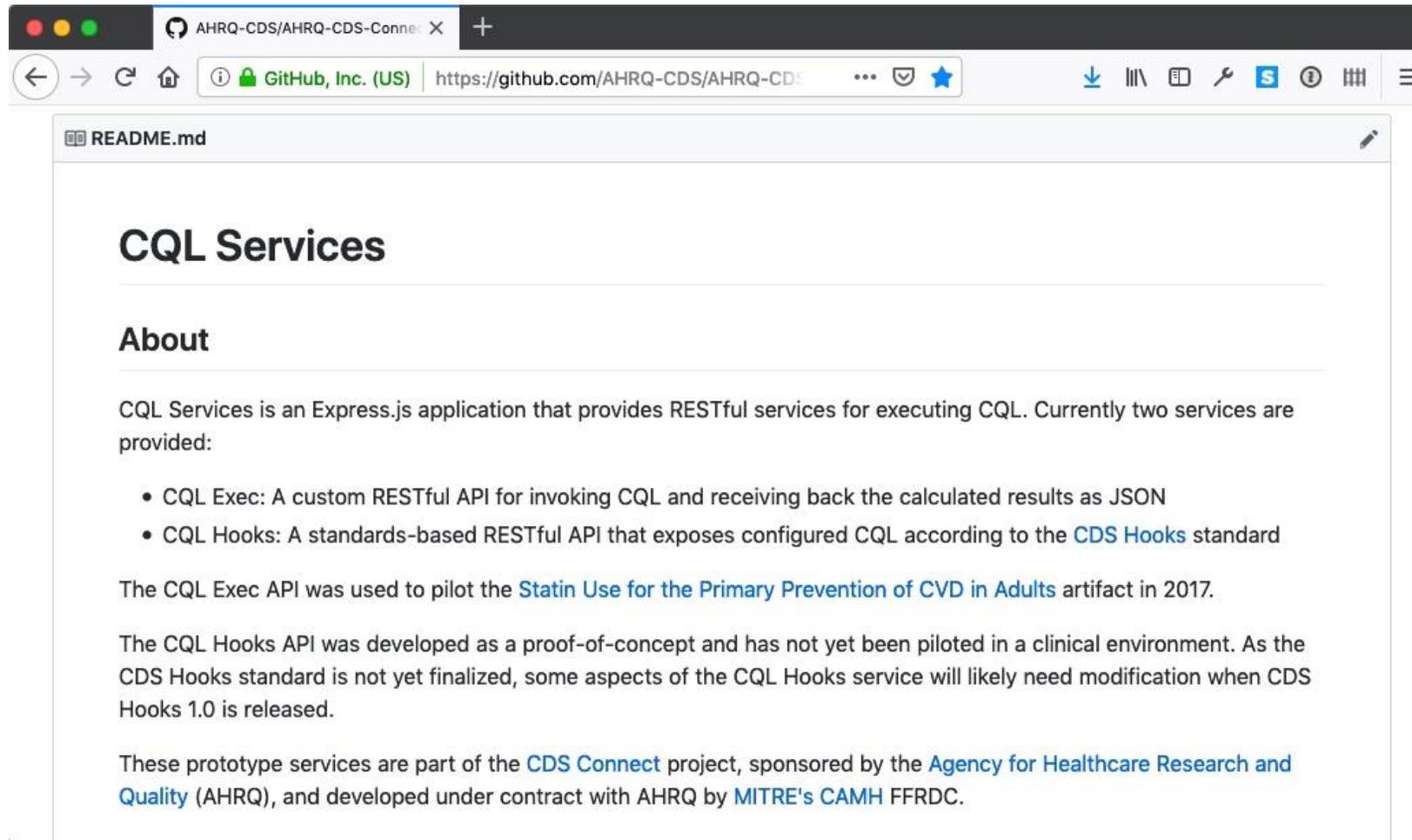
   Summary=<[object Object]>
   + expected - actual

       "Name": "Pain Enjoyment General Activity (PEG) Assessment [Range: 0-10]"
       "Questions": [
         {
           "Name": "Pain"
           -   "Score": "3"
           +   "Score": "7"
         }
         {
           "Name": "Enjoyment of life"
           -   "Score": "1"
           +   "Score": "5"
         }
         {
           "Name": "General activity"
           -   "Score": "2"
           +   "Score": "4"
         }
       ]
       -   "Score": "2"
       +   "Score": "5"
     }
   ]
   "StarTBackAssessments": []
 }
```

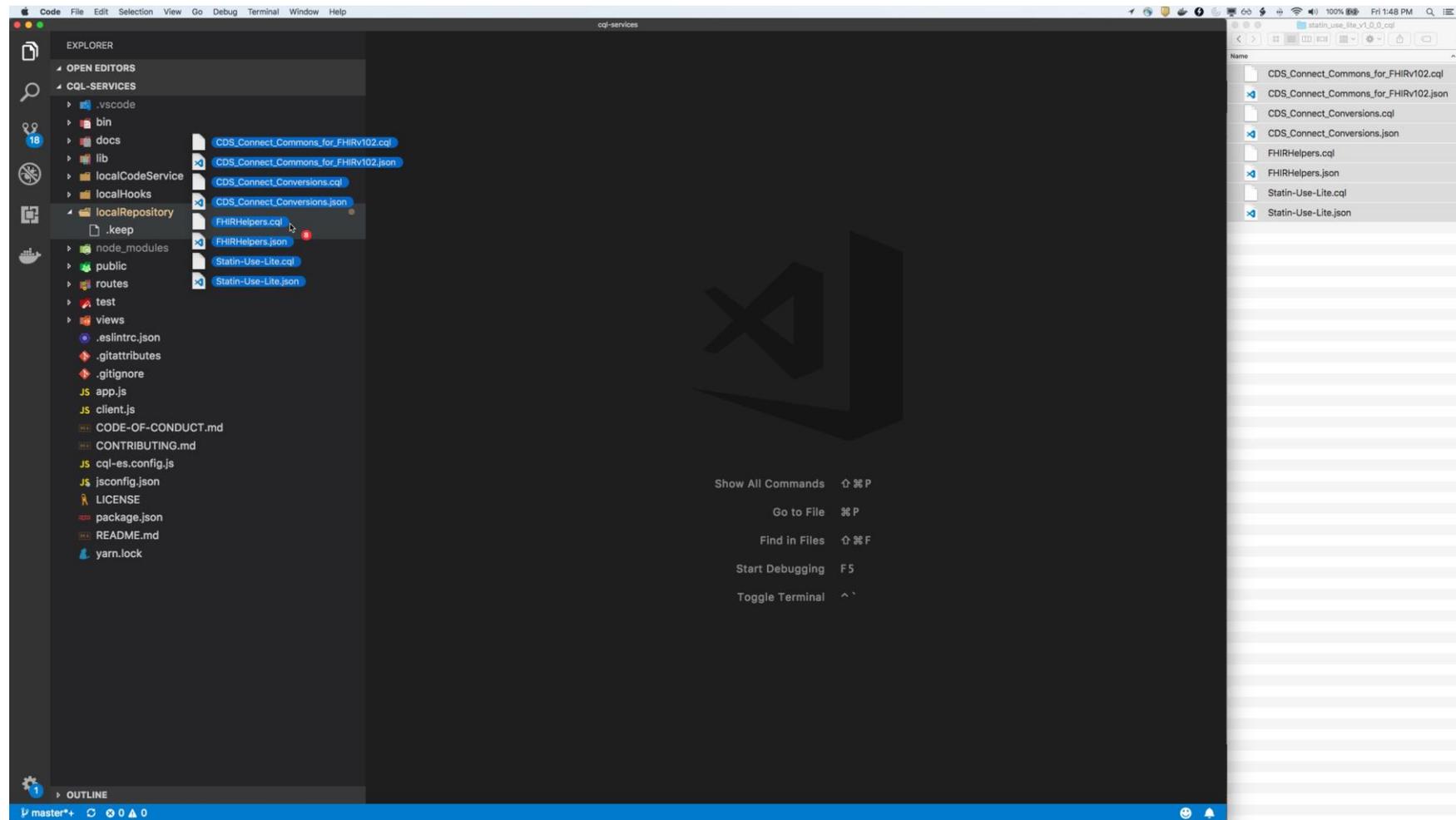
CQL Testing Framework: New Features and Capabilities

- **FHIR STU3**
 - Create FHIR STU3 test patients and test FHIR STU3-based CQL
- **New Resource Types**
 - FamilyMemberHistory
 - ProcedureRequest
 - ReferralRequest
 - Patient CodeableConcept extensions (e.g., race and ethnicity)
- **CQL Hooks Requests**
 - Export test patients as valid CDS Hooks requests that work w/ CQL Services
- **Postman Collections**
 - Export test cases as [Postman](#) collections containing CDS Hooks Requests

CQL Services Review



CQL Services Review: Register CQL



CQL Services Review: Configure CDS Hook

The screenshot shows the Visual Studio Code interface with the Explorer view on the left and the Code editor in the center. The Explorer view shows a project structure with a folder named 'localHooks' containing the file 'statin-use-lite.json'. The Code editor displays the JSON configuration for this hook.

```

1  {
2  "id": "statin-use-lite",
3  "hook": "patient-view",
4  "title": "Statin Use for the Primary Prevention of CVD in Adults (LITE)",
5  "description": "Presents a United States Preventive Services Task Force (USPSTF) statin therapy recommendat
6  "_config": {
7    "cards": [{
8      "conditionExpression": "InPopulation",
9      "card": {
10     "summary": "Statin Use for the Primary Prevention of CVD in Adults",
11     "indicator": "info",
12     "detail": "${Recommendation}",
13     "source": {
14       "label": "CDS Connect: Statin Use for the Primary Prevention of CVD in Adults",
15       "url": "https://cds.ahrq.gov/cdsconnect/artifact/statin-use-primary-prevention-cvd-adults"
16     }
17   }
18 },
19 "cql": {
20   "library": {
21     "id": "Statin-Use-Lite",
22     "version": "1.0.0"
23   }
24 }
25 }
26 }

```

The status bar at the bottom indicates the current position is Line 26, Column 2, with 2 spaces, UTF-8 encoding, LF line endings, and JSON format.

CQL Services Review: CDS Hooks Sandbox

The screenshot shows a web browser window titled "CDS Hooks Sandbox" at localhost:8080. The interface is split into two main sections: "Patient View" and "CDS Developer Panel".

Patient View:

- Patient Name:** Leslie Danielle Landers456
- ID:** CDS-DEMO-LDL Birthdate: 1967-06-09
- Now seeing:** Leslie (Source: Patient greeting service)
- CDS Hook:** "Statin Use for the Primary Prevention of CVD in Adults" (Source: CDS Connect: Statin Use for the Primary Prevention of CVD in Adults). The hook includes an icon and the text "Start low to moderate lipid lowering therapy".

CDS Developer Panel:

- Select a Service:** statin-use-lite - http://localhost:3000/cds-services/statin-use-lite
- Request:** (Collapsed)
- Response:** (Expanded)


```

{
  "cards": [
    {
      "summary": "Statin Use for the Primary Prevention of CVD in Adults",
      "indicator": "info",
      "detail": "Start low to moderate lipid lowering therapy",
      "source": {
        "label": "CDS Connect: Statin Use for the Primary Prevention of CV",
        "url": "https://cds.ahrq.gov/cdsconnect/artifact/statin-use-primar",
        "icon": "https://cds.ahrq.gov/themes/custom/cds_connect/images/cds"
      }
    }
  ]
}
            
```

CQL Services: New Features and Capabilities

- **Register Multiple Concurrent Libraries and Hooks**
 - Allow multiple artifacts (optionally) organized in subfolders
- **CDS Hooks Extensions**
 - Allow CDS Hooks discovery to be configured to return extensions
 - Allow CDS Hooks cards to be configured to return extensions
- **Docker**
 - Deploy CQL Services as a Docker container

CQL Testing Framework and CQL Services

Demo

Demonstration: New Authoring Tool Parameter Type Features

OY2 Pilot Technical Approach

Introduction

- **These slides are taken from a larger deck presented on day two of the pilot kickoff meeting on 4/12/19**
- **They are meant to convey the technical integration options considered at the start of the pilot activities**

OY2 Pilot Partner: b.well Connected Health



- **b.well Connected Health:** www.icanbwell.com
 - Personalized health management resources targeted to consumers and caregivers, to help self-manage the entire health care process
- **b.well meets optimal pilot characteristics:**
 - Utilize some FHIR standards and terminologies
 - Possess mature technical capabilities and well-defined processes
 - Expertise in understanding patient/consumer needs
 - Desire for targeted, patient-facing CDS recommendations

MY HEALTH JOURNEY



Play games with challenges that encourage healthy choices and behaviors.

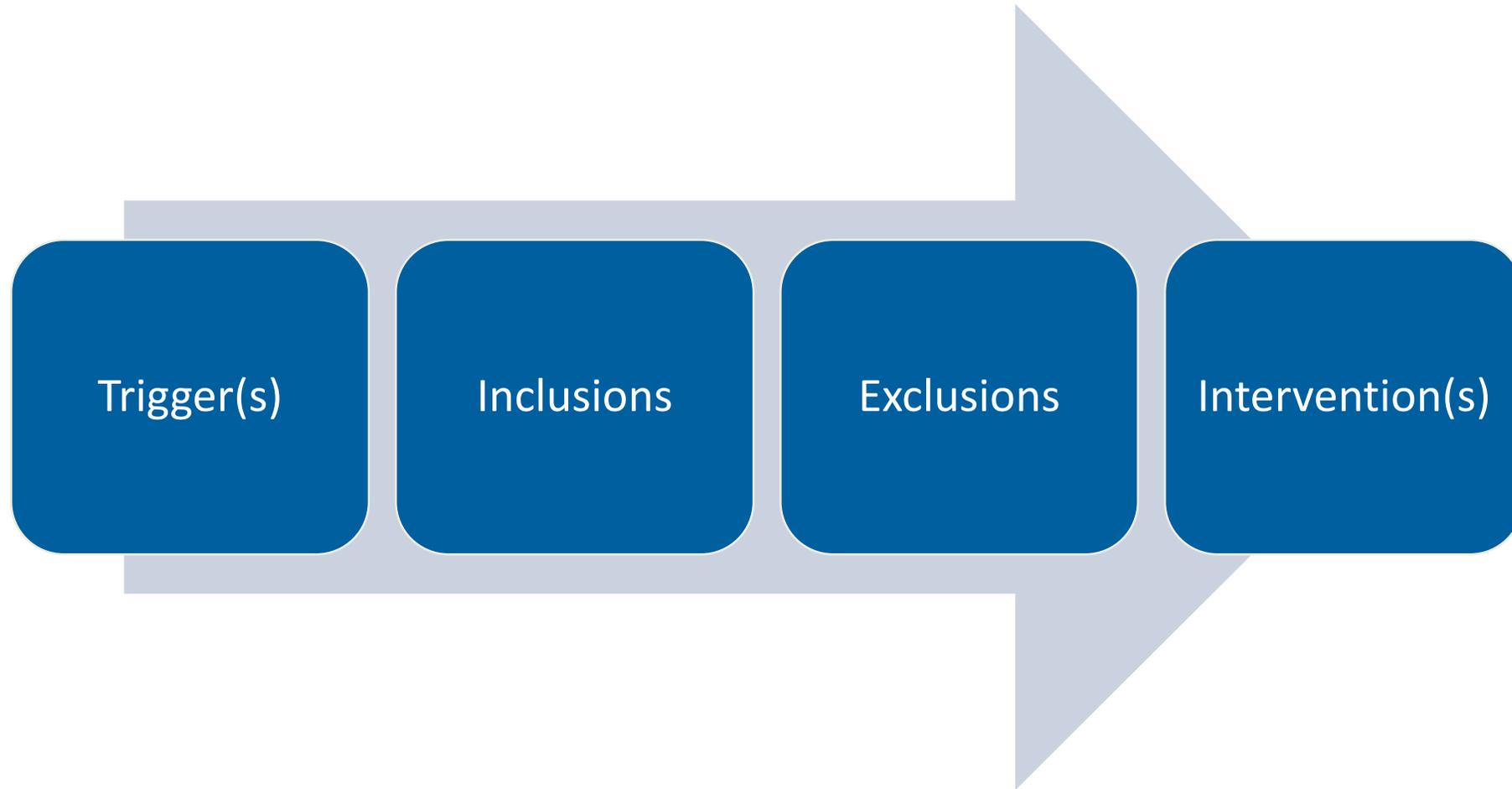


Earn rewards for meeting health and fitness goals personalized for you.

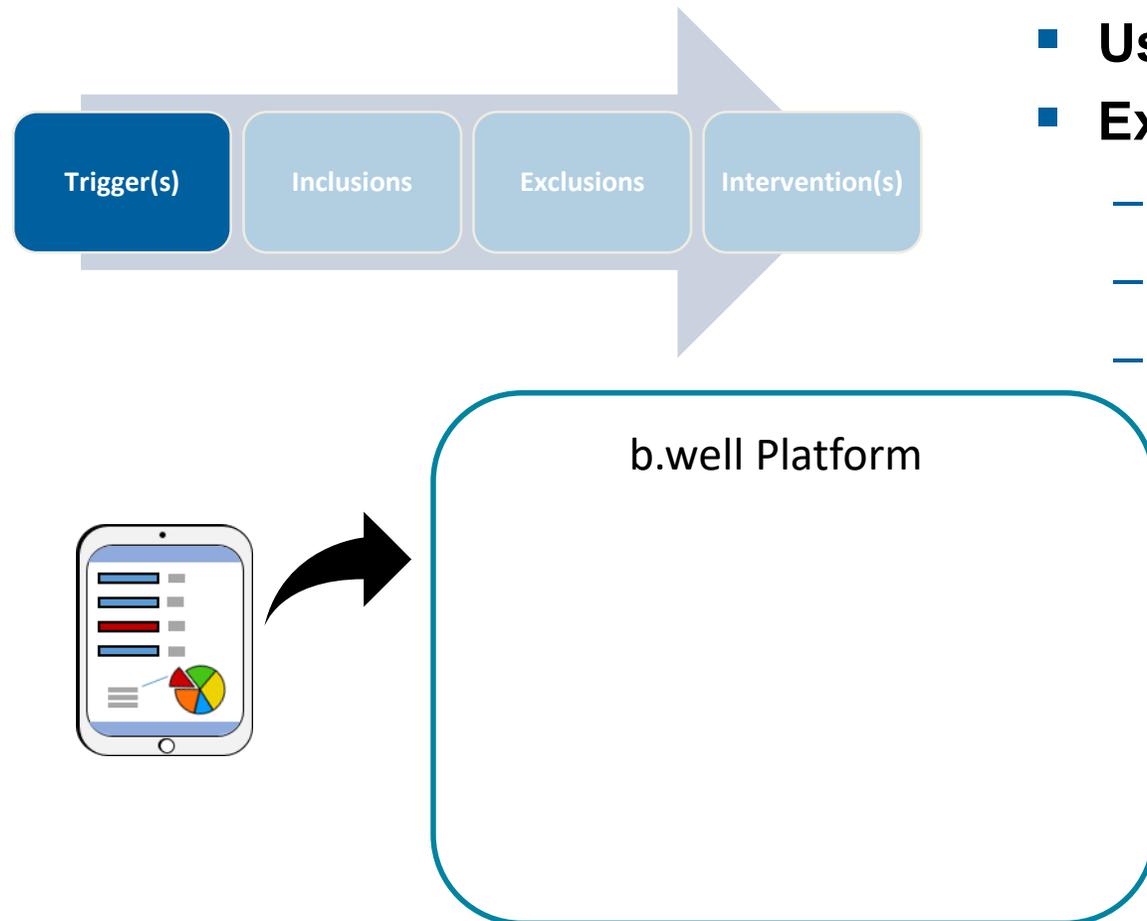


Receive reminders and incentives for preventive screenings and others ways to manage your health.

CDS Overview: Primary Components



CDS Overview: Trigger(s)

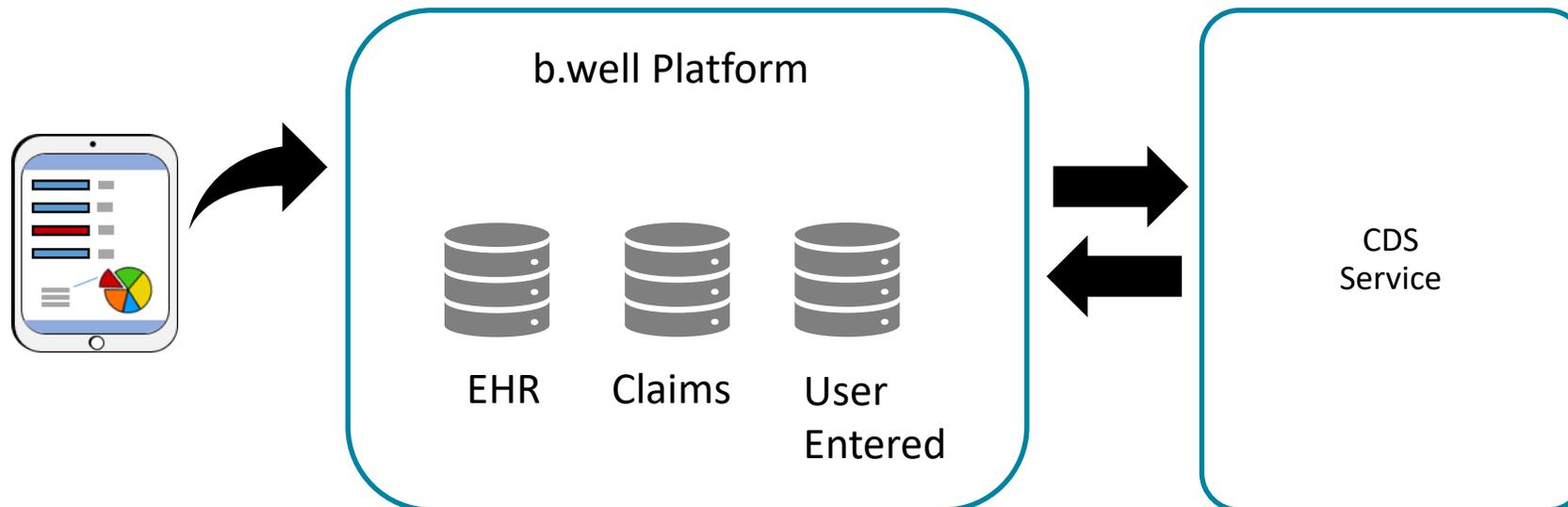


- **User action triggers CDS**
- **Examples could include:**
 - Opens b.well app
 - Updates family history
 - Opens recommendations

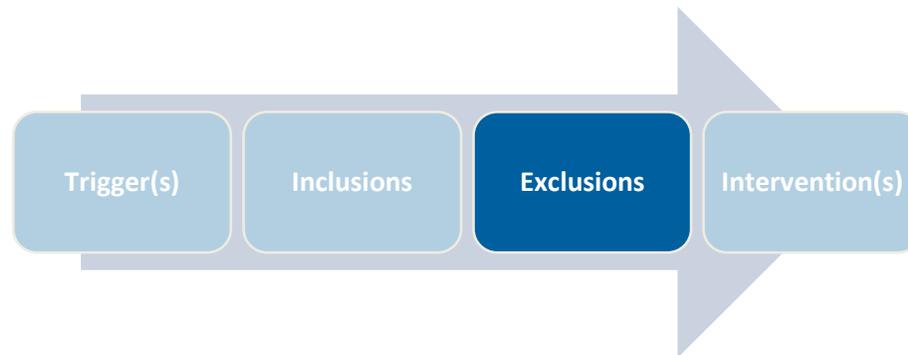
CDS Overview: Check Inclusion Criteria



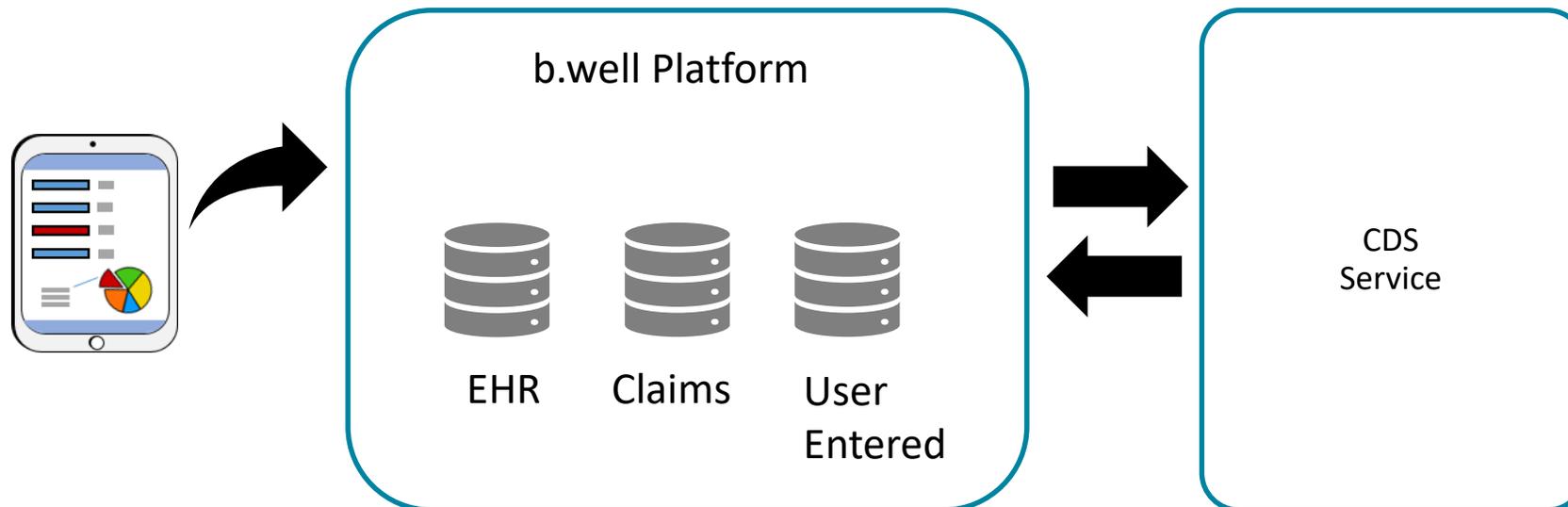
- **Integrated CDS Service checks inclusion criteria**
 - Using multiple data sources available on b.well platform



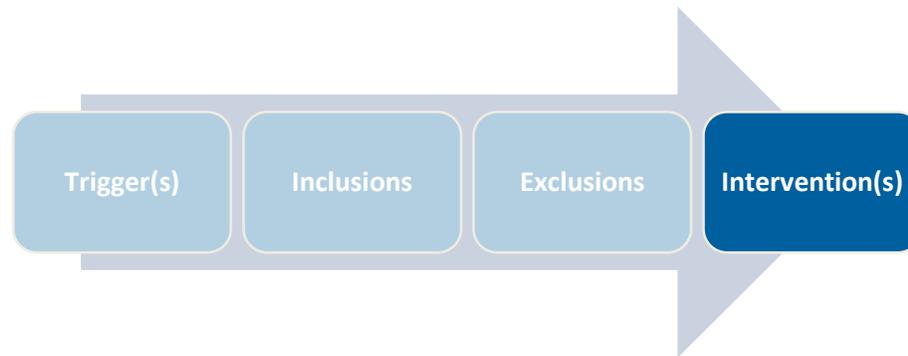
CDS Overview: Check Exclusion Criteria



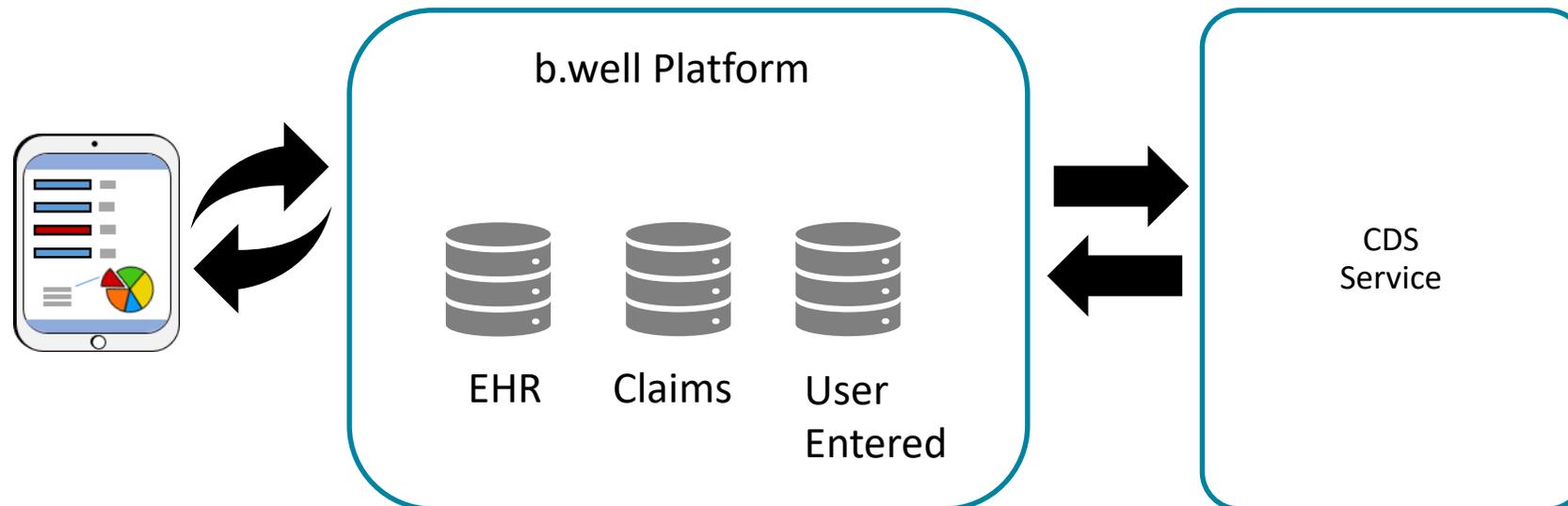
- **Integrated CDS Service then checks exclusion criteria**
- **Both inclusions and exclusions are handled by the same logic**
 - Single request for data



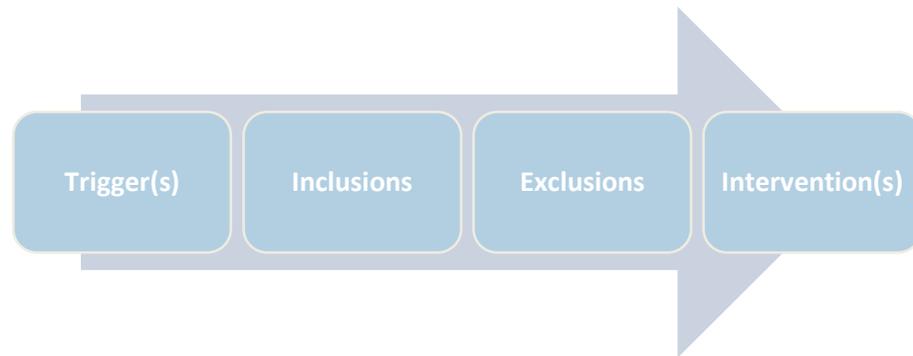
CDS Overview: Recommend Intervention(s)



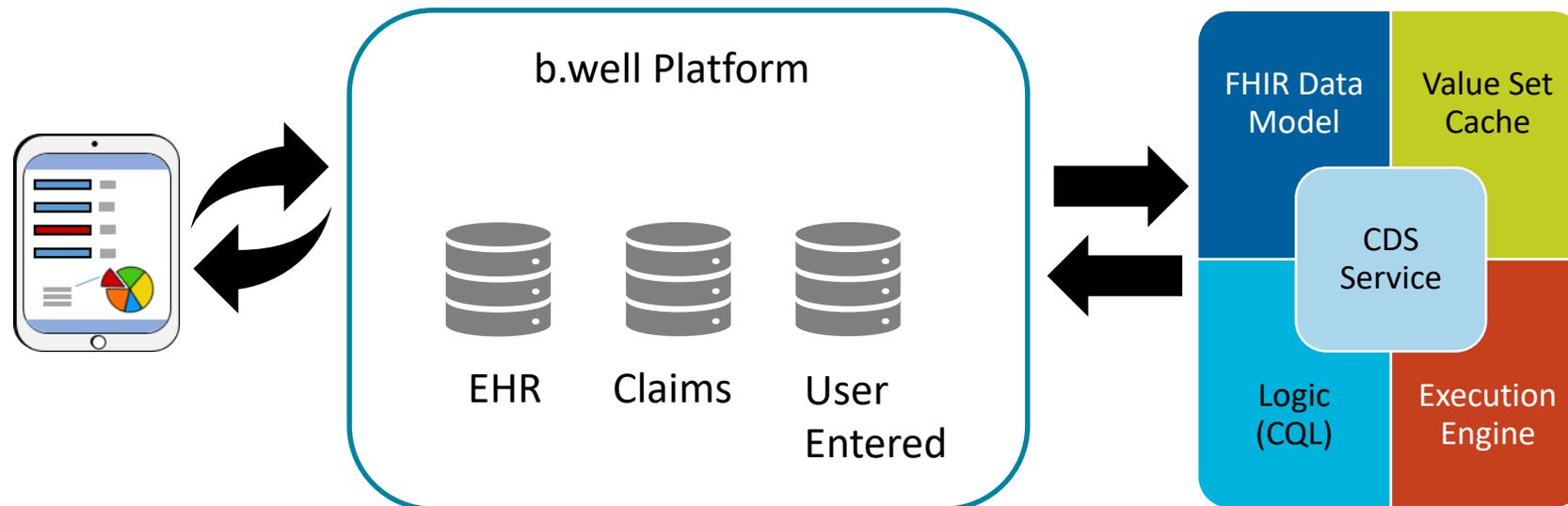
- If user meets inclusion criteria and does not meet exclusion criteria, the CDS Service will recommend an intervention
 - E.g., link to pdf of informational resources



CDS Overview: Service Components



- The CDS Service consists of four main components regardless of integration approach
- Integration will consist of defining context and interfaces



Implementing Executable CDS

- **The CDS logic is being implemented using the Clinical Quality Language (CQL) [1]**
- **CQL is a domain-specific language whose standard has been designed with two applications in mind:**
 - Electronic clinical quality measures (eCQMs)
 - Clinical decision support (CDS)
- **CQL represents an open-source alternative to the otherwise traditionally closed-source production of CDS**
 - This is why it is a good choice for communicating an executable representation of clinical guidelines

[1] http://www.hl7.org/implement/standards/product_brief.cfm?product_id=400

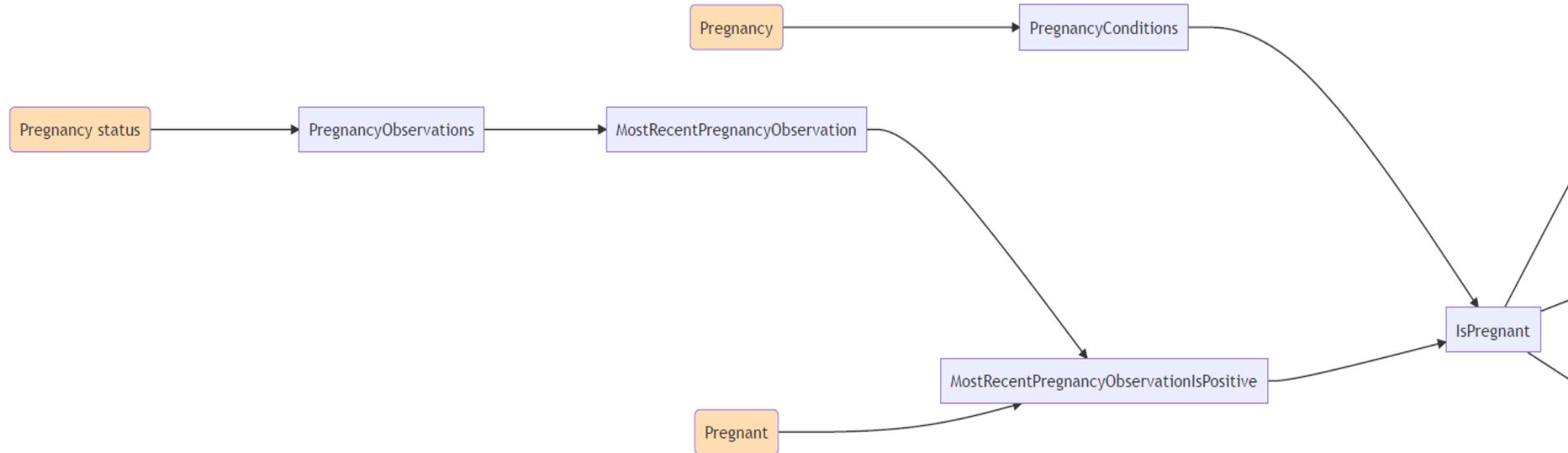
CQL Example (Code)

- **Seemingly simple operations, such as determining whether the patient is pregnant, may require many lines of CQL code**
 - Example below has had code comments removed

```
define PregnancyConditions:  
  C3F.Confirmed(C3F.ConditionLookBack(C3F.ActiveOrRecurring([Condition: "Pregnancy"]), 42 weeks))  
  
define PregnancyObservations:  
  C3F.Verified(C3F.ObservationLookBack([Observation: "Pregnancy status"], 42 weeks))  
  
define MostRecentPregnancyObservation:  
  C3F.MostRecentObservation(PregnancyObservations)  
  
define MostRecentPregnancyObservationIsPositive:  
  C3F.ConceptValue(MostRecentPregnancyObservation) ~ "Pregnant"  
  
define IsPregnant:  
  (exists(PregnancyConditions) and PregnancyConditions is not null)  
  or MostRecentPregnancyObservationIsPositive
```

CQL Example (Graph)

- Example below is a graphical depiction of the code shown on the previous slide
- Dependency graphs can [sometimes] be an easier way to visualize the



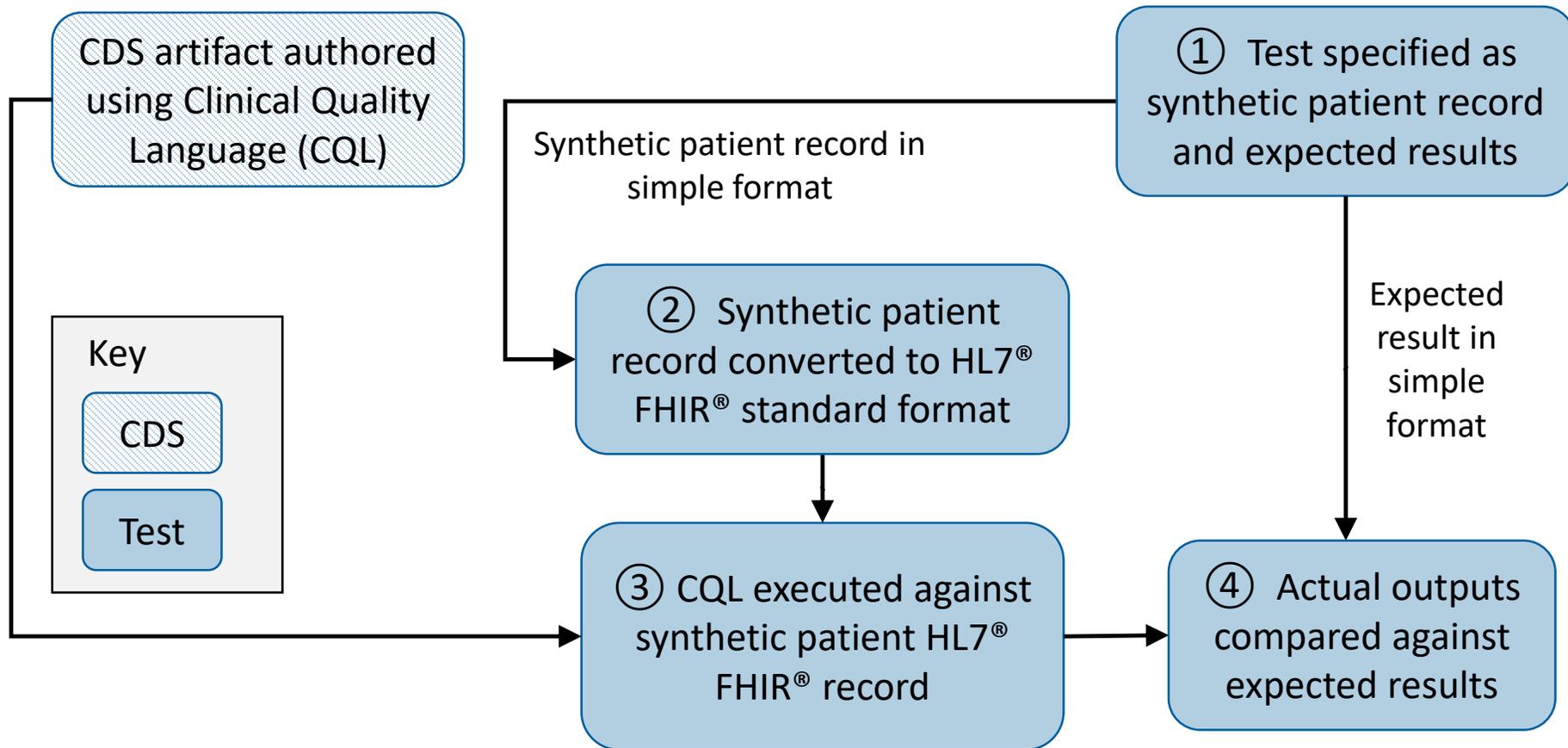
Key:

Code, concept, or value set

Expression

CDS Logic Development Approach

CDS is authored via a Test-Driven Development (TDD) approach to ensure functionality is as expected



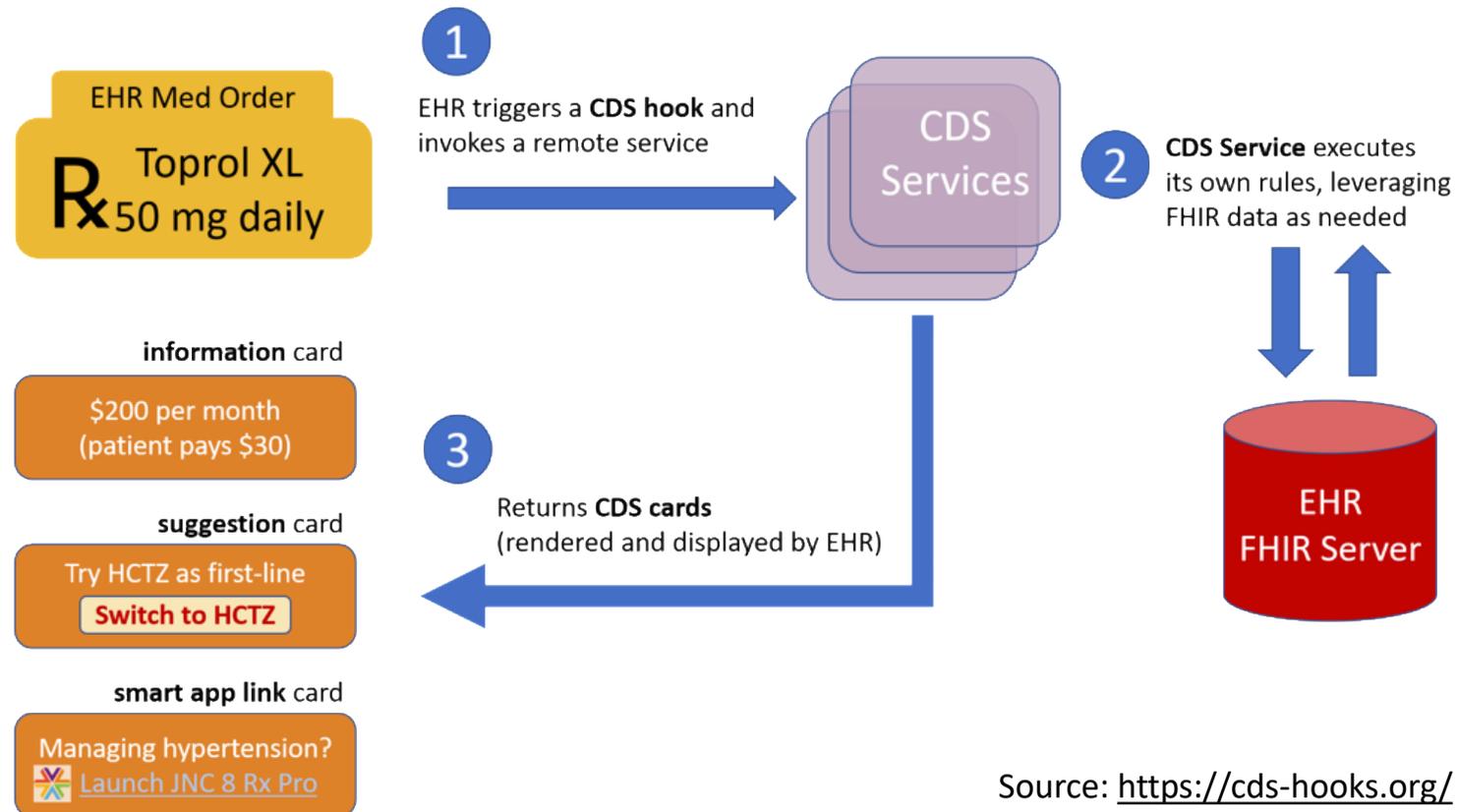
Integration Options

- **CDS Hooks**
- **SMART-on-FHIR**
- **Custom / Non-standard**

Integration Options

- **CDS Hooks**  *Preferred*
- **SMART-on-FHIR**  *Not viable*
- **Custom / Non-standard**  *Backup*

CDS Hooks



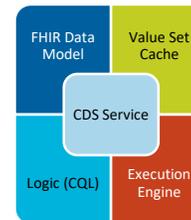
Source: <https://cde-hooks.org/>

- Draft standard
- Plugin framework for custom CDS
- Supports information, suggestion, and app-link “cards” (markdown)
- MITRE has developed a CDS Service which conforms to the CDS Hooks spec

CQL Hooks



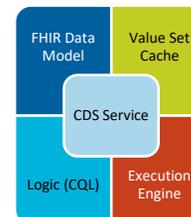
- **A CDS services framework that conforms to the CDS Hooks standard**
- **Available on GitHub in the CQL Services project**
 - <https://github.com/AHRQ-CDS/AHRQ-CDS-Connect-CQL-SERVICES>
- **Consists of the following running in a Node.js Express server**
 - FHIR data model
 - Value set cache
 - CDS logic
 - CQL execution engine
- **Configuration maps CDS Hooks components to CQL expressions**
- **Server analyzes CDS JSON to publish “prefetch” template**
 - <https://cds-hooks.org/specification/1.0/#prefetch-template>
- **Requires all data sent to it via the prefetch**
 - As a result it does not support authentication/authorization
- **When invoked, executes CQL and generates a response “card”**
 - In markdown format



CQL Exec



- **CDS Hooks and SMART-on-FHIR are two standards-based options for CDS service integration**
- **A third option would involve using a non-standard interface**
- **An example is the CQL Exec CDS service**
 - Available on GitHub in the CQL Services project
 - <https://github.com/AHRQ-CDS/AHRQ-CDS-Connect-CQL-SERVICES>
- CQL Exec exposes one or more CDS services via a RESTful API
 - Input data is POSTed to an endpoint
 - CDS results are returned as JSON
- **The CQL Exec service includes all the components listed previously for CQL Hooks and SMART-on-FHIR integration options**
 - FHIR data model
 - Value set cache
 - CDS logic
 - CQL execution engine



CDS Data Requirements

- Each CDS will have its own specific data requirements
- **Proposed general data requirements:**
 - All user information represented using FHIR STU3 resources
 - <https://www.hl7.org/fhir/STU3/resourcelist.html>
 - Example resource usage includes:
 - Conditions, problems, diagnoses, *etc.*
 - Condition (<https://www.hl7.org/fhir/STU3/condition.html>)
 - Several of the artifacts refer to family member history as part of the inclusion / exclusion criteria
 - FamilyMemberHistory (<https://www.hl7.org/fhir/STU3/familymemberhistory.html>)
 - Vital signs, lab data, imaging results, *etc.*
 - Observation (<https://www.hl7.org/fhir/STU3/observation.html>)
 - Counseling (e.g., for nutrition or physical activity)
 - Encounter (<https://www.hl7.org/fhir/STU3/encounter.html>)
 - Procedure (<https://www.hl7.org/fhir/STU3/procedure.html>)
 - ProcedureRequest (<https://www.hl7.org/fhir/STU3/procedurerequest.html>)
 - ReferralRequest (<https://www.hl7.org/fhir/STU3/referralrequest.html>)

Outcomes

- **Selected FHIR DSTU2 as data model**
 - Rationale:
 - Two out of the five artifacts already existed and used DSTU2
 - Allowed MITRE to deliver these ahead of schedule and ease schedule risk
 - Not aware of any major vendors actively pursuing STU3
- **As of 5/13/19, all five artifacts had been delivered to b.well for integration**
 - Statin Use for CVD Prevention
 - Baseline CVD Risk Calculator
 - Healthful Diet & Activity for CVD Prevention
 - Abnormal Blood Glucose, Part 1: Screening
 - Abnormal Blood Glucose, Part 2: Counseling
- **Selected CDS Hooks as the integration standard**
 - All five artifacts running in CQL Hooks service
 - 1000's of test cases provided to b.well to facilitate verification of artifact functionality
 - Using postman tool: <https://www.getpostman.com/>

OY2 Pilot Technical Approach

CDS Connect Outreach

CDS Connect at AMIA 2019 Clinical Informatics Conference: Post Conference Report

- **Panel Discussion: To Share is Human! CDS Connect: A Growing National Repository of Shareable, Interoperable Clinical Decision Support**
 - Ed Lomotan, AHRQ; Ginny Meadows, MITRE; Maria Michaels, CDC; Jeremy Michel, CHOP; & Kristen Miller, Medstar
- **Standing Room Only!**
- **Panel has been invited to submit a manuscript for publication in the Applied Clinical Informatics Journal**



Open Discussion and Close-out

Data Rights Notice

NOTICE

This presentation was produced for the U. S. Government under Contract Number [insert correct contract # for your task order – either: 75FCMC18D0047 or HHSM-5000-2012-00008I], and is subject to Federal Acquisition Regulation Clause 52.227-14, Rights in Data-General.

No other use other than that granted to the U. S. Government, or to those acting on behalf of the U. S. Government under that Clause is authorized without the express written permission of The MITRE Corporation.

For further information, please contact The MITRE Corporation, Contracts Management Office, 7515 Colshire Drive, McLean, VA 22102-7539, (703) 983-6000.

© 2019 The MITRE Corporation.